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Multiple morbidities and health conditions of waste-loaders in Mumbai: A study of the burden of disease and health expenditure

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ABSTRACT

Study assesses the effects of solid-waste loading on workers, the resultant development of occupational morbidities, and economic burden of these morbidities. A cross-sectional survey was conducted with 360 municipal workers from six of 24 municipal wards in Mumbai. The nearest neighborhood method of Propensity Score Matching (PSM) examined the impact of waste-loading on the development of morbidities and to identify the risk factors – multiple logistic regression analysis was performed. The prevalence of musculoskeletal disorders (MSDs), injury, eye and skin infections found significantly higher for waste-loaders compared to comparison group. The PSM method revealed that the occupation of waste-loading significantly raised the risk of injury (34%), MSDs (23%), eye (19%), skin infection (15%) and disability (15%), compared to comparison group. Significantly higher health expenditure is observed among waste-loaders who have sought treatment in private health facility than public. The study recommends to offer assistance the medical insurance for reducing the financial burden on waste-loaders.

KEYWORDS

Disability; injury/accident; musculoskeletal disorder; respiratory infection and treatment seeking; skin infection; waste loader

Introduction

Solid-waste loaders in developing countries are vulnerable to a number of occupational health risks arising out of manual handling of waste.¹ The megacity of Mumbai, in the state of Maharashtra, India, generates 8500 metric tonnes of municipal solid waste every single day. Around 30,000 regular employees of the city's Municipal Corporation of Greater Mumbai (MCGM) are involved in collecting, segregating, loading, transporting and unloading this waste at landfills across the city. The work involves pulling, pushing, lifting and carrying heavy community dustbins, and loading the waste into garbage compactors. The health risks for workers occur at every step in the process of waste collection, from transportation to recycling and disposal. Workers are exposed to health risks related to the materials they handle, emissions from these materials, and equipment being used. Workers physically handle the decaying carcasses of animals, rotten, stinking material, rusted metal pieces, glass bits and shards, household garbage, human and animal excreta, waste that is mixed with sewage leaking from nearby drains, infectious and hazardous hospital waste and

other toxic wastes. They handle these materials with their bare hands and without proper protective measures. These work condition and workplaces make them vulnerable to communicable as well as non-communicable diseases. Workers who handle solid waste in India face a higher risk of fatal and non-fatal occupational morbidities than their counterparts in high-income countries.² They are more vulnerable to injury and illness compared to members of the general population, particularly injuries such as sprains, lacerations, contusions and fractures.^{3–8} Similarly, cross-sectional studies show that workers associated with solid-waste collection are more prone to respiratory ailments, skin and eye infections, gastrointestinal complications and musculoskeletal disorders (MSDs) compared to other workers.^{9–14}

The higher prevalence of morbidities and the source of treatment-seeking imply high expenditure on healthcare. Out-of-Pocket Expenditure (OOPE) remains the primary means of paying for healthcare in low-income countries, including India.¹⁵ There is evidence of increasing medical expenses having serious financial consequences on the economic condition of households.¹⁶ Although waste-loaders are

formal employees of municipal corporations, they are not entitled to health insurance or free medical health facilities, as are other public servants. This, despite the fact that around 1.2 million¹⁷ conservancy workers are involved in cleaning work throughout India's cities. Analyzing the mean health expenditure of these workers would be useful in formulating policy recommendations for informal¹ labor in developing countries such as India.

Frequent episodes of illness and treatment-seeking have economic implications for laborers who are vulnerable to developing morbidities. Previous studies have suggested a high prevalence of morbidities among solid-waste workers compared to the general population, increasing treatment-seeking and health expenditure. Studying the healthcare-seeking behavior and expenditure on healthcare among formal solid-waste employees will provide important insights on catastrophic healthcare expenditure of non-formal or contract employees, leading to impoverishment. There are a limited number of studies conducted to investigate the morbidities and related treatment-seeking behavior among solid-waste workers.¹⁸ The present study aims to address this gap by assessing the effect of the waste-loading occupation on the development of morbidities and health conditions. The study also attempts to identify the co-variables affecting the health of waste-loaders. Finally, we assess sources of treatment and health expenditure among waste-loaders.

