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Occupational hazards and health risks among sanitation workers in Palestine: a cross-sectional study on injuries and skin conditions

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Sanitation workers face multiple occupational hazards, injuries, and skin conditions, particularly where safety measures are limited. This cross-sectional study, conducted in 2024, assessed exposures, personal protective equipment (PPE) use, work-related injuries, and skin symptoms among 381 sanitation workers across four West Bank governorates, Palestine. Participants completed an interviewer-administered questionnaire covering sociodemographics, health practices, PPE use, occupational hazards and injuries, and the Occupational Skin Disease Exposure Scale (OSDES-16). Most participants were male (99.0%), 17.6% lacked health insurance, and 18.9% had no regular vaccinations. Despite variable PPE use, 55.1% reported not receiving training. Common exposures included prolonged standing (78.9%), sun exposure (85.0%), and high temperatures (34.9%). Work-related injuries affected 53.5%, primarily from sharp tools (25.0%), falls (22.5%), and direct blows (18.6%). Skin erythema (10.2%), itching (11.5%), and dryness (6.8%) were the most reported symptoms. OSDES-16 scores were weakly correlated with work duration ($\rho = 0.176$, $p < 0.001$). These findings highlight substantial gaps in occupational safety and the need for targeted interventions to reduce hazards, improve PPE provision, and address occupational health risks. Policies should account for the social, economic, and political context of sanitation work in Palestine.

Keywords Sanitation workers, Occupational hazards, Dermatology, Occupational skin diseases, Occupational safety, West Bank, Palestine

Sanitation workers are essential for maintaining public health by ensuring safe waste collection, disposal, and environmental hygiene. Despite their crucial role, their health and safety are frequently overlooked, particularly in low- and middle-income countries (LMICs)[1,2]. Their work exposes them to multiple occupational hazards, including extreme temperatures, ultraviolet radiation, prolonged standing, contact with biological and chemical agents, and injuries from sharp objects[1,3,4]. These exposures contribute to a higher prevalence of respiratory, musculoskeletal, dermatological, and psychiatric conditions compared to workers in other sectors[3,4]. Among these, dermatological conditions are prevalent, often arising from repeated contact with hazardous substances in the absence of adequate protective measures[4–6].

In addition to physical risks, sanitation workers face social and occupational inequities, including stigmatization, exclusion from decision-making, and violations of labor rights[5,6]. Long working hours, inadequate occupational safety measures, and limited access to healthcare exacerbate their vulnerability[1,3,7]. Such challenges are particularly pronounced in LMICs, where enforcement of environmental and occupational regulations is inconsistent or absent.

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Research on the health of sanitation workers in Palestine is limited, reflecting a broader global and historical neglect of this workforce despite the substantial challenges they face[4]. Evidence on the morbidity and mortality outcomes of sanitation workers, as well as the vulnerability of specific subgroups, remains sparse and inconclusive. To date, only a single study has examined waste pickers in Gaza[8], whose informal working conditions differ markedly from those of formally employed sanitation workers in the West Bank[9]. Distinct political and organizational structures govern the West Bank, and no studies have systematically assessed occupational hazards, safety practices, and health outcomes among this population. Across the broader Eastern Mediterranean Region (EMR), similar research is scarce, with only a few studies in countries such as Egypt and the United Arab Emirates documenting widespread occupational hazards, inadequate preventive practices, and adverse health outcomes[7,10–12].

This lack of evidence represents a critical knowledge gap, particularly regarding the magnitude, patterns, and determinants of occupational health risks among sanitation workers. Descriptive data are necessary to inform interventions, policy development, and occupational health strategies tailored to this vulnerable workforce. Therefore, this study aimed to describe occupational hazards, workplace injuries, dermatological symptoms, and preventive practices among sanitation workers in the Palestinian West Bank. It provides baseline evidence that can guide future research, policy formulation, and targeted interventions to improve occupational health and safety in this population.

Methods

Study design and setting

This cross-sectional study, based on questionnaires, was conducted in 2024 across multiple sanitation centers in four governorates of the West Bank: two in the north, one in the center, and one in the south. The study focused on sanitation workers in the Palestinian West Bank. It was designed as a descriptive study to assess the extent of occupational hazards, injuries, and skin-related symptoms among these workers, addressing a gap since their occupational health had not been previously examined. As a descriptive investigation, it provides essential data to support future analytical or intervention studies and assists policymakers in developing occupational safety strategies.

