

Occupational health problems of municipal solid waste management workers in India

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KEYWORDS

MSW Workers, Health And Safety, Social Security, Working Hours, Health Problems, Occupational Health, Occupational Morbidities, Respiratory Diseases, Morbidities, Well-Being, Karnataka, India.

ABSTRACT

Purpose: Occupational health risks are potential negative health effects that one may experience while working. Around the globe, 2.1 billion tonnes of garbage are created annually, and municipal solid waste workers (MSW) or municipal workers often handle this rubbish. They put in a lot of overtime, so managing the garbage generated is not a simple chore. Throughout the waste management process, Municipal Solid Waste (MSW) employees encounter occupational pressures that negatively impact their well-being and lead to a high prevalence of occupational health issues. To protect MSW workers' safety and wellbeing, it is essential to comprehend their work practices and occupational morbidities.

Aim: The objective of this research was to evaluate the occupational health issues that municipal solid waste management employees face.

Method: In this regard, the research sought to investigate the workplace safety and occupational health practices of MSW employees in Karnataka, India. A cross-sectional descriptive research was carried out among Karnataka, India's solid waste management employees. The research comprised all 408 employees, of whom 313 (77%) took part. Direct interviews and clinical examinations utilising a standardised questionnaire were used to gather data. Clinical examination revealed the observed morbidity, which included nail infections, dermatological issues, ocular disorders, and respiratory ailments. Self-reported complaints and physician diagnoses were used to determine the point prevalence of additional occupationally associated health events that occurred during the study period or during the one-month recall period and that happened after entering the current occupation.

Results: 42.5 ± 7.2 years was the average age. The observed morbidity, which varied from 21% to 47%, was substantial and included respiratory, ocular, dermatological, and nail infections. Occupational morbidities such as falls (63.6%), accidents (22%), injuries (73.2%), and aquatic vector-borne diseases (7.1%) were observed to be quite prevalent. All of the main joints are affected by the present prevalence of musculoskeletal morbidities (17–39%).

Conclusion: The miserable conditions of employment and high workplace morbidities among MSW workers in Karnataka, India, are highlighted in this research. The MSW personnel found it challenging since the workplace lacked basic facilities. Socioeconomic status, education, and unfavourable working circumstances all contribute to the likelihood of occupational risks. The many health effects that municipal employees experience while working are highlighted in this article. It is necessary to establish a holistic strategy that prioritises the MSW workers' health and safety while including social security. Waste handlers must have access to ergonomically designed protection gear, clean drinking water, and facilities for washing and sanitation throughout working hours in order to enhance their working conditions.

I. INTRODUCTION

Any substance that is thrown away after its first use or that is broken, useless, or unusable is considered waste. This comprises radioactive waste, municipal solid waste (home waste), hazardous waste, and so on [1]. Due to economic growth and population expansion, solid waste generation in urban areas is at an all-time high. Hazardous wastes are often released into the environment in developing nations, endangering both the ecology and human health. However, governments seem to find it challenging to control the expanding issue of hazardous substances in the environment due to the wide variety of waste sources [1, 2]. Workers referred to as community labourers often carry out these duties. In impoverished countries, the rubbish that is released for collection is sometimes tossed straight onto the ground rather than being kept in closed containers, which requires human shovelling [2], or it is put in open containers that need manual pickup.

The prevalence of occupational illnesses, job dangers, and fatalities all play a major role in the rise in the worldwide burden of non-communicable diseases (NCDs). A third of an adult's life is spent at work, where hazardous exposures are often several times higher than in any other setting, according to the World Health Organisation (WHO) [2, 3]. The International Labour Organisation (ILO) estimates that 6,500 people worldwide pass away from occupational illnesses and 1,000 people die from workplace accidents every day, with Asia accounting for over 65% of all work-related deaths worldwide each year. According to the WHO, NCDs, [3], injuries, and infectious illnesses account for 70, 22, and 8% of the overall disease burden resulting from occupational health hazards, respectively. Given that many workers are continuously confronted with occupational safety and health hazards, this should not be disregarded [2].