Materials and methods

The study adopted a cross-sectional survey design to compare the prevalence of morbidities and treatment-seeking with health expenditure incurred by exposed and non-exposed municipal workers from similar socioeconomic backgrounds¹⁹ in Mumbai. The exposed population comprised workers engaged in solid-waste loading into garbage compactors for at least 1 year. They worked in teams of six, carrying collected waste in garbage compactors through heavy road traffic in the city to dispose of it at landfill sites. The non-exposed comparison group comprised back-office personnel/peons at the municipal corporation office, employed for at least a year. These were office workers of the MCGM who worked at a single location all day. They represented the general population with a socioeconomic background similar to the waste-loaders. The sample size was determined using the prevalence of major morbidity among municipal solid-waste workers found in the study conducted in Kerala, India. The study of Kerala found that the prevalence of eye-related disease (30%) was the lowest

among solid-waste workers compared to the other morbidities, therefore, the expected prevalence of major morbidities was considered being at least 30% for the sample estimation of present study.² The determined sample size for study was calculated to be 180 workers for a group using the sampling formula by W.G. Cochran and in total for two groups of workers it was 360 municipal workers (180 waste loaders, and 180 comparison group).²⁰

Study was carried out by applying stratified systematic random sampling design where 24 municipal wards had been arranged in the ascending order according to the percentage of slum population acquired from the Census of India 2001 for respective wards.²¹ Then, it was stratified into three strata having low, middle and highest percentages slum population. Each strata had total eight wards, out of eight wards – two wards were randomly selected which would be the representative of other wards in that strata for the sample selection. At the final stage 60 workers were selected from each ward systematically (30-Waste Loaders and 30-Compare Group) with the help of workers list provided by the municipal corporation. The interviews were conducted with the workers at their working places through self-administered questionnaire from March to September 2015. The data entry was done in the CPro 6.0 software and analysis performed in STATA 13.

The Standardised Nordic Questionnaire and modified ATS-DLD-78 Adult Questionnaire were used to record musculoskeletal symptoms as well as disabilities and respiratory symptoms.²² Workers who were prevented from performing day-to-day normal activities due to MSDs in the preceding 12 months were considered disabled. Workers were administered the General Health Questionnaire of 12 items (GHQ-12) to assess their mental health status. In GHQ-12, workers were asked whether they had experienced any positive or negative emotions in a previous month. Each negative response was coded 1, while the absence of it was coded 0. The items were summed to a score for each respondent. The higher the score from 0 to 12, the more severe the mental health problem was considered to be. Further, through the principal component analysis method, the score was divided into three categories, namely low, medium and high. The GHQ-12 scale is acceptable with internal consistency ($\alpha = 0.94$).²³

Previous studies suggest that as the number of working years and age increase, so do complaints of fractures and injury.^{3,24} Similarly, workers who are overweight and obese showed higher prevalence of respiratory and MSDs. On MSDs in particular, there

is sufficient literature to show a positive association between overweight and obesity and anatomical pain.^{25–27} Meta-analysis of earlier studies revealed that substance use – such as chewing tobacco, smoking and alcoholism – affects the physical capacity of a worker and causes respiratory and musculoskeletal pain.^{24,28} Psycho-social factors such as anxiety, work stress and job satisfaction also influence the prevalence of occupationally associated morbidities among solid-waste workers.^{29,30} Therefore, number of working years, age, body mass index (BMI), substance use, mental health status and job satisfaction of the studied waste-loaders were considered as confounding variables.

In order to examine the effects of waste-loading on the development of selected morbidities and health conditions, the study adopted the nearest neighborhood method of Propensity Score Matching (PSM). This approach offers an opportunity to assess the impact of exposure on outcomes through cross-sectional survey data.³¹ To analyze the impact of waste-loading on selected morbidities as well as disabilities, the average exposure effect on exposed (AEEE) was calculated as the difference between the outcomes of treated and matched cases from the comparison group, which measured the increase/decrease in selected morbidities and health conditions.