Population, inclusion, and exclusion criteria

All sanitation workers employed in the included municipalities for at least six months prior to the start of data collection, whose work involved waste collection, transportation, and sewage and fecal waste treatment, were eligible for inclusion. Workers employed in roles not directly related to sanitation work, such as administrative staff, were excluded. Pregnant or breastfeeding sanitation workers were also excluded because of potential hormonal influences on skin conditions.

Sample size and sampling

Stratified random sampling was employed by recruiting participants based on the municipality's location as northern, middle, or southern West Bank. The minimum total sample size (X) was calculated using the formula: $X = z^2.P.\ (1\text{-}P)/d^2$., with a 95% confidence level (z = 1.96), a margin of error of 5% (d = 0.05), and a conservative proportion estimate of 50% ($P = 0.5$) to maximize the required sample size. This calculation resulted in a target of 384 participants.

Data collection and variables

The data were gathered using an interviewer-administered questionnaire. The questionnaire was divided into five sections:

Section 1: The sociodemographic section included the following variables: age, sex, residency (urban, rural, or camp settings), educational level (the highest degree or level of schooling attained by a participant), smoking status (a current smoker was a participant who smoked at least one cigarette per day during the six months preceding the study[13], type of smoking (cigarette, waterpipe, or electronic cigarette), age at which smoking was initiated, pattern of smoking (< 10 cigarettes, 10–20 cigarettes, > 20 cigarettes, one waterpipe head, and more than one waterpipe head[14], alcohol consumption, self-reported weight, and having received a diagnosis of asthma, diabetes, or hypertension.

Section 2: The second section assesses health insurance status, vaccinations, and adherence to hygienic practices.

Section 3: The third section includes questions about the patterns of PEE use, including types, availability, quality, and training.

Section 4: The fourth section assessed exposure to occupational hazards and injuries, including the type, cause, and affected body site. Exposure to occupational hazards and injuries was evaluated by a structured questionnaire that captured the type, cause, and affected body site of each reported injury. An *occupational injury* was defined as any injury directly resulting from an individual's duties or work environment. Participants were presented with a list of common workplace hazards categorized into physical, biological, chemical, ergonomic, and psychological types. For each hazard, participants reported their exposure frequency ("continuously," "occasionally," "not sure," or "no exposure") and whether an injury had occurred as a result.

Each response was numerically coded in accordance with the Occupational Health and Safety Assessment Series (OHSAS 18001) risk assessment framework, which employs a 5 × 5 risk matrix to quantify risk levels based on likelihood and severity[15]. Exposure frequency (likelihood) was coded as follows:

1 = No exposure, 2 = Not sure, 3 = Occasionally, 4 = Continuously, and 5 = Injury occurred.

Severity (impact) was coded as: 1 = No injury, 2 = Minor injury, 3 = Three-day injury, 4 = Major injury, and 5 = Fatal outcome.

A risk assessment matrix is a structured analytical tool used to evaluate and prioritize occupational risks by combining the likelihood of occurrence with the potential severity of consequences. The matrix consists of two intersecting criteria:

1. Likelihood (Probability): The estimated probability that a specific hazard or injury event will occur (e.g., very likely, likely, possible, unlikely, very unlikely).
2. Severity (Impact): The expected magnitude of harm or adverse outcome should the event occur (e.g., fatal, major, moderate, minor, or negligible).

By combining these two factors, each hazard was assigned a composite risk score, calculated as:

Risk = Likelihood × Severity, yielding a numerical value ranging from 1 to 25. Risk scores were then categorized as follows: 1–5 = Low risk, > 5–10 = Moderate risk, > 10–15 = High risk, and > 15 = Critical risk.

The matrix was represented visually using a color-coded scheme in which *red* denotes high or critical risk, *yellow/orange* indicates moderate risk, and *green* represents low risk. This approach enables rapid identification of priority hazards and facilitates evidence-based decision-making regarding preventive measures.

For each hazard, the mean likelihood score and mean severity score were calculated across all participants, and their product was used to determine the composite risk score. The results, expressed as means ± standard deviations (SD), were used to summarize the exposure and risk distribution patterns for each occupational hazard among sanitation workers.

Section 5: Skin symptoms were assessed using the validated Occupational Skin Disease Exposure Scale-16 (OSDES-16), a self-report questionnaire designed to capture the frequency and severity of common work-related skin conditions such as redness, dryness, itching, and eczema. Participants rated symptom frequency on a standardized scale, and the total score was calculated to evaluate overall exposure risk. As this instrument relies on self-report rather than clinical examination, the findings may be subject to reporting bias, including over- or underestimation of symptom prevalence. Nevertheless, self-reported data provide valuable information in occupational health studies where clinical assessments of all participants may be logistically challenging. The calculation of the OSDES-16 score is described elsewhere[16]. Binary items were coded Yes = 1 and No = 0, and frequency items were weighted 0 (not present), 0.25 (occasional), 0.5 (regularly < once per month), 0.75 (regularly ≥ once per week), and 1.0 (regularly ≥ once per week but subsiding during leave). The total score of the OSDES-16 is used to evaluate the overall skin health risk, with higher scores indicating greater exposure and more severe or frequent symptoms[16].