Human activity produces waste, which is unavoidable in every community. Globally, it is essential to manage all of this garbage, but doing so entails a lot of manual handling duties and is linked to physical, chemical, and psychological risks [2, 6]. Compared to workers in industrialised nations, where direct handling of municipal solid waste (MSW) is restricted to improve process efficiency and guarantee worker safety, workers in developing nations are more vulnerable. Waste is collected from homes and businesses in developing nations like India and disposed of at landfills, where city governments hire a lot of MSW personnel [2, 6]. Depending on the instruments they use and the waste material they handle, these MSW personnel face occupational hazards and morbidities throughout the trash collection, management, and disposal process [5, 6].

Despite being avoidable, this varied set of occupational morbidities may not get the required attention and treatment because of restricted access to healthcare. The majority of nations worry about the production, handling, and environmental effects of garbage [2, 4], with little regard for worker safety [5]. Laws and policies emphasise reducing trash and reusing it, yet in the haste to implement waste management technology, the occupational health hazards faced by MSW personnel were not given enough consideration. Occupational morbidities are a significant public health concern worldwide [5, 6], but they are not well studied in low- and middle-income nations. This is despite the fact that several policy documents, including the WHO Declaration on Workers Health and the ILO promotional Framework for Safety and Health at Work Convention, have focused on the need to protect and promote health and safety at work [6, 7].

Approximately 75% of the world's workforce lives and works in third-world nations. The International Labour Organisation (ILO) reports that over 125 million workers suffer from

occupational diseases and accidents in a single year, resulting in around 220,000 deaths and over 10 million people with severe impairments [5, 9]. Municipal solid waste handlers perform a variety of duties, such as trash collection, physical garbage bag loading and unloading into trucks, and landfill disposal [9, 10, 11]. These employees face a number of health and safety concerns while doing their jobs as a result of these obligations and the dangers that come with waste management.

Waste handlers had occupational health difficulties, such as eye illnesses, injuries, and respiratory troubles, according to an Indian research. Waste pickers collect a variety of commodities, including plastics, paper, cardboard, cables, glass bottles, rubber goods, and even potentially dangerous electrical components [12]. Because they work with infectious agents and poisonous chemicals that might cause sickness, they are exposed to possible health risks. In addition to these health hazards, garbage pickers often experience social prejudice and abuse from certain societal groups, which may exacerbate more general socioeconomic issues [16].

The term "solid waste management" refers to a broad variety of tasks, such as gathering trash, sorting recyclables, and collecting and processing commercial and industrial waste. Every stage of the process has risks, including collection at households, transportation, and recycling or disposal locations [14, 16]. Because of the products they handled, the emissions from those compounds, and the equipment they were using, they were at risk for accidents and occupational health problems. Garbage collectors are exposed to a variety of hazards in places where hazardous industrial wastes and infectious medical wastes are not separated from household garbage [16, 17]. They have significant rates of occupational health issues as a consequence of being exposed to several risk factors [19].

The majority of illnesses (airborne, waterborne, and contact) have exposure routes, while the majority of injuries (tetanus, HIV, and hepatitis B virus [HBV]) have contact pathways. Risks may be decreased by containing waste technology, lowering pollutant emissions, altering working procedures to block routes, and wearing protective gear.

In the course of their employment, MSW professionals encounter several challenges, including wounds and infections from sharp objects, respiratory illnesses, skin infections, and harmful fumes from burning garbage [19, 20].

According to studies, between 73.2 and 90 percent of MSW employees had work-related injuries. Compared to the general population, MSW workers had respiratory issues 1.4–2.6 times more often and infections three–6 times more frequently [20]. They may find sharp objects and contaminated garbage when searching through trash in an unsuitable working environment without the appropriate protective gear, which puts them at danger of contracting and spreading infectious illnesses. Additionally, MSW employees engage in unhealthy lifestyle choices that increase their risk of illness, such as smoking, drinking, chewing tobacco, and eating poorly [1, 6].

There are several risks for street sweepers who handle trash and filth. Road cleaning is often done by hand by people or organisations in the majority of nations, whether they are industrialised, developing, or emerging. Sweeping may be done automatically, such with a leaf blower, or manually, like with a push broom, which is popular in poor nations [2, 9]. One of the most popular jobs for underprivileged individuals in India is street sweeping. Thirty percent of street sweepers were uneducated. Most of the 70 street cleaners who took part in the research knew very little about the dangers of occupational health and safety, including the transmission of viruses.