The propensity score was estimated by logistic regression with the dichotomous exposure variable, for instance 1 = exposed to waste-loading and 0 = unexposed to waste-loading, using the associated observed demographic and occupational characteristics of the waste-loaders as predictor variables. The principal assumption of the PSM is that observable characteristics of the exposed group and the comparison group have similar distributions. This assumption test is applied by using the ‘p-score’ command. To calculate the impact of waste-loading on morbidities and related disabilities, the average effects in both groups were weighted by the proportion of respondents in both, the exposed and comparison groups.

$$P(x) = \text{prob}(D = 1|x) = E(D|x)$$

where $D = \{0, 1\}$ is the indicator of exposure, and x is the multidimensional vector of pre-exposure characteristics. The AEEE is defined as the conditional expectation of difference in the exposure effect for the exposed units only. The outcomes of the two groups were compared after matching the propensity scores of the exposed group and the counterfactual scores of the comparison group.

$$\begin{aligned} \text{AEEE} &= E(\Delta | p(x), D = 1) = E(y_1 | p(x), \\ &D = 1) - E(y_0 | p(x), D = 1) \end{aligned}$$

To identify the co-variates affecting selected morbidities and related disabilities among the waste-loaders, multiple logistics regression analysis was applied. Additionally, the mean health expenditure is calculated for major morbidities and health conditions among waste-loaders according to their access of healthcare and was tested by *t*-test statistics. As shown by McIntyre et al. (2006), the present study considers only direct costs, including the cost of consultation, diagnostic investigations, drugs and transportation.¹⁶

Ethical considerations

As respondents of the study were formal employees of the municipal corporation, the MCGM was asked for permission to conduct the primary survey. Informed consent of the participants was obtained in the local language. Participants were assured of confidentiality and informed that survey data would be used for research purposes only. Ethical clearance prior to data collection was obtained from the Student Research Ethics Committee (SREC) of the International Institute for Population Sciences, Mumbai (SREC12/3144).

Results

Table 1 shows the socioeconomic and occupational details of the waste-loaders as well as workers from the comparison group. The mean age of waste-loaders (36 years, SD \pm 8.69) was found to be similar to that of workers from the comparison group (38 years, SD \pm 7.39). A similar pattern was observed for years of work among the waste-loaders (10.35 years, SD \pm 8.16) and those in the comparison group (11 years, SD \pm 6.35). Substance use – such as chewing tobacco, smoking, and alcohol consumption – was found to be higher among waste-loaders as compared to the comparison group. For instance, 46% of waste-loaders chewed tobacco compared to 34% of workers in the comparison group. Alcoholism among waste-loaders was found to be extremely high, compared to the comparison group. Forty-seven per cent of waste-loaders consumed alcohol, compared to only 22% of workers in the comparison group. Mental health status shows substantial differences between the two study groups. Workers engaged in solid-waste loading showed poor mental health status, with a higher mental health score, compared to workers in the comparison group. Forty-five per cent of waste-loaders reported a high score on the mental health scale compared to those in the comparison group (26.1%),

Table 1. Descriptive statistics of the study groups.

Characteristics	Waste loaders (N = 180)	Comparison group (N = 180)
<i>Age</i>		
19–34 years	53.3	34.4
35 and above	46.7	65.6
Mean age \pm SD	35.8 \pm 8.7	38.1 \pm 7.4
<i>Years of working</i>		
Below 10	67.8	51.1
10 and above	32.2	48.8
Mean years \pm SD	10.4 \pm 8.2	11.4 \pm 6.4
<i>Tobacco</i>		
Yes	46.1	34.4
<i>Smoking</i>		
Yes	17.8	11.1
<i>Alcohol</i>		
Yes	47.2	21.7
<i>Mental health</i>		
Low	21.1	50.5
Moderate	33.8	23.3
High	45.0	26.1
<i>Job satisfaction</i>		
Good	17.2	30.6
Average	58.9	61.1
Bad	23.9	8.3
<i>Body mass index</i>		
Less than 25	67.2	51.7
More than 25	32.8	48.3
Mean BMI \pm SD	23.5 \pm 3.4	25.1 \pm 3.4

Figures are in percent (%).

revealing a higher burden of poor mental health for waste-loaders compared to their counterparts.

