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Original Article

Occupational health conditions and personal protective equipment utilization among women waste workers in Kathmandu: A cross-sectional study

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ABSTRACT

Introduction: Women Waste Workers (WWWs) face significant occupational health risks due to minimal safety practices, limited access to vaccinations, and inadequate use of Personal Protective Equipment (PPE). These factors contribute to respiratory diseases, injuries, and musculoskeletal disorders (MSDs).

Methods: A cross-sectional study was conducted from February to March 2024 among 90 WWWs in Kathmandu Metropolitan City (Wards 10, 12, and 32) using purposive sampling. Data on demographics, work conditions, occupational health status, and PPE use were collected through semi-structured interviews and analyzed using descriptive statistics, Pearson's chi-square test, and multivariable logistic regression.

Results: Most participants were aged 30–40 years (47.8%), illiterate (55.6%), and married (87.8%). The majority handled dry waste (61.1%) and had ≤7 years of work experience (65.6%). Only 12.2% had received occupational health and safety (OHS) training. Vaccination rates were low for tetanus (48.9%) and Hepatitis B (28.9%). MSDs (71%) were most common, followed by mental health-related issues (45.6%), skin diseases (42.2%), and respiratory diseases (41.1%). Despite 92.2% reporting PPE use, concerns remained over quality and effectiveness. Multiple binary logistic regression showed that workers earning ≤17,000 rupees had 6.7 times higher odds of skin disease ($p = 0.038$), while those with >7 years of experience had 85% lower odds ($p = 0.002$). Visiting a clinic once a year reduced the odds by 90% ($p = 0.003$), but never visiting showed no significant impact ($p = 0.374$).

Conclusion: WWWs face severe occupational health risks, highlighting gaps in OHS training, vaccinations, health-seeking behavior, and workplace policies. Strengthening OHS programs and improving PPE utilization are essential to protecting their health.

Keywords: Musculoskeletal Disorders, Occupational Health and Safety, Personal Protective Equipment, Tetanus Toxoid, Women Waste Workers

Introduction

Informal Waste Workers (IWWs) in Nepal generally have inadequate awareness of occupational health and safety issues.[1] Inadequate protection against workplace and environmental hazards puts workers at significant risk of health problems. The workers faced challenges in accessing and correctly using PPE, making them more susceptible to infections and long-term health issues. Waste management jobs are often socially stigmatized, and the majority of workers have reported experiencing mental health issues.[2]

Waste workers are the individuals who are responsible for the collection, sorting, recycling, and disposal of waste to manage and process it effectively.[3] Municipal Solid Waste (MSW) collection and handling are considered among the riskiest jobs. Laborers working as collectors have fatal and nonfatal musculoskeletal problems.[4] MSW workers are also exposed to several pathogens, toxic substances, and chemicals originating from waste decomposition, vehicle fumes, noise, extreme temperatures, and ultraviolet radiation.[5] The rapid increase in fatalities among waste collectors has been attributed to their inadequate awareness and poor compliance with OHS safety measures.[6]

Municipal waste collectors are regularly exposed to physical, chemical, and biological hazards due to the nature of their work. In low- and middle-income countries such as Nepal, inadequate use of personal protective equipment, low vaccination coverage, and limited health monitoring may increase the risk of occupational illnesses and injuries. Despite their essential role in public sanitation, evidence on their occupational health and safety remains limited.[7] Sociodemographic factors, occupational lifestyle, and personal hygiene behaviors were all linked to health outcomes, safety awareness, and safety practices among e-waste workers. Thus, improving safety awareness, alongside these factors, is essential for fostering sustainable safety behaviors.[8]

Women in the informal sector face poor working conditions, low income, safety risks, and minimal decision-making power. In waste management, unregulated work exposes women to crime, violence, and hazardous conditions. They earn lower wages than men, who typically handle heavier, more skilled tasks. Limited PPE use increases health risks like respiratory issues, skin infections, and injuries, which are worsened by poor hygiene and inadequate healthcare access.[9]

This study aims to assess the occupational health conditions of WWWs in Kathmandu Valley, focusing on the utilization of PPE and its impact on the prevalence of occupational diseases.

Methods

A cross-sectional study was conducted between February and March 2024 among women waste workers (WWWs) in selected wards (10, 12, and 32) of Kathmandu Metropolitan City using convenience sampling. The major waste collection and processing sites in Baneshwor, Teku, and Koteshwor, were purposively selected. Women engaged in both formal and informal waste management sectors were recruited through convenience sampling techniques and were approached directly at their workplaces for data collection.