In order to increase the quality of service delivery and boost the socioeconomic status of people, local authorities must be involved [2, 16]. Factors include their unhygienic living circumstances in urban slums and the nature of their jobs, which expose them to potentially hazardous bio-aerosols that may spread a number of illnesses. The working conditions at landfills are made even less hygienic by the abundance of fleas, offensive odours, [16], and inadequate protection gear [18].

Research on the health and injury rates of solid waste workers in developing nations like India is lacking. Poor exposure assessment and a lack of information on pertinent confounders are the main weaknesses of the majority of the examined studies [18, 19]. In addition to including gender difficulties, waste labour is overshadowed by social, economic, and environmental deprivations. Women sweepers often labour in very unfavourable circumstances; they could not have any safety gear or clothing, although rarely voice their displeasure [11].

In these circumstances, a research was carried out among women in order to comprehend and evaluate the health concerns associated with municipal solid waste management. Municipal solid waste workers in Kerala state, India [11], where the issue has become worse because of increasing consumption patterns, poor land availability per capita, and per capita solid waste creation [15, 16].

II. METHODS

In 2010, solid waste management personnel in the Calicut Corporation region of Kerala, India participated in a cross-sectional descriptive research [16, 17]. Kozhikode Corporation is home to 436,527 people (2001 Census) and has an area of 82.67 square kilometres. An estimated 477 grammes of trash are generated daily per person [18].

Every day, Kozhikode Corporation generates around 250 tonnes of municipal solid trash, of which 47% comes from households [16, 17], 24% from businesses and hotels, 9% from street sweepings, 6% from building sites, and 3% from slaughterhouses. The firm collects around 120 to 150 tonnes of this each day [19].

In 2004, the city's solid waste management program was launched. Household garbage is collected and transported to the transit sites by women from economically disadvantaged households (those living below the poverty line, or BPL) who are members of Kudumbashree's Community Based Organisations (CBOs) (Women Self Help Groups) [19, 20]. The employees arrange for the door-to-door collection of rubbish from homes and businesses, separate it, put it into cars, and drive it to secondary collection locations where it is emptied. It is taken straight from these locations to the solid waste treatment facility, where it undergoes processing and is turned into manure [11].

Given the 70% reported incidence of respiratory issues [19], a minimum sample size of 252 was required at a 95% confidence level and a precision of 5%. All employees were invited to screening camps, and there are 68 women's CBO groups with 408 members overall. Within a month, four regional screening camps were set up on Sundays to guarantee accessibility. The scientists used a standardised questionnaire to gather data from the screening camps via direct interviews and clinical examinations [19, 20]. The institutional ethics committee gave its approval to the research protocol. Everyone's written informed permission was gathered. The camp was attended by 313 people (77%) in total, and data from all reported attendees (100%) was gathered and examined [20, 22].

The research was carried out over the course of a month in order to remove the confounding influence of seasonal change, and all data were gathered by the same individuals in order to

prevent inter-personal mistakes. Clinical examination revealed the observed morbidity, which included nail infections, dermatological issues, ocular disorders, and respiratory illnesses [22]. Self-reported complaints and medical diagnoses were used to determine the point prevalence of other occupationally related health events that occurred during the study period or within a one-month recall period and that happened after starting the current job. These events included road traffic accidents, falls with waste, injuries from sharp objects, fire, chemicals, and animal bites, as well as water-borne illnesses like jaundice, typhoid, leptospirosis, vector-borne diseases like dengue and malaria [21]. Epi Info and SPSS software (version 17.0) were used for statistical analysis [22].

Continuous variables were compared using an independent sample t test, whereas qualitative variables were compared using a Chi square test [23]. A P-value was deemed statistically significant if it was less than 0.05. Calculations and reports of 95% confidence intervals (95% CI) for the measures of association were submitted [21].

III. RESULTS

96% had more than four years of service, and the average age was 42.5 ± 7.2 years (24-65 years), with an average experience of 4.8 ± 0.7 years [29]. They all worked full-time, seven days a week, with an average of 6.2 ± 1.7 hours per day and a monthly salary of $\text{INR } 1889.4 \pm 914.7$. They gathered rubbish from 55 locations on average. 55% did not have a regular employment before to starting their present position, and 89% were now married. Table 1 lists the high observed morbidity of the workers, which varied from 21% to 49% and included respiratory, ocular, dermatological, and nail infections [29, 30].