Table 2 reveals that prevalence of selected morbidities and health conditions are significantly higher among waste-loaders compared to workers in the comparison group, specifically in the case of MSDs (45%), injury/accident (43%), eye disease (24%) and skin disease (18%), compared to 33%, 8%, 14% and 7%, respectively for the comparison group. Similarly, waste-loaders differed significantly from the comparison group in terms of sub-category morbidities and health conditions during the reference months. For instance, waste-loaders displayed a significantly higher prevalence of fractures (15%), lacerations caused by needles/glass (37%) and contusions on the job (14%) compared to those in the comparison group (1%, 3% and 6% respectively). Waste-loaders engaged in handling waste without adequate protective measures tend to have more skin-related problems, as evidenced in Table 2. Waste-loaders have a higher prevalence of skin rashes/infections (14%), itching (14%) and dermatitis (4%) compared to workers in the comparison group (4%, 6% and 4% respectively). In addition, eye problems – soreness, redness, watering and itchy eyes – were significantly higher than the comparison group. Musculoskeletal pain and related disabilities were also found to be significantly higher among waste-loaders than the comparison group. Shoulder pain (26%), pain in the hip/thigh (34%) and lower

back (39%) were all significantly higher in the waste-loading group compared to the comparison group (11%, 20% and 29%, respectively). Likewise, among the waste-loaders, disabilities of the shoulder (16%), hip/thigh (23%) and lower back (31%) were higher compared to 9%, 8% and 18% respectively for comparison group workers.

The PSM method was employed to assess the effects of waste-loading on the development of selected morbidities and health conditions. Table 3 exhibits the AEEE for major morbidities and health conditions during the previous 6 and 12 months. The results of the AEEE reveal that the occupation of waste-loading significantly associated with the risk of morbidities and health conditions, particularly injury/accident (34%), MSDs (23%), eye disease (19%), skin disease and disability (15% respectively), and respiratory ailments (10%), as compared to workers in the matched comparison group. It is clear, therefore, from the PSM results that the occupation of waste-loading significantly associated with the development of major morbidities and health conditions.

Individual risk factors that significantly affect major morbidities and health conditions among waste-loaders were identified after adjusting for workers' age, BMI and job satisfaction. Table 4 demonstrates that years of working is a significant predictor to the development of major morbidities. Workers who had worked for 10 or more years, in particular, were more likely to suffer from respiratory ailments (odds ratio (OR) = 7.51; $p < .01$), skin diseases (OR = 6.75; $p < .01$), disabilities (OR = 5.57; $p < .01$), MSDs (OR = 3.65; $p < .01$) and injury/accidents (OR = 3.61; $p < .01$) as compared to waste-loaders who had been working for <10 years. Mental health status among waste-loaders was also found to be significantly correlated with major morbidities; loaders who scored high on the mental health scale were significantly more likely to have suffered from MSDs (OR = 5.31; $p < .01$), disabilities (OR = 3.49; $p < .01$) and eye disease (OR = 3.76; $p < .05$) as compared to loaders who had a low score. Substance use did not significantly affect the health of waste-loaders, apart from alcohol consumption. Waste-loaders who consumed alcohol were more likely to suffer from morbidities and health conditions during service. For instance, waste-loaders who are alcoholics are significantly more likely to develop respiratory diseases (OR = 7.38; $p < .01$), suffer injury/accidents (OR = 3.1; $p < .01$), disabilities (OR = 2.90; $p < .01$), MSDs (OR = 2.53; $p < .01$) and eye disease (OR = 2.23; $p < .05$) than non-alcoholic workers. Similarly, the location of work was found to

Table 2. Prevalence rate of morbidities and health conditions among study groups in past six and 12 months.