Study sites were purposively selected based on predefined criteria aligned with the research design. Because the eligible population within the selected sites was small and finite, a census (complete enumeration) approach was adopted, whereby all eligible women waste workers present during the study period were invited to participate (N = 90).

The required sample size for the cross-sectional study was initially estimated using Cochran's formula, assuming a 95% confidence level (Z = 1.96), a margin of error of 10% (d = 0.10), and an expected prevalence of 50% (p = 0.5) due to the

absence of prior local estimates.[10,11,12] The calculated minimum sample size was 96 participants. However, as the total number of eligible workers available at the selected sites during the data collection period was 90, all eligible individuals were included. All approached participants consented to participate, resulting in a response rate of 100%, and no adjustment for non-response was required. A total of 40 participants were recruited from Baneshwor, 30 from Koteshwor, and 20 from Teku. Data were collected through face-to-face structured questionnaires administered at dumping sites and waste management organizations.

Descriptive analyses were performed on demographic and occupational health data, while chi-square and multivariate logistic regression analyses were used to examine relationships and health impacts. Occupational health outcomes, such as skin, respiratory, musculoskeletal, eye, gastrointestinal, and chronic diseases, were assessed. PPE use, clinic visits, job type, and training were considered, while income and work experience, originally quantitative, were grouped as ⩽17,000/>17,000 NPR and ⩽7/>7 years. The adjusted odds ratio (AOR) and 95% confidence intervals (CI) were reported, with a significance level of 5% ($p < 0.05$). The multicollinearity among the explanatory variables was assessed using the variance inflation factor (VIF)13, with values kept within acceptable limits (VIF ⩽ 3, Tolerance ⩾ 0.1). Data analysis was conducted using SPSS version 26.

WWWs aged 18–60 years with a minimum of 3 months of experience in waste collection, sorting, or handling were eligible if they were working at selected study sites during data collection and were willing to provide verbal informed consent. The study exclusively focused on women, as this vulnerable population remains underrepresented in occupational health research, while male workers were excluded to address women-specific health knowledge gaps.

Recruitment was conducted in collaboration with owners and supervisors of solid waste management companies. All 90 waste workers approached across three sites met eligibility criteria and agreed to participate (100% response rate). Of these, 70 (77.8%) were informal workers (self-employed, daily-wage workers, or independent workers without formal contracts), and 20 (22.2%) were formal workers (employed by registered waste management companies or municipal facilities at the Teku Transfer Station). Data collection was completed within 15 days in March 2024. The participant number represents the workforce present during this period, though employment fluctuates due to informal and temporary work arrangements.

A structured questionnaire adapted from validated tools was used: demographic and disease-related sections from Salve and Bansod's municipal solid waste loader study, and PPE use and vaccination assessment from Marahatta et. al.'s occupational health hazards questionnaire. A pilot study was conducted among women waste workers in a similar setting outside the selected study areas to assess clarity and feasibility, and minor modifications were made based on the findings. Content validity was established through expert review by the research supervisor and faculty members from the School of Environmental Science and Management (SchEMS), Pokhara University. Internal consistency reliability of the scale items was measured using Cronbach's alpha, yielding 0.81. Face-to-face structured interviews lasting approximately 15 minutes were conducted in Nepali by a single trained researcher (the principal investigator) at workplaces, including dumping sites, transfer stations, and organization premises, during operational hours. Verbal informed consent was obtained, and confidentiality was maintained throughout.

Results

Table 1: Demographic characteristics

Variable	Category	Frequency (%), N=90
Demographic characteristics		
Age (in years)	(20-30) years	15(16.7)
	(30-40) years	43(47.8)
	40 years and above	32(35.6)
Educational level	Illiterate	50(55.6)
	Can read and write	25(27.8)
	Under SLC	8(8.9)
	Intermediate	7(7.8)
Marital status	Single	11(12.2)
	Married	79(87.8)
Caste	Brahmin	10(11.1)
	Chhetri	19(21.1)
	Janajati	47(52.2)
	Dalit	8(8.9)
	Madhesi	1(1.1)
	Other	5(5.6)
Monthly income	≤17 thousand	74(82.2)
	>17 thousand	16(17.8)

The socio-demographic analysis of the 90 surveyed WWWs in Kathmandu revealed that the majority (47.8%) were aged between 30 and 40 years, with a median age of 37 years. Over half (55.6%) of the respondents were illiterate, and only 8.9% had an education up to the Secondary Level Certificate (SLC). A large proportion (87.8%) was married. In terms of caste, more than half belonged to the Janajati group (52.2%), followed by Chhetri (21.1%) and Brahmin (11.1%). In terms of income, 82.2% of respondents reported earning at most 17,000 NPR per month, indicating low incomes among most workers.