Table 1 The frequency of the observed morbidity.

Morbidity	Number	%	95% CI
Respiratory disease (infections/allergies)	60	21.0	16.00-36.5
Eye problems	106	36.2	25.5-62.59
Skin Problems	108	32.9	27.9-42.6
Nail Infections	115	49.9	31.6-66.5
Genitourinary problems	109	36.3	29.6-42.6

Table 2 shows the point and period prevalence of occupational morbidities, including aquatic vector-borne diseases, accidents, injuries, and [18], the former of which has a high occurrence.

Table 2 The frequency of reported diseases.

Events/Morbidity	Current (within 30 days)			Past (after entry in service)		
	Number	%	95% CI	Number	%	95% CI
Hospitalizations						
Road accidents	2	0.9	0.5-2.9	41	16.9	9.8-17.8
Falls	04	1	0.9-3.6	69	24	19.8-69.9
Injury with sharps	11	3.9	1.9-1.8	199	63.9	58.9-69.8
Animal bites	16	5.9	3.6-8.9	31	79.9	0.8-3.9
Fire burns	2	0.8	0-0	08	9.8	0.8-69.9
Chemical injury	0	0	0-0.5	09	2.6	01-08.9
Water borne disease	1	0.8	0-0	17	0.9	0.5-09.8

All of the main joints are affected, according to Table 3's current prevalence of musculoskeletal morbidities [19].

Table 3 Current Musculoskeletal Morbidity Prevalence.

Joint affected	In attendance at the examination		
	Number	%	96% CI
Low back	109	36.9	28.9-39.8
Neck	85	19.8	14.9-89.9
Shoulder	93	28.9	21.89-29.8
Elbow wrist	89	29.8	25.9-41.9
Knee	61	29.7	18.9-74.9
Ankle	123	39.8	38.9-19.8
Musculoskeletal	70	28.9	19.9-78.9
Disorders*	177	59.5	79.68-2.98

IV. DISCUSSION

96% of them had served for more than five years, were women, were from BPL homes, had permanent residency status in the corporate area, and had no tobacco use or other addictions. Confounders and selection bias are removed [19, 20]. A non-fatal health outcome that is seen to be comparatively error-free in reporting sickness is hospitalisation, which may be used as a stand-in for severe morbidity [20]. Compared to the general population, the hospitalisation rate during this time was 13.1%, or 27.5 per 1000 person years [20, 21]. Their own illnesses accounted for 23% of the absence. According to data from India, trash handlers had a 2.5 relative risk of morbidity when compared to other people living in the same housing areas [22].

This is the first research to show that garbage handlers had a significant rate of nail infections. The majority of fungal infections (Paronychia) and lesions with subsequent bacterial infections, which were exacerbated by frequent soaking from direct contact with waste, were the cause of nail infections in 47% of cases in either the fingers or the toes [22]. As previously mentioned, they were not given access to washing facilities here either during work breaks or at the end of the day. It was not done anywhere in the state to wash the containers, cars, temporary storage facilities, [23], and treatment yard every day and collect the cleaned water in septic tanks.

Where a solid waste worker has the most interaction with garbage and the least amount of protection, there is a stronger correlation between exposure to solid waste and higher health risk. 78.5% of respondents expressed dissatisfaction about receiving mixed rubbish from homes that were not separated. Solid waste workers and rubbish pickers often come into contact with the waste when collecting in underdeveloped nations [24].

A third reported issues with their eyes. In India, 89% of people from Bombay and 15% of those from Calcutta have eye issues. The majority of eye issues were itching, watering redness, and burning [26]. This occupation's temporal connection (6 18%) and degree of association (relative risk 1.7) with eye disease were previously documented [26].

In our research, a higher prevalence of genitor urinary symptoms (25% vs. 33.5%) was identified compared to women workers in the state. These symptoms were caused by either urinary tract or reproductive tract infections. Reduced water intake and delayed bladder emptying were identified as risk variables (Odds ratio OR 1.1 2.1) for related urinary symptoms in a previous investigation on female employees. This was explained by the absence of drinking water and restrooms in the work locations, which has also been seen in other underdeveloped nations [29, 30].