Sub-categories of major morbidities	Waste loaders (N = 180)	Comparison group (N = 180)	Chi-square
<i>Injuries/accident</i>	43.3	8.3	$\chi^2 = 57.542; p = .000$
Fracture	15.6	1.1	$\chi^2 = 24.581; p = .000$
Laceration needles/glass	36.6	2.8	$\chi^2 = 65.283; p = .000$
Contusion on job	14.4	5.6	$\chi^2 = 7.901; p = .005$
<i>Skin diseases</i>	18.3	6.6	$\chi^2 = 11.200; p = .001$
Rashes/infective	14.0	3.9	$\chi^2 = 11.112; p = .001$
Itching	14.4	6.1	$\chi^2 = 6.777; p = .009$
Dermatitis	9.4	4.4	$\chi^2 = 3.481; p = .062$
<i>Respiratory diseases</i>	17.7	16.6	$\chi^2 = .077; p = .780$
Episode of asthma	9.4	12.2	$\chi^2 = .718; p = .397$
Chronic cough	7.8	7.8	$\chi^2 = .000; p = 1.000$
Running nose	3.3	8.3	$\chi^2 = 4.096; p = .043$
Breathlessness	11.6	15.5	$\chi^2 = 1.157; p = .282$
<i>Eye diseases</i>	24.4	14.4	$\chi^2 = 5.745; p = .017$
Soreness/infection	14.4	7.2	$\chi^2 = 4.859; p = .027$
Redness	17.8	8.9	$\chi^2 = 6.153; p = .013$
Watering	18.9	12.0	$\chi^2 = 3.045; p = .081$
Itching	13.3	10.5	$\chi^2 = 0.660; p = .416$
<i>Musculoskeletal disorders^a</i>	45.0	33.3	$\chi^2 = 5.141; p = .023$
Neck	13.3	10.6	$\chi^2 = 0.660; p = .416$
Shoulder	26.1	11.1	$\chi^2 = 13.368; p = .000$
Elbow	10.6	8.9	$\chi^2 = 0.284; p = .594$
Wrist/hand	18.9	18.9	$\chi^2 = 0.000; p = 1.000$
Upper back	31.7	27.2	$\chi^2 = 0.855; p = .355$
Low back	38.9	29.4	$\chi^2 = 3.569; p = .059$
Hip/thigh	34.4	20.0	$\chi^2 = 9.478; p = .002$
Knee	3.3	3.9	$\chi^2 = 0.079; p = .778$
<i>Disability^a</i>	36.1	32.2	$\chi^2 = 0.605; p = .437$
Neck	5.5	9.4	$\chi^2 = 1.962; p = .161$
Shoulder	15.5	9.4	$\chi^2 = 3.073; p = .080$
Elbow	5.0	5.5	$\chi^2 = 0.056; p = .814$
Wrist/hand	13.9	13.3	$\chi^2 = 0.023; p = .878$
Upper back	25.0	18.9	$\chi^2 = 1.932; p = .161$
Low back	30.5	17.8	$\chi^2 = 8.018; p = .005$
Hip/thigh	22.8	7.8	$\chi^2 = 15.644; p = .000$
Knee	2.2	3.3	$\chi^2 = 0.411; p = .521$

^aMorbidities and disabilities were considered for past 12 months.

Table 3. Average exposure effect (AEE) and average exposure effect among exposed (AEEE) of waste loader occupation on major morbidities and health conditions.

Major morbidities	AEE		AEEE	
	Coef.	95% Conf.	Coef.	95% Conf.
Injury/accident	0.33***	(0.21 to 0.43)	0.34***	(0.23 to 0.45)
Skin	0.15***	(0.07 to 0.24)	0.15***	(0.09 to 0.21)
Respiratory	0.04	(-0.03 to 0.12)	0.10***	(0.03 to 0.18)
Eye	0.15***	(0.07 to 0.24)	0.19***	(0.12 to 0.27)
Musculoskeletal disorders ^a	0.19***	(0.09 to 0.29)	0.23***	(0.14 to 0.33)
Disability ^a	0.09*	(-0.00 to 0.19)	0.15***	(0.05 to 0.24)

* $p < .1$; ** $p < .05$; *** $p < .01$. Coef: coefficient; Conf: confidence interval.