The questionnaire was developed based on a comprehensive literature review and a validated instrument. It was reviewed by experts in public health, toxicology, and dermatology to ensure content validity. An initial pilot study using a self-administered format revealed that several participants experienced difficulties understanding certain OSDES-16 items. The feedback was analyzed, and the questionnaire was revised for clarity, relevance, and accuracy. To overcome these comprehension issues, a second pilot study was conducted using an interviewer-administered format, which ensured complete understanding and standardized clarification of all items. Data collectors received multiple supervised training sessions to maintain consistency in data collection. Following these refinements, all 16 original items of the validated OSDES-16 tool were retained for the final data collection. The internal consistency of the full scale was excellent (Cronbach's alpha = 0.848), confirming its reliability and suitability for this population. The pilot study included 40 participants who were excluded from the final analysis.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software for Mac (version 26, IBM Corp., Armonk, NY, USA). The Shapiro–Wilk test was applied to assess the normality of continuous variables. Descriptive statistics were used to summarize participant characteristics and exposure patterns. Continuous variables are presented as the means and standard deviations (SDs) or medians and interquartile ranges (IQRs) where appropriate, whereas categorical variables are presented as frequencies and percentages. Mean hazard and severity scores were calculated as the average coded values (ranging from 1 to 5) assigned to each level of exposure and injury severity using the OHSAS 18,001 risk assessment matrix. These mean scores provide a quantitative summary of the likelihood and seriousness of occupational hazards. Spearman's rank correlation coefficient (ρ) was used to assess the relationship between the OSDES-16 total score and work duration, as both variables were non-normally distributed. A p-value of < 0.05 was considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) at An-Najah National University (ANNU) in Palestine (Ref: Mas. Dec. 2023/17). All procedures followed the ethical standards of the responsible committee on human experimentation and followed the Helsinki Declaration[17]. Additionally, permission was secured from the municipalities and waste department officials, and informed consent was obtained from each participant to conduct the study. The privacy and confidentiality of participants were maintained, and access to the collected data was restricted to the research team to ensure anonymity.

Results

Sociodemographic data

Out of the total 391 sanitation workers who were invited, 10 declined to participate. A total of 381 sanitation workers participated in the study, with a mean age of 36.7 (SD = 11.7) and an overwhelming majority being male (99.0%). Participants were relatively evenly distributed across residential settings, with 39.6% living in villages, 32.3% in refugee camps, and 28.1% in cities. Geographically, the sample was balanced across governorates, with 32.0%, 33.3%, and 34.7% residing in the northern, middle, and southern regions, respectively. Smoking was

prevalent, reported by 63.3% of participants. Cigarette smoking was the most common type (85.4%), followed by waterpipe use (13.8%) and electronic cigarettes (0.8%). Among smokers, nearly half (46.8%) consumed 10–20 cigarettes per day, while 33.3% smoked more than 20 cigarettes daily, indicating substantial exposure to tobacco-related health risks. Chronic medical conditions were relatively uncommon, with hypertension (7.6%) and diabetes (7.1%) being the most frequently reported, followed by asthma (1.3%). Educational attainment was predominantly primary-to-secondary (91.8%), with very few participants reporting higher education (2.4%) and 5.8% having no formal education. Only small percentages reported alcohol consumption (0.3%), or a diagnosis of diabetes (7.1%), hypertension (7.6%), or asthma (1.3%) (Table 1). The median duration of working experience was 7.0 years (IQR = 14) (Table 1).

Occupational hygiene and safety practices, and PPE use

Most participants reported having health insurance (82.4%) and having received regular vaccinations (81.1%). While the majority said that they shower immediately after work (90.2%) and wash work clothes daily (86.1%), fewer than one-third change their clothes before leaving work (19.6%). Fewer than one-half of respondents reported eating food during work, with only 32.5% doing so regularly (Table 2).

Personal protective equipment (PPE) use

The participants reported varying patterns in the use of different types of PPE. The most consistently used items were gloves (59.8%), jackets (57.5%), and rainproof clothing (51.7%). However, the majority did not wear masks (60.9%), aprons (71.1%), goggles (69.6%), hearing protection headphones (71.1%), or long-sleeve clothing (53.8%). Over half of the respondents (56.9%) rated the quality of PPE as good, but another majority (55.1%) said they had not received guidance on PPE use. The most common reason for not using PPE was that a participant 'does not want to use it' (52.8%), followed by 'not provided at work' (40.2%) (Table 3).