There was no difference in occurrence between married and unmarried women (OR 1.19 95% CI 0.38 4.02. $P = 0.74$), which is contrary to the results of a research among general women workers (OR 3.15 95% CI 1.2 8.6. $P = 0.04$), [11], suggesting that profession alone is the only factor at play.

There were one instance of dengue and one of malaria. Containers, tires, and tin cans found in rubbish heaps are among the tiny, clean water pools that the dengue vector mosquito, *Aedes Aegyptus*, prefers for reproducing [11, 16]. The physicochemical properties of coconut shells, which were abundant in the solid wastes of these areas, encourage mosquito breeding when compared to plastics and pots [19, 20]. Accident rates among solid waste workers are often high in underdeveloped nations owing to inadequate working conditions and a lack of protective gear, and it has been shown that work-related injuries represent a significant health impact of the job. Most have provided a history of injuries and falls. In Kathmandu, Nepal, 82% of trash workers reported injuries, which is consistent with our results [20].

The stated relative risk of injuries was 5.6 in Denmark and 1.3 in Romania when compared to general workers. According to earlier reports from the nation, puncture wounds were the most frequent injury suffered by garbage workers here as well [29]. Eighty-three percent got plastic garbage and seventy percent received sharps waste. Only three of our participants had received the HBV vaccination, and none of them were known to be HIV or HBV positive [20]. According to estimates, the chance of contracting HIV and HBV after a puncture is around 0.3% and 3%, respectively [22].

According to a research article, solid waste workers are not at a substantial risk of contracting HBV since they are less likely to have needle stick injuries [5] Of the 228 wounded, 36 (16%) had never taken Tetanus toxoid (TT), despite the fact that 77% had taken prophylactics against Tetanus [21].

Compared to the general workforce, garbage collection personnel had a greater rate of occupational accidents [11]. Road traffic accidents account for 22% of the accidents, while collapses involving loads of rubbish account for 64%. The majority had falls, which were exacerbated by rain and slick conditions. The majority of traffic accidents were caused by mechanical or human fault. The majority of car accidents were caused by either driver error, braking failure, or poor vehicle maintenance [20]. 59% of them cited the issue with off-road vehicles as their primary operating concern. Solid trash collectors had the ninth most hazardous employment in the United States, according to the U.S. Department of Labour, with a relative risk of 10 among all industrial workers [19].

Animal bites were more common (9.6%) than in the overall population. 24.9% of respondents said that pets like dogs and cats were making it difficult to collect rubbish. Dogs, cats, and rats were the animals that bitten [19, 20]. 16% and 49% of Calcutta residents, respectively, reported rat and dog bites. Animals are drawn to the rubbish because it is disposed of in open areas or stored in open containers [3]. The absence of cages or chains for the pets in the vicinity could be a more significant aspect. Heavy weight lifting, which damages major joints, is a characteristic of waste collecting labour [21]. Low back discomfort and musculoskeletal conditions of the arms, shoulders, and neck are quite likely [11].

Numerous studies on waste collection movements have shown that mechanical loads on the skeleton often surpass the recommended maximum acceptance limits; carrying loads caused excessive torque to the shoulder, which increased the incidence of musculoskeletal problems, and throwing waste bags resulted in high shear forces on the spine [19, 20]. In order of inclination, the joints that are impacted include the knee, back, shoulder, elbow, ankle, and

neck (range 39–17%). Additionally, higher joint problems were observed from Bangalore, Calcutta, and Bombay, India [23, 24].

According to reports, the degree of link as a relative risk for musculoskeletal issues ranged from 1.9 to 4 [23, 24]. Strong evidence from a review of the international literature links work-related lifting and forceful motions with high odd ratios (2.2–11) to low back problems [26]. Inappropriate ergonomics and a lack of tools and equipment that are both worker- and woman-friendly exacerbate muscular skeletal issues [26, 27]. Workers were 150 ± 8 cm tall on average, and 14.4% of them were underweight (BMI <18.5) [30, 31]. Corporation officials sometimes buy inappropriate trucks that are excessively tall or hefty dumpsters that are hard to move without taking suitability into account [32]. According to reports from other developing nations, open trucks and auto rickshaws are also used for collecting, however the high loading heights increase the risk of harm.