Table 2: Work characteristics of WWWs

Work characteristics of WWWs		
Variable	**Category**	**Frequency (%), N=90**
Types of waste handled	Wet	6 (6.7)
	Dry	55 (61.1)
	Dry and wet both	29 (32.2)
Work shift	Morning	37 (41.1)
	Day	45 (50)
	Morning and day both	8(8.9)
Total working hours per day	≤ 8 hours	79 (87.8)
	> 8 hours	11 (12.2)
Received any specific training	Yes	11 (12.2)
	No	79 (87.8)

Among the 90 women waste workers (WWWs) surveyed, the majority (61.1%) handled dry waste, while 32.2% handled both dry and wet waste. Half of the workers (50%) reported working the day shift, with 41.1% working the morning shift and 8.9% working both the morning and day shifts. Most participants (87.8%) worked 8 hours or less per day, and only 12.2% reported working more than 8 hours. Notably, only 12.2% had received any specific training related to their work, while the vast majority (87.8%) had not received any training.

Table 3: Panel A: PPE use and vaccination Status, among WWWs

Variable	Category	Frequency (%), N=90
Use of personal protective equipment (PPE)	Yes	83 (92.2)
	No	7(7.8)
Types of PPE use	Mask and gloves	59(65.6)
	Gloves only	31(34.4)
Vaccinated against hepatitis	Yes	26(28.9)
	No	61(67.8)
Vaccination with tetanus toxoid (TT)	Yes	44(48.9)
	No	46(51.1)

Among the 90 WWWs, 92.2% reported using personal protective equipment (PPE), with 65.6% using both masks and gloves and 34.4% using only gloves. Despite high PPE usage, vaccination coverage was low; only 28.9% had received hepatitis vaccination, and 48.9% had received tetanus toxoid (TT) vaccination. A significant proportion remained unvaccinated: 67.8% for hepatitis and 51.1% for TT. A majority (92.2%) reported using at least one type of PPE, with 65.6% using both masks and gloves and 34.4% using only gloves. Regarding vaccinations, 28.9% had received the hepatitis vaccine, whereas 67.8% had not. Similarly, 48.9% were vaccinated with TT, while 51.1% had not received it.

Table 3: Panel B : Occupational health issues among WWWs

Disease type	Category	Frequency (%)	Overall Disease Prevalence
Cuts and injuries	Fracture	3 (15)	22.2%
	Glass object	14 (70)	
	Dog bite	2 (10)	
	Injuries	1 (5)	
	Total	20 (100)	
Chronic disease	Asthma	1 (5)	22.2%
	Cardiovascular Disease	2 (10)	
	Mental health disorder	17 (85)	
	Total	20 (100)	
Eye Disease	Yes	16 (17.8)	17.8%
	No	74 (82.2)	
	Total	90 (100)	
Skin Disease	Rashes	4 (10.5)	42.2%
	Fungal infection	7 (18.4)	
	Allergy	27 (71.1)	
	Total	38 (100)	
Gastrointestinal Disease	Loose motion	14 (48.3)	
	Worm infection	6 (20.7)	

	Ulcer	6 (20.7)	32.2%
	Foodborne Disease	2 (6.9)	
	Gastrointestinal cancer	1 (3.4)	
	Total	29 (100)	
Respiratory Disease	Dust allergy	20 (54.1)	41.1%
	Asthma	9 (24.3)	
	Running nose	8 (21.6)	
	Total	37 (100)	
Muscle related disease	Neck	18 (25.4)	78.9%
	Upper back	4 (5.6)	
	Lower back	9 (12.7)	
	Shoulder	14 (19.7)	
	Wrist and hand	19 (26.8)	
	Chest	7 (9.9)	
	Total	71 (100)	

The study found that women WWWs reported a range of occupational health problems. The most common issues were skin diseases (42.2%), with skin allergies accounting for 71.1% of these cases. Respiratory diseases were reported by 41.1% of respondents, primarily dust allergies (54.1%). Musculoskeletal disorders were also prevalent, with 25.4% reporting neck pain. Among chronic conditions, 85% of those affected reported mental health disorders. Gastrointestinal issues were noted in 32.2% of respondents, mainly diarrhea (48.3%), worm infections, and ulcers. Eye problems affected 17.8% of workers, and 20 workers (22.2%) reported injuries, mostly from glass objects.