Exposure to occupational hazards and injuries

Most participants reported that they were continuously standing for long periods (78.9%) or were excessively exposed to the sun (85.0%). A significant minority experienced exposure to high temperatures (35.1%) and sharp objects (24.1%), with 84 participants having sustained an injury from sharp objects (22.0%). However, most participants did not report exposure to other occupational hazards, including loud noise (92.7%), gas fumes (87.1%), liquid chemicals (77.4%), and solid chemicals (84.7%). The highest proportions of exposure to occupational hazards were among those whose work involves managing animal waste, waste from worms, insects, or snakes, or contact with blood, with 25.2%, 24.5%, and 23.2% reporting continuous exposure in these areas, respectively (Table 4).

Variable		*n* (%)
Gender	Male	377 (99.0)
	Female	4 (1.0)
Residency	City	107 (28.1)
	Village	151 (39.6)
	Refugee Camp	123 (32.3)
Governorate	Northern	122 (32.02)
	Middle	127 (33.33)
	Southern	132 (34.65)
Smoking status	Yes	241 (63.3)
	No	140 (36.7)
Type of smoking	Cigarettes	210 (85.4)
	Waterpipe	34 (13.8)
	E-cigarette	2 (0.8)
Pattern of smoking (cigarette or waterpipe head per day)	< 10	20 (8.4)
	10–20	111 (46.8)
	> 20	79 (33.3)
	0–1	13 (5.5)
	> 1	14 (5.9)
Reported medical conditions*	Diabetes	27 (7.1)
	Hypertension	29 (7.6)
	Asthma	5 (1.3)
Educational level	Did not receive education	22 (5.8)
	Primary-to-secondary education	349 (91.8)
	Higher education	9 (2.4)

Table 1. Sociodemographic data.

	Variable	*n* (%)		
		Yes	No	Sometime
Health practice	Do you shower immediately after work?	342 (90.2)	18 (4.7)	19 (5.0)
	Do you change work clothes after work?	74 (19.6)	304 (80.4)	0 (0.0)
	Do you wash your work clothes daily?	328 (86.1)	15 (3.9)	38 (10.0)
	Do you share protective equipment?	13 (3.4)	357 (93.7)	11 (2.9)
	Do you eat food during work?	124 (32.5)	88 (23.1)	169 (44.4)
Health insurance	Do you have health insurance?	314 (82.4)	67 (17.6)	
Vaccination	Have you received regular vaccinations?	309 (81.1)	72 (18.9)	
Type of the vaccine	Hepatitis	30 (9.0)		
	Tetanus	24 (6.2)		
	COVID-19	17 (4.1)		
	I do not know the name of it	42 (11.0)		

Table 2. Occupational health practices among sanitation workers.

	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
	Yes, always	Yes, sometimes	Rarely	Not available when intended to use it	Do not remember	Never used it
Gloves	228 (59.8)	46 (12.1)	30 (7.9)	20 (5.2)	0 (0.0)	57 (15.0)
Tight-toe shoes	117 (30.7)	40 (10.5)	34 (8.9)	40 (10.5)	1 (0.3)	149 (39.1)
Mask	18 (4.7)	16 (4.2)	38(10.0)	75 (19.7)	2 (0.5)	232 (60.9)
Apron	6 (1.6)	2 (0.5)	14 (3.7)	86 (22.6)	2 (0.5)	271 (71.1)
Jacket	219 (57.5)	42 (11.0)	34 (8.9)	4 (1.0)	0 (0.0)	82 (21.5)
Hat	164 (43.0)	31 (8.1)	17 (4.5)	37 (9.7)	1 (0.3)	131 (34.4)
Goggles	6 (1.6)	4 (1.0)	13 (3.4)	91 (23.9)	2 (0.5)	265 (69.6)
Hearing protection tool	0 (0.0)	0 (0.0)	10 (2.6)	98 (25.7)	2 (0.5)	271 (71.1)
Long sleeve clothing	71(18.6)	54 (14.2)	26 (6.8)	24 (6.3)	1 (0.3)	205 (53.8)
Rainproof clothing	197(51.7)	44 (11.5)	17 (4.5)	27 (7.1)	1 (0.3)	95 (24.9)

Table 3. Personal protective equipment (PPE) use.