In a highly urbanised metropolis like Karnataka, the high volume of vehicles and dense population may be the cause of frequent hit-and-run incidents [32]. Due to conflicting goals for survival, livelihoods, and food, the government and even the MSW workers themselves seem to be less concerned about the safety and health of the workers. Despite MSW workers being ESIC beneficiaries, the survey found underutilisation of health insurance services due to rudeness at government facilities [33, 34].

According to the sociocultural value systems in the Indian subcontinent, cleaning tasks like sweeping and rubbish collection were often seen as traditional work positions for lower caste groups [34, 35]. Article 16 of the Indian Constitution guarantees the right to equal work opportunities, whereas Article 19 (1) (g) guarantees the freedom to practise any job [36].

Numerous essential rights outlined in the Indian Constitution, including the right to a fair and humane workplace [37], the right to health, and others, were found to have been violated, according to the research. Discussions with the MSW professionals in the study supported this, which warrants further research. This research does not examine the relationship between caste and employment as an MSW professional. The research concluded that in order to enhance the health of MSW workers, there must be a sufficient supply of PPEs and medical resources [38, 39]. Poor health, access, and use of health services were caused by a number of factors, including a lack of care, government and authority indifference, a lack of health knowledge, and other deeply ingrained conventional work practices [39, 40].

One of the factors preventing MSW workers from demanding their rights to safe working conditions, respectable living standards, and a good workplace was illiteracy. The safety and health of MSW personnel are seldom taken into consideration, despite the fact that India has laws and regulations governing waste management procedures. For trustworthy data reporting and analysis, nations like India need an efficient Occupational Safety and Health (OSH) data gathering infrastructure [11, 26]. In occupational health, worker health surveillance—the ongoing evaluation of health and environmental hazards for employees—is essential.

In order to build national action plans and initiatives to enhance workers' health, it is necessary to maintain health records and conduct routine screenings in order to understand the working environment and associated dangers [33, 38]. In order to address concerns about the health and safety of workers, their global plan of action for their health aims to integrate worker health into other policies, such as those pertaining to employment, socioeconomic development, trade, and environmental protection [39, 40]. A comprehensive strategy that prioritises the health and safety of MSW workers with social security is necessary since they are an essential component of urban life.

V. LIMITATION OF THE STUDY

The study's handy sampling strategy may have introduced bias. But in an effort to lessen the bias, the sample size was maintained big. The subjective morbidities that the MSW workers claimed could not be verified by their medical data. The research has geographical limits since its conclusions do not apply to other Indian states, districts, or nations.

VI. CONCLUSION

This study draws attention to the poor working conditions and significant dangers to occupational health faced by MSW employees in Karnataka, India. The most common occupational health issue among them was musculoskeletal discomfort, which was followed by sharps wounds. It is crucial to ensure MSW personnel' occupational safety by providing them with protective gear to reduce risks to their bodily and mental well-being and enhance their working conditions.

The government has to give it more thought when creating guidelines and suggestions for MSW personnel in general. In order to investigate the inherent difficulties encountered by MSW workers and provide welfare programs and humanitarian relief, human rights advocates, researchers, and administrative staff should collaborate. It is advised to conduct studies that examine different groups of MSW workers in order to have a deeper comprehension of their means of subsistence. An investigation on the work habits of MSW employees during and after public health crises might be beneficial.

Due to the cross-sectional nature of our investigation, it was not possible to determine the true incidence or establish a causal relationship between the health outcomes. Because of the "healthy worker effect," employees with serious illnesses may quit their jobs, which leads to underreporting in occupational health studies. Waste handlers' working conditions must be improved by making sure that safety gear, clean drinking water, and restrooms and washing stations are available during business hours. There should be more incorporation of ergonomic ideas. Solid waste workers should be routinely monitored and have a system in place for monitoring their health. Given the severe lack of epidemiological data in this field and the need for further follow-up research, local medical schools and occupational health institutes should be encouraged to investigate the health of solid waste workers in comparison to suitable baseline control groups.