Table 4: Panel A: Bivariate analysis

Bivariable analysis of types of disease and types of PPE used					
Types of disease		Types of PPE use			χ2-value (p-value)
Chronic Disease	Category	Mask and Gloves Count (%)	Gloves Only Count (%)	Total Count (%)	
	Yes	13 (22%)	7 (22.6%)	20(22.2%)	0.953 (0.576)
	No	46(78%)	24 (77.4%)	70 (77.8%)	
	Total	59 (100.0%)	31 (100.0%)	90 (100.0%)	
Eye diseases	Yes	11(18.60%)	5(16.10%)	16(17.80%)	0.089 (0.505)
	No	48(81.40)	26(83.90)	74(82.20)	
	Total	59 (100%)	31(100%)	90(100%)	
Skin diseases	Yes	30(50.80%)	8(25.80%)	38(42.20%)	**5.224 (0.019*)**
	No	29(49.20%)	23(74.20%)	52(57.80%)	
	Total	59 (100.0%)	31 (100.0%)	90 (100.0%)	
Respiratory disease	Yes	27(45.80%)	10(32.30%)	37(41.10%	1.513(0.156)
	No	32(54.20%)	21(67.70%)	53(58.90%)	
	Total	59(100.0%)	31 (100.0%)	90 (100.0%)	
Noise-related disease	Yes	25(42.40%)	16(51.60%)	41(45.60%)	0.735 (0.487)
	No	34(57.60%)	15(48.40%)	49(54.40%)	
	Total	59 (100.0%)	31 (100.0%)	90 (100.0%)	

Muscle-related disease	Yes	46(78%)	25(80.60%)	71(78.90%)	0.88 (0.497)
	No	13(22%)	6(19.40%)	19(21.10%)	
	Total	59(100.0%)	31 (100.0%)	90 (100.0%)	
Gastrointestinal disease	Yes	18(30.50%)	11(35.50%)	29(32.20%)	0.230 (0.401)
	No	41(69.50%)	20(64.50%)	61(67.80%)	
	Total	59(100.0%)	31 (100.0%)	90(100.0%)	
Bivariable analysis of different diseases with different variables					
Variables	Presence of chronic disease				χ2-value (p-value)
	Yes Count (%)		No Count (%)	Total Count (%)	
Presence of eye disease					
Clinic visit	Never	11(68.8)	18(24.3)	29(32.2)	12.55 (0.07*)
	Once in six months	1(6.3)	26(96.3)	27(30)	
	Once in a year	4(25)	30(88.2)	34(77.8)	
	Total	16(100)	74(100)	90	
Presence of skin disease					
Income	≤17000 rupee	26(68.4)	48(92.3)	74(82.2)	8.57 (0.005*)
	>17000 rupee	12(31.6)	4(7.7)	16(17.8)	
	Total	38(100)	52(100)	90	
Years of working	≤ 7 years	16(42.1)	43(82.7)	59(65.6)	16.01 (0.00*)
	>7 years	22(57.9)	9(17.3)	31(34.4)	
	Total	38(100)	52(100)	90	
Clinic visit	Never	17(45.9)	11(22)	28(32.2)	5.77 (0.053*)
	Once in six months	12(32.4)	21(42)	33(37.9)	
	Once in a year	8(21.6)	18(36)	26(29.6)	
	Total	16(100)	71(100)	87	
Presence of Gastrointestinal Disease					
Smoking habit	Yes	23 (79.3)	37 (60.7)	60 (66.7)	3.078 (0.0*)
	No	6 (20.7)	24 (39.3)	30 (33.3)	
	Total	29 (100.0)	51 (100.0)	90	
Presence of Respiratory Disease					
Income	≤17000 rupee	27 (73.0)	47 (88.7)	74 (82.2)	3.67 (0.091)
	>17000 rupee	10 (27.0)	6 (11.3)	16 (17.8)	
	Total	37 (100.0)	53 (100.0)	90	
Job type	Sorter	7 (18.9)	25 (47.2)	32 (35.6)	7.88 (0.036*)
	Sweeper	25 (67.6)	24 (45.3)	49 (54.4)	
	Waste picker	3 (8.1)	3 (5.7)	6 (6.7)	
	Both sweeper and Sorter	2 (5.4)	1 (1.9)	3 (3.3)	
	Total	37 (100.0)	53 (100.0)	90	
Type of waste handled	Wet	2(5.4)	2(3.8)	4(4.4)	5.68 (0.065)
	Dry	29(78.4)	30(56.6)	59(65.6)	
	Dry and wet both	6(16.2)	21(39.6)	27(30)	
	Total	37 (100.0)	53 (100.0)	90	
Years of working	≤ 7 years	19(51.4)	40(75.5)	59(65.6)	5.61 (0.024*)
	>7 years	18(48.6)	13(24.5)	31(34.4)	
	Total	37 (100.0)	53 (100.0)	90	