	No exposure *n* (%)	Not sure, *n* (%)	Occasionally, *n* (%)	Continuously, *n* (%)	Injury occurred, *n* (%)	Mean hazard (SD)	Mean severity (SD)
Occupational hazards							
Noise	353 (92.7)	2 (0.5)	14 (3.7)	12 (3.1)	0 (0.0)	1.17 (0.63)	1.07 (0.25)
Vibration	352 (92.4)	0 (0.0)	11 (2.9)	16 (4.2)	0 (0.0)		
Radiation	374 (98.4)	4 (1.1)	1 (0.3)	1 (0.3)	0 (0.0)		
Low temperatures	372 (97.9)	3 (0.8)	3 (0.8)	2 (0.5)	0 (0.0)		
High temperatures	218 (57.5)	6 (1.6)	21 (5.5)	133 (35.1)	1 (0.3)		
Gas fumes	331 (87.1)	5 (1.3)	32 (8.4)	12 (3.2)	0 (0.0)	1.28 (0.76)	1.12 (0.32)
Liquid chemicals	294 (77.4)	4 (1.1)	63 (16.6)	19 (5.0)	0 (0.0)	1.50 (0.94)	1.22 (0.41)
Solid chemicals	321 (84.7)	4 (1.1)	28 (7.4)	26 (6.9)	0 (0.0)	1.38 (0.90)	1.15 (0.35)
Psychological pressure	215 (56.7)	1 (0.3)	64 (16.9)	97 (25.6)	2 (0.5)	2.13 (1.34)	1.43 (0.49)
Standing for long hours	14 (3.7)	0 (0.0)	60 (15.8)	299 (78.9)	6 (1.6)	3.74 (0.68)	1.98 (0.27)
Sun exposure	28 (7.4)	0 (0.0)	25 (6.6)	322 (85.0)	4 (1.1)	3.73 (0.81)	1.92 (0.26)
Sharp objects (e.g., Needles)	157 (41.2)	0 (0.0)	48 (12.6)	92 (24.1)	84 (22.0)	2.86 (1.66)	1.16 (0.63)
Work nature - Fall or collision risk	244 (64.0)	1 (0.3)	72 (18.9)	35 (9.2)	29 (7.6)	1.96 (1.37)	1.91 (1.31)
Exposure to occupational hazards stratified by work setting and nature							
Farms and slaughterhouses	270 (71.1)	0 (0.0)	50 (13.2)	59 (15.5)	1 (0.3)	1.75 (1.20)	1.29 (0.45)
Animal waste	182 (47.8)	2 (0.5)	97 (25.5)	96 (25.2)	4 (1.0)	2.31 (1.32)	1.52 (0.50)
Worms, insects, snakes	183 (48.3)	2 (0.5)	99 (26.1)	93 (24.5)	2 (0.5)	2.30 (1.31)	1.51 (0.50)
Quarry, crusher, brick Factory	328 (86.1)	1 (0.3)	22 (5.8)	28 (7.3)	2 (0.5)	1.36 (0.92)	1.14 (0.34)
Blood (Animals and Humans)	211 (55.5)	1 (0.3)	78 (20.5)	88 (23.2)	2 (0.5)	2.14 (1.31)	1.44 (0.49)

Table 4. Exposure to occupational hazards among sanitation workers.

Injury-related information

In Table 5, injury-related data information: 53.5% of participants were exposed to work injuries (53.5%, the majority of whom had only one injury (72.5%) and received treatment for their injuries (86.8%). Exactly half of the injuries were open injuries (50.0%), with the wound being contaminated, as reported by the participants (89.2%). The upper limbs were the most commonly reported site of injury (35.3%), followed by the lower limbs (29.4%) and the face and neck (23%). Exposures to sharp tools (25.0%), falls (22.5%), or direct blows by objects (18.6%) were the most frequently reported causes of injury, with cuts and lacerations (50.2%) and bruises (25.8%) as the most common types of injuries (Table 5).

Work-related skin symptoms and diseases

Table 6 presents the frequencies of various skin symptoms reported by sanitation workers. Part A details specific skin symptoms. The most prevalent symptom is skin redness, with 89.8% of respondents reporting it does not occur. Dryness (93.2%), burning sensation (95.8%), and eczema/dermatitis (98.2%) also showed high percentages of "no" responses. Itching was reported by some, with 88.5% stating it does not occur.