VII. REFERENCES

- [1] Jayakrishnan T, Jeeja M, Bhaskar R. Occupational health problems of municipal solid waste management workers in India. *Int J Environ Health Eng* 2013; 2:42.
- [2] Devi KS, Swamy AVV, Hema Krishna R. Studies on the solid waste collection by Rag Pickers at Greater Hyderabad Municipal Corporation, India. *Int Res J Environ Sci* 2014; 3:13-22.
- [3] Mondal NK. Municipal solid waste exposure and health concern: Indian women are at risk. *J Health Educ Res Dev* 2016; 4:e124.
- [4] Kadam DH, Gawde NC. Understanding pathways to health with legacy of caste among sanitation workers: An eco-social approach. *Int J Preven Curat Comm Med* 2017; 3:84-96.
- [5] Anekal S. Challenges in the Informal Waste Sector: Bangalore, India [Internet]. Philadelphia: Penn Institute for Urban Research; 2019 Nov p. 6.
- [6] Thakur P, Ganguly R, Dhulia A. Occupational Health Hazard Exposure among municipal solid waste workers in Himachal Pradesh, India. *Waste Manag* 2018; 78:483-9.
- [7] Kuijer PPFM, Sluiter JK, Frings-Dresen MHW. Health and safety in waste collection: Towards evidence-based worker health surveillance. *Am J Ind Med* 2010; 53:1040-64.
- [8] Reddy BA, Laxmi PSS. Urban Infrastructure: A Special Reference to PPP in Karnataka, India State. *Nagarlok*. 2020.
- [9] Environment Protection Training and Research Institute. State of Environment Report Karnataka, India state 2015. p. 667.
- [10] Haifete AN, Justus AH, Iita H. Knowledge, attitude and practice of healthcare workers on waste segregation at two public training hospitals. *Eur J Pharm Med Res* 2016; 3:674-89.
- [11] Statistical Year Book 2017 [Internet]. Directorate of Economics and Statistics, Hyderabad, Government of Karnataka, India; 2017.