Presence of noise-related disease					
Training received	Yes	2 (4.9)	9 (18.4)	11 (12.2)	0.378 (0.061)
	No	39 (95.1)	40 (81.6)	79 (87.8)	
	Total	41 (100.0)	49 (100.0)	90	
Presence of muscle-related disease					
Years of working	<=7 years	43(60.6)	16(84.2)	59(65.6)	3.71 (0.062)
	>7 years	28(39.4)	3(15.8)	31(34.4)	
	Total	71(100)	19(100)	90	
Use of PPE	Yes	68(95.8)	15(78.9)	83(92.2)	5.91 (0.034*)
	No	3(4.2)	4(21.1)	7(7.8)	
	Total	71(100)	19(100)	90	
Training received	Yes	5(7)	6(31.6)	11(12.2)	8.41 (0.010*)
	No	66(93)	13(68.4)	79(87.8)	
	Total	71(100)	19(100)	90	

* Indicates the statistically significant at 5% level of significance

In bivariate analysis, a statistically significant association (χ^2=5.22; p=0.019) was found between the types of PPE used and the occurrence of skin diseases among women waste workers. The presence of eye disease was significantly associated with clinic visit frequency (χ^2 = 12.55, p = 0.007), with participants who visited clinics and used PPE more regularly reporting fewer eye problems. Skin disease was significantly associated with income level (χ^2 = 8.57, p = 0.003), with a higher prevalence among workers earning ⩽ 17,000 NPR. Respiratory disease showed a significant association with job type (χ^2 = 7.88, p = 0.036), with a higher prevalence among sorters. Similarly, years of work experience were significantly associated with respiratory disease (χ^2 = 5.61, p = 0.024), indicating an increased risk with longer work duration. The presence of muscle-related disease was significantly associated with the use of PPE (χ^2 = 5.91, p = 0.034), occurring more often among those not using proper PPE. It was also associated with training received (χ^2 = 8.41, p = 0.010), with a lower prevalence among trained workers.

The study examined the association between different disease types and PPE use in a sample population. Among the diseases studied, skin diseases showed a statistically significant association with PPE use (χ2 = 5.22, p = 0.019). For other types of diseases studied, such as chronic disease, eye disease, respiratory disease, noise-related disease, muscle-related disease, and gastrointestinal disease, no statistically significant associations with PPE use were found.

Multicollinearity was examined using tolerance and variance inflation factor (VIF). The tolerance values ranged from 0.701 to 0.874 (> 0.10), and VIF values ranged from 1.144 to 1.427 (< 10), indicating no evidence of problematic multicollinearity among the independent variables. Therefore, all predictors were retained in the multivariable logistic regression model. [11]

Multivariable analysis

Separate multivariable logistic regression models were fitted for each disease outcome to identify factors independently associated with that outcome. Independent variables that were statistically significant in the bivariate analysis (p < 0.05) were entered into the multivariable models. Specifically, income, years of work experience, and frequency of clinic visits were included as covariates. In the final analysis, skin disease was the only dependent variable that showed statistically significant associations with the explanatory variables.

Table 4: Panel B: Multivariable analysis of skin disease and independent variable

Variables	Category	B	S.E. (B)	Wald	df	Adjusted Odds Ratio	95% C.I. for odds ratio		p-value
							Lower	Upper	
Constant									
Income	≤17000 rupees	1.895	0.913	4.311	1	6.652	1.112	39.786	0.038*
	>17000	®							
Years of working	> 7 years	-1.91	0.605	10.01	1	0.148	0.045	0.483	0.002*
	≤ 7 years	®							
Clinic visit	Once a year	-2.29	0.785	8.566	1	0.1	0.022	0.468	0.003*
	Never	-0.71	0.808	0.789	1	0.488	0.1	2.376	0.374
	Once in six-months	®							
® Indicates the reference category									
* Indicates statistically significant at the 5% level of significance									

Multivariable logistic regression analysis (Table 4: Panel B) revealed that women waste workers earning ⩽ 17,000 NPR per month were significantly more likely to report skin diseases than those earning>17,000 NPR (AOR = 6.652, 95% CI: 1.112 – 39.786, p = 0.038). Similarly, workers with more than 7 years of experience were significantly less likely to report skin diseases than those with ⩽7 years of experience (AOR = 0.148, 95% CI: 0.045 – 0.483, p = 0.002). Furthermore, clinic visits once a year were associated with significantly lower odds of skin disease compared to those who visited once in six months (AOR = 0.1, 95% CI: 0.022–0.468, p = 0.003).