Variable		*n* (%)
History of injury	Yes	204 (53.5)
	No	177 (46.5)
Frequency of injury	Once	148 (72.5)
	Twice	43 (21.1)
	Three times	11 (5.4)
	Four times	2 (0.98)
When was the injury sustained?	≤ 1 year	92 (45.3)
	> 1–2 Years	25 (12.3)
	≥ 3 Years	86 (42.4)
Nature of injury	Open injury	102 (50)
	Closed injury	102 (50)
Contamination of open injury	Yes	91 (89.2)
	No	6 (5.9)
	I do not know	5 (4.9)
Was a treatment received for injury?	Yes	177 (86.8)
	No	27 (13.2)
Site of injury	Face and neck	47 (23)
	Upper limbs	72 (35.3)
	Lower limbs	60 (29.4)
	Abdomen	3 (1.5)
	Chest	18 (8.8)
	Back	4 (2)
Type of injury	Bruises	55 (25.8)
	Cut and lacerations	107 (50.2)
	Fractures	41 (19.2)
	Concussion	1 (0.5)
	Miscellaneous injuries	9 (4.2)
Cause of injury	Struck by a vehicle	30 (14.7)
	Sharp injury	51 (25.0)
	Needle stick	20 (9.8)
	Fall injuries	46 (22.5)
	Crush injuries	10 (4.9)
	Struck by a physical object other than vehicles	38 (18.6)
	Poor body posture	4 (2.0)
	Sting	4 (2.0)
	Sunstroke	1 (0.5)
Work absence due to an injury	Yes	167 (81.5)
	No	38 (18.5)
Number of days of absence	1–7 days	101 (60.84)
	8–30 days	46 (27.71)
	> 30 days	19 (11.45)

Table 5. Injury-related information.

		n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Part A: Skin symptoms *n*		Sometimes	Yes, at least once per week	Yes, at least once per month	Yes, Symptoms disappear during work leave	No
	Redness in the skin	15(3.9)	9 (2.4)	7 (1.8)	8 (2.1)	342 (89.8)
	Dryness in the skin	8(2.1)	9 (2.4)	5 (1.3)	4 (1.0)	355 (93.2)
	Burning sensation	8(2.1)	3 (0.8)	2 (0.5)	3 (0.8)	365 (95.8)
	Itching	2(0.5)	9 (2.4)	7 (1.8)	7 (1.8)	356 (93.5)
	Eczema/Dermatitis *n*	4(1.0)	2 (0.5)	1 (0.3)	0 (0.0)	374 (98.2)
Part B: Sudden onset *n* (%)		Yes	Do not know	No		
	Sudden skin lesions	37(9.7)	4 (1.2)	340(65.9)		
	Symptoms appear after 24–72 h after work	20 (5.2)	13 (3.4)	348 (91.3)		
	Reduction in the severity of symptoms	21(5.5)	2(0.6)	358(94.0)		
	Similar symptoms in other employees	14(3.7)	9(2.4)	358(94.0)		
Part C: Accompanied symptoms: analysis of symptoms occurring alongside burning, redness, and dryness	Runny nose	7(1.8)	3(0.8)	371(97.4)		
	Eye discharge *n*	12 (3.1)	2 (0.6)	367(96.3)		
	Eczema	0 (0.0)	8 (2.1)	372(97.6)		
Part D: OSDES-16 results	Score category	n (%)				
	0	165(43.3)				
	1	165(43.3)				
	2–8	44 (11.5)				
	9-11.75	7 (1.8)				

Table 6. Frequencies of various skin symptoms reported by sanitation workers. Reported skin symptoms were based on the self-administered OSDES-16 scale; clinical verification was not conducted, which may introduce reporting bias and should be considered when interpreting these findings.

Part B addresses sudden skin issues. 9.7% reported sudden skin lesions, while 5.2% experienced symptoms 24–72 h after work. The majority (91.3%) said symptoms do not appear after this timeframe. A significant 94% stated that the severity of symptoms does not reduce.

Part C examines other symptoms accompanying skin issues. Very few reported a runny nose (1.8%) or eye discharge (3.1%) alongside skin problems, indicating limited co-occurrence.

Part D provides results from the OSDES-16 questionnaire. 43.3% scored 0 or 1, while 11.5% scored between 2 and 8, and only 1.8% scored between 9 and 11.75. A Spearman correlation test between work duration and OSDES-16 scores showed a positive correlation coefficient of 0.176, with a significant p-value (<0.001) (Table 6).

Discussion

Sanitation workers provide essential public health services but are exposed to hazardous working environments that threaten both physical and social well-being. Their work entails exposure to high temperatures, biological and chemical agents, sharp objects, and long-standing hours, often under conditions of social marginalization and limited labor protection[1–4]. This study is the first systematic assessment of occupational hazards, injuries, skin symptoms, and safety practices among sanitation workers in the West Bank, addressing a critical knowledge gap where previous research has been largely absent.