^aMorbidities were considered for past 12 months.

be a significant predictor of major morbidities. Waste-loaders working in moderate or high slum concentration areas were significantly more likely to contract respiratory diseases (OR = 7.26; $p < .01$) and skin diseases (OR = 6.00; $p < .01$) compared to loaders working in low slum concentration areas.

A majority of waste-loaders seek healthcare at private health facilities rather than public health facilities. Seventy per cent of waste-loaders who suffered from respiratory ailments took treatment at private health

facilities, followed by 58% for MSDs, and 53% for eye infections, compared to public health facilities (30%, 42% and 47% respectively). However, 63% of waste-loaders accessed treatment at public health facilities for skin diseases, and 52% for injury/accidents, while 37% and 48% respectively sought help for these conditions at private facilities. Waste-loaders reported that they preferred going to private health facilities for the treatment of respiratory ailments and MSDs because public facilities/hospitals offer inadequate and inefficient treatment. Examples of this would be the absence of modern diagnostic methods to detect macrobacterium and computed tomography scans for respiratory diseases. Likewise, many workers reported that they had to visit private health facilities to take an MRI scan for treatment of musculoskeletal pain in the lower back and neck. Workers visited to public health facility stated that the overcrowding at the public facility led to the poor care and treatment.

Medical expenditure according to source of treatment for major morbidities and health conditions as depicted in Table 5, shows the mean difference in health

Table 4. Odds ratio of association between major morbidities and socio-demographic characteristics among waste loaders.

Characteristics	Injury/accident	Skin	Respiratory	Eye	MSDs ^a	Disability
<i>Years of working</i>						
Below 10 ^b						
10 and more	3.61*** (1.52–8.55)	6.75*** (1.87–24.30)	7.51*** (1.89–29.78)	1.17 (0.45–3.03)	3.65*** (1.47–9.04)	5.57*** (2.22–13.90)
<i>Mental health</i>						
Low ^b						
Moderate	1.23 (0.43–3.49)	3.79 (0.60–23.77)	10.86*** (1.53–76.80)	4.79** (1.08–21.23)	3.04** (0.94–9.77)	2.65* (0.76–9.25)
High	1.22 (0.47–3.13)	3.12 (0.57–17.00)	2.05 (0.34–12.21)	3.76** (0.94–15.06)	5.31*** (1.84–15.33)	3.49*** (1.14–10.68)
<i>Smoking</i>						
No ^b						
Yes	0.88 (0.35–2.21)	1.14 (0.33–3.87)	0.71 (0.20–2.48)	0.75 (0.26–2.14)	0.68 (0.25–1.82)	0.71 (0.26–1.95)
<i>Tobacco</i>						
No ^b						
Yes	0.47** (0.22–1.00)	1.81 (0.67–4.86)	0.74 (0.25–2.16)	1.01 (0.46–2.22)	0.76 (0.36–1.62)	1.05 (0.48–2.30)
<i>Alcohol</i>						
No ^b						
Yes	3.1*** (1.48–6.47)	1.81 (0.67–4.86)	7.38*** (2.07–26.32)	2.23** (0.97–5.13)	2.53*** (1.17–5.46)	2.90*** (1.30–6.45)
<i>Location of work based on proportion of slums</i>						
Low ^b						
Middle	1.72 (0.68–4.33)	6.00*** (1.49–24.03)	7.26*** (1.68–31.38)	2.05* (0.71–5.90)	1.74 (0.65–4.64)	1.73 (0.62–4.85)
High	0.95 (0.37–2.41)	4.08** (1.00–16.59)	1.41 (0.29–6.93)	1.59 (0.54–4.67)	1.24 (0.48–3.19)	0.92 (0.33–2.60)

* $p < .1$; ** $p < .05$; *** $p < .01$.^aMSDs: musculoskeletal disorders, the model is additionally adjusted for workers Age, BMI and Job satisfaction.^bReference category.**Table 5.** The Source of treatment seeking behavior and mean expenditure on major morbidities and health conditions of waste loaders by government and private health facilities.