The overall logistic regression model was statistically significant, as indicated by the Omnibus Test of Model Coefficients (Chi-square = 28.493, df = 4, $p < 0.001$), suggesting that the set of predictors significantly improved model fit compared to a null model. The -2 Log Likelihood value was 94.087, indicating an acceptable fit of the model. The pseudo-R^2 values suggested moderate explanatory power, with Cox & Snell $R^2 = 0.271$ and Nagelkerke $R^2 = 0.365$. The Hosmer & Lemeshow goodness-of-fit test showed a non-significant result (Chi-square = 0.072, df = 5, p = 1.000), indicating that the model fits the data very well. Overall, the model meets the assumptions for a good fit and demonstrates adequate predictive capability for the outcome variable.[14]

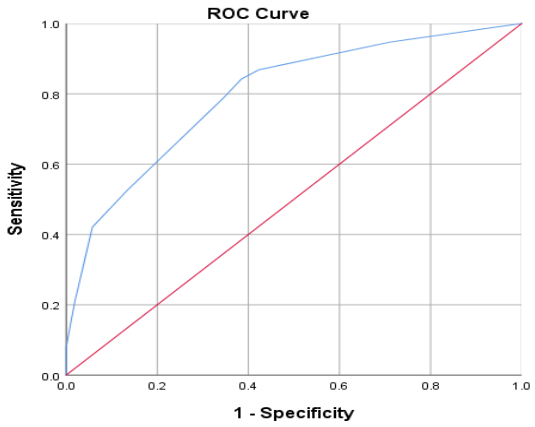

Figure 1. ROC Curve for the Logistic Regression Model of Skin Disease

The discriminative ability of the logistic regression model was assessed using the receiver operating characteristic (ROC) curve. The area under the curve (AUC) was 0.798, indicating good predictive accuracy and acceptable discrimination between individuals with and without skin disease.[14]

Discussion

This study revealed that a substantial proportion of women waste workers (WWWs) in Kathmandu experienced occupational health problems, particularly musculoskeletal disorders (71%), skin diseases (42.2%), and respiratory conditions (41.1%). The high prevalence of musculoskeletal and dermatological problems reflects the hazardous and physically demanding nature of informal waste work. Similar findings have been reported in studies from India and Bangladesh, where musculoskeletal disorders (65.2%), and skin allergies (32.9%) were among the most common occupational ailments among waste workers. The slightly lower prevalence of musculoskeletal disorders in the present study may be attributable to task variation, as women in Kathmandu are primarily involved in sorting rather than heavy lifting. Conversely, the higher rate of respiratory conditions may be attributed to Kathmandu's poor air quality and increased exposure to dust and bioaerosols during sorting activities.[15]

PPE use among participants was notably high (92.2%), similar to previous findings (87.2%) (13), suggesting increased awareness of occupational risks—possibly enhanced by the COVID-19 pandemic and institutional efforts to promote safety. However, only 65.6% reported consistent use of both masks and gloves, and 87.8% had never received formal training. Studies from other regions have emphasized that PPE use is influenced by workplace culture and supervision rather than individual motivation.[16] These results underscore that PPE distribution alone is insufficient without complementary training, vaccination programs, and ongoing health education.

Vaccination coverage among WWWs was critically low (28.9% for hepatitis and 48.9% for tetanus). Comparable studies from industrial waste sectors have also reported suboptimal coverage (7.5% for hepatitis and 46.8% for tetanus).[17] The slightly higher hepatitis vaccination rate in this study may reflect localized NGO health campaigns, but the persistent gender gap in access to preventive healthcare remains evident. Women's limited mobility, health literacy, and economic dependence likely constrain vaccine uptake.