In agreement with previous studies[8,18], sanitation workers in this study reported frequent occupational hazards, including prolonged standing, sun exposure, high temperatures, and contact with sharp objects, which contributed to a high prevalence of work-related injuries. These injuries often resulted in periods of work absence, disrupting workflow, reducing income, and potentially affecting the overall efficiency of sanitation services. Beyond immediate physical harm, repeated injuries can have cumulative effects on workers' long-term health, including chronic musculoskeletal problems and heightened vulnerability to further accidents. Moreover, most participants reported following basic hygiene practices such as handwashing and vaccinations; however, other protective behaviors, including changing clothes and maintaining proper nutrition during shifts, were less frequently observed. Consistent with previous studies, PPE use remained low, reflecting both supply- and demand-side barriers, including limited training opportunities[19–24]. Similarly, inadequate training and supervision have been widely reported among sanitation workers in several LMICs LMICs[22,25,26], underscoring the need for tailored occupational safety interventions in the West Bank context.

Legal frameworks, such as Palestinian Labor Law No. 7 of 2000, provide general health and safety regulations but lack targeted provisions tailored to the unique hazards of sanitation work[27]. Interventions should ensure the proper provision, training, and supervision to maximize PPE effectiveness. Evidence indicates that appropriate PPE use and occupational safety training can substantially reduce injuries among sanitation workers[20,23,24]. Policy strategies should integrate occupational health considerations into municipal planning, enforce existing labor laws, and provide sustainable education and monitoring systems. Implementation must also account for

local constraints, such as political instability, limited institutional capacity, and resource limitations, which can impede the adoption of safety measures.

The findings of a previous study suggested that skin conditions increase with age and years of work among sanitation workers[28]. Other health outcomes, including occupational injuries and deterioration of respiratory function, have also been shown to worsen with increasing years of service[29]. This study revealed that skin symptoms were associated with the number of years of work. Self-reported skin symptoms such as erythema, itching, and dryness showed a weak correlation with longer work duration. Similar findings have been reported in local studies involving workers under comparable conditions[8,18]. Consistent trends have also been observed in studies from India, the UAE, and Egypt, where sanitation workers commonly experienced contact dermatitis and fungal infections[11,19,30]. While these studies suggest cumulative exposure may contribute to skin conditions, this study's cross-sectional design limits causal interpretation; associations between work duration, hazard exposure, and skin symptoms reflect correlations rather than causal effects. The weak observed association in this study should be interpreted with caution. The relationship may reflect not only the cumulative effect of exposure but also differences in workers' perception, reporting, or adaptation over time. Self-reported outcomes without clinical validation may be subject to recall bias, misclassification, and underreporting, particularly for stigmatized conditions. These limitations likely attenuate the strength of observed associations, including the weak correlation between OSDES-16 scores and years of service. Future longitudinal studies incorporating clinical assessment and multivariable analysis are warranted to examine causality.

Skin symptoms can result from exposures common in sanitation work, such as UV light, sharp objects, or contact with chemical and biological waste[30,31]. In particular, exposure to UV light increases the risk of skin cancers and eye diseases and accelerates photoaging[32–34]. Signs of photoaging, including coarse pores, deep wrinkles, pigmentation spots, and telangiectasia, are more prevalent among sanitation workers than among the general population[35]. While no clinical signs of photoaging were assessed in this study, most participants reported prolonged sun exposure, which indicates potential long-term UV-induced harm and contributes to the development of some skin symptoms. Moreover, the OSDES-16 tool, used in this study, attempts to examine the link between developing skin symptoms and exposure to occupational hazards by surveying the temporality of these symptoms, including the timing of onset, development, and resolution[16].

Moreover, these skin symptoms are part of a broader context in which sanitation workers have worse overall health outcomes than the general population does[4]. Two systematic reviews revealed that sanitation workers are at high risk of gastroenteritis, respiratory diseases, musculoskeletal disorders, and mental health conditions[3,4]. The methodology of the present study was limited to assessing occupational injuries and skin symptoms, demonstrating a substantial incidence of the former. Work conditions are a key social determinant of health that contributes to creating, maintaining, or exacerbating health disparities[36]. This is especially relevant to sanitation work, as it involves an environment where three social determinants of health intersect: poor work conditions, climate change, and low socioeconomic status[36,37]. Indeed, studies have indicated that sanitation workers have low socioeconomic status globally, as was the case in the present study[38,39]. For example, only 2.4% of the participants had received an education higher than the secondary school level. Moreover, employment in sanitation is inherently precarious, as the nature of sanitation work exposes employees to several occupational hazards, coupled with a culture of few protection measures and long, irregular working hours[37,40–42]. Climate change further exacerbates these vulnerabilities by intensifying outdoor hazards to which sanitation workers are exposed, including extreme temperatures, pollution, and increasing UV radiation[43].