- [12] Annual Report: Periodic Labour Force Survey (PLFS) 2017/2018 [Internet]. National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India; 2019.
- [13] Dutkiewicz, J., (1997). Bacteria and fungi in organic dust as potential health hazard. *Annals of Agricultural Environmental Medicine*, 4, 11-16.
- [14] Enger, E. D., & Smith, B. F. (2004). *A study of interrelationships*. Environmental Science. Edward E. Bartell. California, USA.
- [15] Ewis, A. A., Rahma, M. A., Mohamed, E. S., Hifnawy, T. M., & Arafa, A. E. (2013). Occupational health-related morbidities among street sweepers and waste collectors at Beni-Suef, Egypt. *Egyptian Journal of Occupational Medicine*, 37(1), 79-94.
- [16] Gbekor, A. (2003). Domestic waste management. Ghana Environmental Protection Agency (EPA) Newsletter, 47(5), 12-17.
- [17] Inyang, M. P. (2007). Educating young people against risky sexual behaviors. *Education for Social Transformation*. Ibadan University Press, 8(2), 290-300.
- [18] Ivens, U. I., Ebbelohj, N., Poulsen, O. M., & Skov, T. (1997). Gastrointestinal symptoms among waste recycling workers. *Annals of Agricultural and Environmental Medicine*, 4(1), 153-157.
- [19] Jaithli, H. (2012). Health problems. A rapid assessment survey of the health and environmental impacts of solid waste recycling. *Centre for Study in Man and Environment*, 1(1), 36-42.
- [20] Lopez-Arquillos A, Rubio-Romero JC, CarrilloCastrillo J, Suarez-Cebador M, Galindo Reyes F. Occupational accidents in municipal solid waste management (MSW) companies. *Environ Eng Manage J*. 2019; 18(5):1029-1038.
- [21] Thakur P, Ganguly R, Dhulia A. Occupational health hazard exposure among municipal solid waste workers in Himachal Pradesh, India. *Waste Manage*. 2018; 78:483-489.
- [22] Moussiopoulos N. Investigation of the occupational health and safety conditions in Hellenic solid waste management facilities and assessment of the in-situ hazard level. *Safety Sci*. 2017; 96:192-197.
- [23] Chitra, Nagaraj, Shivaram C, Jayanth Kumar, Narasimha Murthy. A Study of Morbidity and Mortality Profile of Sweepers Working Under Bangalore City Corporation. *Indian J Occup Environ Med*. 2004; 08.
- [24] Poulsen OM, Breum NO, Ebbelohj N, Hansen AM, Ivens UI, van Lelieveld D, Malmros P, Matthiasen L, Nielsen BH, Nielsen EM, Schibye B, Skov T, Stenbaek EI, Wilkins CK. Collection of domestic waste. Review of occupational health problems and their possible causes. *Sci Total Environ*. 1995; 170(1-2):1-19.
- [25] Emiru Z, Gezu M, Chichiabellu TY, Dessalegn L, Anjulo AA. Assessment of respiratory symptoms and associated factors among solid waste collectors in Yeka Sub City, Addis Ababa, Ethiopia. *J Public Health Epidemiol*. 2017; 9(6):189-197.
- [26] Jerie S. Occupational risks associated with solid waste management in the informal sector of Gweru, Zimbabwe. *J Environ Public Health*. 2016; 2016:9024160.
- [27] Landi F, Calvani R, Picca A, Tosato M, Martone AM, Ortolani E, Sisto A, D'Angelo E, Serafini E, Desideri G, et al. Body Mass Index is Strongly Associated with Hypertension: Results from the Longevity Check-Up 7+ Study. *Nutrients*. 2018; 10(12):1976.
- [28] Ali N, Ahmed S, Mahmood S, et al. The prevalence and factors associated with obesity and hypertension in university academic staff: a cross-sectional study in Bangladesh. *Sci Rep*. 2023; 13:7309.
- [29] Babu GR, Murthy GVS, Ana Y, Patel P, Deepa R, Neelon SEB, Kinra S, Reddy KS. Association of obesity with hypertension and type 2 diabetes mellitus in India: A meta-analysis of observational studies. *World J Diabetes*. 2018; 9(1):40-52.
- [30] Gupta R, Gupta VP, Bhagat N, Rastogi P, Sarna M, Prakash H, Deedwania PC. Obesity is a major determinant of coronary risk factors in India: Jaipur Heart Watch studies. *Indian Heart J*. 2008; 60:26-33.
- [31] Reddy S, Prabhhu G. Prevalence and risk factors of hypertension in adults in an Urban Slum, Tirupati, AP. *Indian J Community Med*. 2005;30:84.
- [32] Rao BB, Harikumar PS, Jayakrishnan T, George B. Characteristics of *Aedes (Stegomyia) albopictus* Skuse (Diptera: Culicidae) breeding sites. *Southeast Asian J Trop Med Public Health* 2011; 42:1077-82.
- [33] Institute for Solid Wastes of the American Public Works Association, US Environmental Protection Agency. Chapter 8. Solid Waste Collection Practice. 4th ed. Chicago, Illinois, USA: Slavik Printing Company; 1975. p. 322-45.
- [34] Krajewski JA, Tarkowski S, Cyprowski M. Hazardous health effects in communal waste collection and disposal workers. *Med Pr* 2000; 51:159-72.
- [35] Feachem RG, Bradley DJ. *Health Aspects of Excreta and Wastewater Management*. Sanitation and Disease: Chi Chester, UK: John Wiley and Sons; 1983. p. 501.
- [36] Pruess A, Giroult E, Rushbrook P. Health and safety practices for health-care personnel and waste workers. In: *Safe Management of Wastes from Health-care Activities*. Geneva, Switzerland: World Health Organization; 1999. p. 226.
- [37] Rushton L. Health hazards and waste management. *Br Med Bull* 2003; 68:183-97.
- [38] Poulsen OM, Breum NO, Ebbelohj N, Hansen AM, Ivens UI, van Lelieveld D, et al. Collection of domestic waste. Review of occupational health problems and their possible causes. *Sci Total Environ* 1995; 170:1-19.
- [39] Barrera R, Navarro JC, Mora JD, Domínguez D, González J. Public service deficiencies and *Aedes aegypti* breeding sites in Venezuela. *Bull Pan Am Health Organ* 1995; 29:193-205.
- [40] Kabir A, Farhana N, Akter F, Jesmin S, Ali A. Sweeping practices, perceptions and knowledge about occupational safety and health hazards of street sweepers in Dhaka city, Bangladesh: A qualitative inquiry. *Int J Community Med Public Health* 2015; 2:237-43.