Socioeconomic and educational factors were strongly linked to health outcomes. The majority of participants belonged to low-income groups (82.2%) and had low literacy levels (55.6%). Illiteracy was significantly associated with skin diseases ($p = 0.003$). These results align with findings from South Africa and India, where lower income and education levels limited workers' ability to recognize and manage occupational hazards.[18] Interestingly, longer work experience (>7 years) appeared protective against skin diseases (OR = 0.148, $p = 0.002$), suggesting that workers may develop adaptive behaviors such as improved waste handling or PPE practices over time.[19]

Job role-specific risks were also evident. Sorters had significantly higher rates of respiratory diseases ($p = 0.036$), consistent with literature showing that prolonged exposure to dust and chemical pollutants during sorting elevates respiratory vulnerability. Furthermore, PPE use ($p = 0.034$) and training ($p = 0.010$) were significantly associated with muscle-related disorders, reaffirming that preventive measures, when properly applied, mitigate occupational risks.[19] However, the persistence of musculoskeletal problems, even among PPE users, points to possible gaps in ergonomic practices or PPE quality.

Overall, this study reinforces that occupational health problems among WWWs are shaped by a complex interplay of task type, socioeconomic conditions, training, and preventive practices.

Limitations

This study has several limitations. The sample size was small (N = 90) and limited to three purposively selected wards, which may reduce the generalizability of the findings to other areas. The cross-sectional design prevents causal inferences between occupational exposures and health outcomes. A non-probability sampling approach may have introduced selection bias, and self-reported data could be affected by recall or social desirability bias.

In the analysis, a significance level of 0.05 was used for bivariate testing, and only statistically significant variables were included in the multivariable logistic regression. While this ensures robust associations, it may have excluded variables that are potentially relevant. The small sample size also affects the precision of multivariable estimates, resulting in wider confidence intervals for some predictors. Despite these limitations, the study provides important insights into the occupational health of women waste workers in the sampled wards.

Conclusion

This study provides evidence of the occupational health challenges faced by women waste workers (WWWs) in Kathmandu Valley and highlights the role of personal protective equipment (PPE) in mitigating health risks. The majority of participants reported exposure to occupational hazards, including skin diseases, musculoskeletal disorders, respiratory problems, gastrointestinal issues, eye disorders, and injuries. Skin diseases were the most prevalent, with allergies being the leading type, while musculoskeletal complaints, particularly in the neck and wrist/hand regions, were also highly common.

Bivariate analysis indicated that PPE use was significantly associated with a lower prevalence of skin and musculoskeletal diseases, whereas other diseases were influenced by factors such as income, job type, years of working experience, and clinic visit frequency. Multivariable logistic regression confirmed that low income, shorter work experience, and infrequent clinic visits were independently associated with skin disease. Workers who received occupational training and used PPE properly reported fewer musculoskeletal issues.

The overall logistic regression model demonstrated good a fit and moderate explanatory power, indicating that the included predictors are relevant for understanding skin disease risk among women waste workers.

In conclusion, women waste workers in Kathmandu are highly vulnerable to occupational health hazards. Promoting PPE utilization, health education, and workplace safety measures can significantly reduce disease burden and improve overall health and well-being.

Recommendations

Based on the findings of this study, improving occupational health among women waste workers in the sampled wards of Kathmandu Valley requires several targeted measures. Structured and practical training programs should be provided, focusing on proper waste handling and the correct use of PPE, with periodic refresher sessions to reinforce knowledge and ensure consistent application. Fit-tested and durable PPE, such as masks and gloves, should be supplied, along with guidance on proper use, maintenance, and safe disposal to maximize protection. Access to hepatitis and tetanus vaccinations should be strengthened through targeted outreach in collaboration with local health authorities, and vaccination records should be maintained to ensure ongoing coverage. Municipal authorities and waste management organizations should support safe working conditions by facilitating training, providing PPE, and ensuring access to occupational health services. These

recommendations are specific to Baneshwor, Koteshwor, and Teku wards, and caution is advised when applying them to other areas.