Major morbidities	Govt. (%) ^a	Govt ^b (mean ₹)	Private (%) ^a	Private ^b (mean ₹)	Total ^b (mean ₹)	t-Test	N
Injuries/accident	52.1	1250	47.9	5239	4210	$t = -2.426$ Pr ($ T > t $) = 0.022	48
Respiratory	30.0	933	70.0	3000	1760	$t = -2.641$ Pr ($ T > t $) = 0.030	19
Eye	47.4	580	52.6	4400	2013	$t = -2.045$ Pr ($ T > t $) = 0.087	20
Musculoskeletal disorders	41.8	2621	58.2	4778	3465	$t = -1.753$ Pr ($ T > t $) = 0.094	19
Skin	63.2	1000	36.8	1000	1000	No mean difference	55

^aSource of treatment.^bMean expenditure on morbidities-values in rupees (₹).

expenditure among waste-loaders. Waste-loaders spend a considerably higher amount (₹4210) on treatment for injury/accidents, followed by ₹3465 on MSDs, and ₹2013 on eye infections. Those seeking treatment at private health facilities spend more on treatment for injury/accidents compared to waste-loaders going to government facilities. For instance, waste-loaders spent ₹5239 on treatment for injury/accident at a private health facility with compared to ₹1250 at a government facility. Likewise, waste-loaders seeking treatment at a private health facility spent ₹4778 on MSDs, ₹4400 on eye infections, and ₹3000 on respiratory ailments, compared to ₹2621, ₹580 and ₹933 respectively at a public health facility. No discernible difference in mean expenditure by source of treatment for skin diseases was observed among waste-loaders.

Discussion

Waste-loaders are at a comparatively higher risk of developing fatal and non-fatal morbidities than the general population. The results of the study show a significantly higher prevalence of injury/accident, skin disease, eye problems and MSDs among waste-loaders, compared to the comparison group. They were also

found to be at greater risk of incurring injuries such as laceration from needles/glass, fractures and contusions. This is evident in earlier studies as well. In a clinical evaluation study conducted on waste collectors in San Francisco, the majority reported work-related injuries such as lacerations, fractures and sprains.⁸ Further, past studies suggested that there is an increased risk of hepatitis B and C virus infections due to exposure to sharp instruments handling during waste collections.³² Similarly, instances of sore eyes, redness, watering and itching of eyes were considerably higher among waste-loaders compared to the comparison group. This could be attributed to long-term exposure to harmful gases emitted from community dustbins and landfills and additionally, to the particulate matter released by road traffic in megacities like Mumbai. A study conducted on solid-waste workers in the south Indian state of Kerala supported the findings of the present study, finding eye disease, particularly a burning sensation, watering, redness and itching, common among waste-loaders.²

MSDs – pain in the lower back/hip/thighs and shoulders – were found to be significantly higher for waste-loaders compared to workers in the comparison

group. This is likely to be caused by pulling, pushing, lifting and loading solid waste from community dustbins to waste-carrying compactors.^{25,33–36} Previous studies conducted with waste workers have exhibited similar findings.^{6,9,10,12,37,38} The PSM methods highlighted that the occupation of waste-loading significantly associated with raising risk of injury/accident, MSDs, eye disease, skin disease, disability and respiratory diseases. In addition, study highlighted the potential risk factors for developing major morbidities and health conditions among waste-loaders. Risk factor such as years of work, poor mental health, alcoholism and location of work were found to be significant predictors of major morbidities and health conditions. Waste-loaders who consumed alcohol were significantly more likely to suffer all the major morbidities and health conditions, except for skin disease. Waste-loaders are prone to habitual alcohol consumption due to the nature of their occupation and conditions of work, as evident in the words of one 45-year-old waste-loader: “It is necessary for us to have alcohol before engaging in our work, otherwise it is not possible to work continuously in this filthy environment. The alcohol provides an anaesthetic.”