Regional and local contextual factors may explain differences in observed occupational health outcomes. Findings from different locations indicate a general pattern of exposure to skin symptoms and conditions among sanitation workers; however, the prevalence and types of skin problems vary across settings. These differences likely reflect methodological and contextual factors, including variations in measurement tools, sampling frames, climate, PPE availability and enforcement, as well as local political and organizational conditions[7,10–12,22–26]. In the West Bank, sanitation workers face additional systemic barriers, including precarious employment, low socioeconomic status, and limited access to healthcare and occupational training, which exacerbate occupational health risks[36–39]. This underscores the descriptive nature of the present study, which documents self-reported skin symptoms, occupational injuries, and workplace practices among sanitation workers in Palestine. These contextual factors highlight the importance of tailored interventions rather than simple extrapolation from other regions. By focusing on this specific context, the study provides baseline evidence to inform targeted interventions while avoiding overgeneralization to other populations or settings.

The findings of this study highlight the need for comprehensive occupational safety interventions, including regular risk assessments, provision of appropriate PPE, targeted training on safe handling of tools and hazardous materials, and structured policies for injury reporting and management. Additionally, implementing preventive strategies, such as ergonomic adjustments to reduce prolonged standing, scheduling rest breaks during extreme temperatures, and supervising safe work practices, could mitigate the frequency and severity of injuries. By addressing both environmental and procedural risks, policymakers and municipal authorities can reduce the health and economic burden of occupational injuries while improving worker well-being and productivity. However, translating these recommendations into interventions and policies is challenged by the contextual challenges in the case of Palestine. Chronic political instability, limited financial and institutional capacity due to conflict and weak governance, and competing priorities amid conflict may limit the enforcement of labor regulations and the integration of occupational health measures into municipal systems and the workplace.

Limitations and strengths

This cross-sectional study has several limitations. The primary limitation is the reliance on self-reported skin symptoms without clinical confirmation, which may introduce measurement error, recall bias, and social desirability bias, particularly underreporting of stigmatized conditions. This is in addition to the potential recall

bias that is often associated with self-reporting of data. Second, the absence of a control group limits the ability to compare outcomes with unexposed populations. Third, the cross-sectional design prevents causal inference between occupational exposures and health outcomes. Additionally, potential confounding, misclassification, and measurement challenges may influence observed associations, such as the weak positive correlation between OSDES-16 scores and years of work.

Despite these limitations, the study has notable strengths. It is among the few studies in the region to systematically assess occupational hazards, PPE use, and skin symptoms among sanitation workers. A geographically representative sample enhances generalizability, and validated instruments were used to ensure reliable data collection. These findings provide essential baseline evidence to inform interventions, occupational safety policies, and future analytical studies in this underexplored population.

Conclusions

Sanitation workers in the West Bank experience multiple occupational hazards and high rates of injuries and skin symptoms. Interventions should prioritize consistent PPE provision, structured training, workplace modifications, and incorporation of social determinants of health to protect and improve worker well-being. Policymakers must consider local contextual challenges, including political instability and limited institutional capacity, when designing and implementing these interventions. Further longitudinal and interventional research is recommended to establish causality and evaluate the effectiveness of occupational health strategies.

Data availability

All data generated or analysed during this study are included in this published article.

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Author contributions
BD: Study conception and design, formal analysis, and interpretation of the results. HN, SS, MIJ, LD: Study conception and design, collaboration in formulating the idea, and data collection. HN, SS, MIJ, LD, ST, IM: Interpretation of the results and writing the draft of the manuscript. All authors approved the final version for publication. They agreed to take responsibility for all aspects of the work and thoroughly investigate and resolve any questions regarding the accuracy or integrity of any part of the work.

Declarations

Competing interests
The authors declare no competing interests.

Ethics approval
Ethical approval was obtained from the Institutional Review Board (IRB) at An-Najah National University (ANNU) in Palestine (Ref: Mas. Dec. 2023/17). All procedures followed the ethical standards of the responsible committee on human experimentation and followed the Helsinki Declaration[17]. Additionally, permission was secured from the municipalities and waste department officials, and informed consent was obtained from each participant to conduct the study. The privacy and confidentiality of participants were maintained, and access to the collected data was restricted to the research team to ensure anonymity.

Consent to participate
Informed consent was obtained from each participant before the study.

Additional information
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