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References

1. Khanal A, Sondhi A, Giri S. Use of personal protective equipment among waste workers of Sisdol landfill site of Nepal. International Journal of Occupational Safety and Health. 2021;11(3):158-64. Available from: https://doi.org/10.3126/ijosh.v11i3.39768
2. Black M, Karki J, Lee AC, Makai P, Baral YR, Kritsotakis EI et al. The health risks of informal waste workers in the Kathmandu Valley: a cross-sectional survey. Public health. 2019;166:10-8. Available from: https://doi.org/10.1016/j.puhe.2018.09.026
3. Kaza S, Yao L, Bhada-Tata P, Van Woerden F. What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications. 2018. Available from: https://doi.org/10.1596/978-1-4648-1329-0
4. Thakur P, Ganguly R, Dhulia A. Occupational health hazard exposure among municipal solid waste workers in Himachal Pradesh, India. Waste Management. 2018;78:483–9. Available from: https://doi.org/10.1016/j.wasman.2018.06.020
5. Poulsen OM, Breum NO, Ebbehøj N, Hansen ÅM, Ivens UI, van Lelieveld D et al. Collection of domestic waste: Review of occupational health problems and their possible causes. Science of the Total Environment. 1995;170(1–2):1–19. Available from: https://doi.org/10.1016/0048-9697(95)04524-5
6. Atsumbe BN, Maigida JF, Abutu F, Amine JD, Enoch EB. Occupational diseases and illnesses in manufacturing industries in Adamawa State: Causes and effects. IOSR Journal of Environmental Science, Toxicology and Food Technology. 2013;3(4):7–13. Available from: https://doi.org/10.9790/2402-0340713
7. Pradhan A, Thapa A, Karki R, Kaphle M. Self-reported occupational hazards among waste management staff in Lalitpur Metropolitan City: A pilot study from Nepal. Int J Occup Saf Health. 2025;15(1):108-17. Available from: https://doi.org/10.3126/ijosh.v15i1.59722
8. Decharat S, Peeranart Kiddee. The Relationship between Socio-Demographic Characteristics, Safety Awareness, and Safety Behaviors among Workers in E-Waste Recycling Shops in Thailand. Int J Occup Saf Health. 2024;14(4):492-503. Available from: https://doi.org/10.3126/ijosh.v14i4.60642
9. Kunwar N, Singh S. The integration of informal female waste workers in solid waste management of Kathmandu. Proceedings of IOE Graduate Conference. 2021;10:106-141. Available from: https://conference.ioe.edu.np/ioegc10/papers/ioegc-10-106-10141.pdf
10. Cochran WG. Sampling techniques (3rd ed). New York: John Wiley & Sons. 1977. Available from: https://www.scribd.com/document/534046574/Cochran-1977-Sampling-Techniques-Third-Edition
11. Krejcie RV, Morgan DW. Determining sample size for research activities. Educational and Psychological Measurement. 1970;30(3):607–10. Available from: https://doi.org/10.1177/001316447003000308
12. Kaphle M, Shai S, Thapa A, Karki R. Occupational health problems among waste collectors in a metropolitan city: a cross-sectional study. International Journal of Occupational and Environmental Safety. 2024;8(2):41–52. Available from: https://doi.org/10.24840/2184-0954_005.001_0001
13. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. 7th ed. Upper Saddle River, NJ: Pearson Prentice Hall. 2010. Available from: https://elibrary.pearson.de/book/99.150005/9781292035116

14. Hosmer JDW, Lemeshow S, Sturdivant RX. Applied logistic regression. John Wiley & Sons. 2013. Available from: https://doi.org/10.1002/9781118548387

15. Acharya SR. Utilization pattern of personal protective equipment among industrial workers of Nawalparasi, Nepal. Health Prospect. 2014;13(2):24–7. Available from: https://doi.org/10.3126/hprospect.v13i2.11833

16. Made F, Ntlebi V, Kootbodien T, Wilson K, Tlotleng N, Mathee A, et al. Illness, self-rated health and access to medical care among waste pickers in landfill sites in Johannesburg, South Africa. International Journal of Environmental Research and Public Health. 2020;17(7):2252. Available from: https://doi.org/10.3390/ijerph17072252

17. Chaudhuri N, Fossier HA, Fauvel G, Lee A, Black M, Karki J. Health status and occupational risks in Nepali informal waste workers. Environmental Epidemiology. 2019;3:59. Available from: https://doi.org/10.1097/01.EE9.0000606300.25322.64

18. Marahatta SB, Katuwl D, Adhikari S, Rijal K. Knowledge on occupational health hazard and safety practices among the municipal solid waste handlers. Journal of Manmohan Memorial Institute of Health Sciences. 2017;3(1):56–72. Available from: https://doi.org/10.3126/jmmihs.v3i1.19179

19. Salve PS, Bansod D. Occupational morbidity among municipal solid waste loaders in Mumbai. Social Science Spectrum. 2016;2(3):195-202. Available from: https://www.researchgate.net/profile/Pradeep-Salve/publication/318671880_Occupational_Morbidity_among_Municipal_Solid_Waste_Loaders_in_Mumbai/links/5976d84caca2728d02706fab/Occupational-Morbidity-among-Municipal-Solid-Waste-Loaders-in-Mumbai.pdf