This article also examines the treatment-seeking among waste-loaders and expenditure incurred therein. Results suggest that a higher proportion of waste-loaders sought treatment from private health facilities which eventually lead to economic burden of morbidities and health conditions. For instance, the healthcare expenditure is significantly higher who visit private healthcare facility than government particularly for respiratory infections and for injury/accident. The multiple morbidities and health conditions among waste-loaders cause a constant increase in expenditure on health. Although they are government employees, most waste workers prefer to visit private health facilities rather than public ones. The survey also revealed that none of the waste-loaders had health insurance. A similar study based on solid-waste workers highlighted that the healthcare expenditure was significantly higher among waste-pickers.³⁹ The present study has several methodological strengths. The comparison group sample was selected on condition that their socioeconomic characteristics matched those of the waste-loaders. The ratio of waste-loaders to comparison group workers was 1:1. The sample was representative of municipal waste-loaders as it was obtained by systematic random sampling from six out of 24 municipal wards in Mumbai. Standardised questionnaires such as the ATS-DLD-78 Adult Questionnaire and Standardised Nordic Questionnaire were applied to assess respiratory as well as MSDs

among municipal workers. The Nordic Questionnaire featured visuals of different body parts to identify various musculoskeletal symptoms.

At the same time, the study had some limitations as well. The cross-sectional survey design for data-collection likely have limitations to present actual prevalence of morbidities and health conditions because of the self-reported morbidities, recall bias and faced difficulties in establishing the cause-effect relationships.⁴⁰ A limitation of the cross-sectional study design is that the survey is carried out at a single point in time. This offers no indication of the sequence of events⁴¹ that might follow. The results may generalized with caution as this study exclusively conducted with the municipal solid waste loaders in Mumbai. Reporting expenditures and the probability of misreporting increases as the time span between the interview and the event of morbidity increases.⁴² This study recommends that waste-loaders work on job rotation³⁴ with other municipal workers in the solid-waste department. They should undergo a medical examination every year and be advised on how to prevent, treat, cure and minimize morbidities and health conditions. Municipal corporations should offer assistance for medical insurance to reduce the financial burden on waste-loaders. An urgent need of health education should be provided which can increase the awareness among workers. A Thailand-based study highlighted the significance of health risk reduction behavior model decreases the healthcare costs of individual and significantly improved knowledge, attitude and practices among waste-pickers. The percentage of physical symptoms was reduced due to the use of personal protective equipment compared to the control group.⁴³ The body posture during working hours and physical loads could have been studied as they are identified as key contributors to MSDs in waste collection occupation and perhaps a future scope of research.^{44,45} There could also be seasonal variations in the prevalence rate of morbidities and health conditions related to waste-loading work. These were not covered in the study, and may be considered in a future study. The growing trend of outsourcing informal labor services in developing countries further compromises the social security and healthy life of labor, as contractual organizations have little regard for the basic rights of workers. There is, therefore, scope for studies to be conducted on the morbidities and associated health-seeking behavior among the speedily-growing sector of informal labor in solid-waste management.

Conclusion

A study of municipal conservancy workers in the megacity of Mumbai reveals that in low-income countries, where waste management is labor-intensive and unorganized resulted in developing the higher health risk for workers including fatal morbidities and health conditions such as injury, MSDs, respiratory, eye and skin disorders, disability. The working place and nature of work has significant implication on developing the health risk, for instance in developing countries municipal workers physically handle decaying carcasses of animals, rusted/sharp material, human and animal excreta, infectious and hazardous material with no proper protective measures which effect their health severely. The additional contextual factors such as poor diet, poor mental health status and, regular substance use resulted in deterioration of health. With health problems workers also tend to bear a higher burden of health expenditure, with no provisioning of health insurance.

Availability of data and material

All the relevant data is presented in the manuscript.

Consent for publication

Institutional consent form applicable.

Disclosure statement

The authors declare that they have no competing interests.

Ethical approval and consent to participate

Informed consent of the participants was obtained in the local language. Ethical clearance prior to data collection was obtained from the Student Research Ethics Committee (SREC12/3144) of the International Institute for Population Sciences, Mumbai.

Note

1. The condition of informal conservancy workers in a developing country is even worse. They include those who work as conservancy staff in municipal corporations throughout India, but without entitlement to any welfare schemes as formal employees are. They are treated as voluntary workers and work without protective measures, on minimum wages of ₹200–250 per day.

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