ORIGINAL RESEARCH ARTICLE

Sleep Quality, Daytime Sleepiness, and Chronotype Profile of Municipal Street Sweepers in Urmia, Iran: Associations with Night Shift Work and Socio-Demographic Factors

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Abstract

Background Municipal street sweepers perform physically demanding work, often during night shifts, with occupational hazards impacting sleep and circadian health. This study aimed to assess sleep quality, daytime sleepiness, and chronotype distribution among municipal street sweepers in Urmia, Iran, and to explore associations with socio-demographic and occupational factors.

Methods This cross-sectional study was conducted in 2022 with 135 municipal street sweepers in Urmia. Data were collected using the Pittsburgh Sleep Quality Index for sleep quality, the Epworth Sleepiness Scale for sleepiness, and the Morningness-Eveningness Questionnaire for chronotype. Descriptive statistics, independent samples t-tests, ANOVA, and ANCOVA were used for data analysis, with significance set at $p < 0.05$.

Results The majority of participants (92.6%) worked night shifts. Exceptionally high poor sleep quality (94.1%, PSQI > 5) and excessive daytime sleepiness (93.3%, ESS ≥ 10; mean ESS 19.40 ± 6.4) were observed. The predominant chronotype was intermediate (72.6%), then morning (16.3%), and evening (11.1%). Night shift workers reported significantly poorer sleep quality (mean PSQI 10.63 ± 3.33) compared to day shift workers (mean PSQI 8.40 ± 2.37, $p = 0.040$). Higher daytime sleepiness was significantly associated with longer work experience (>10 years, $p = 0.032$) and being single ($p = 0.007$). Chronotype was not significantly related to overall PSQI or ESS scores.

Conclusion Municipal street sweepers in Urmia, predominantly working night shifts, experience extremely high levels of poor sleep quality and severe daytime sleepiness. These findings highlight a critical occupational health concern, underscoring the need for targeted interventions for their sleep health and well-being.

Keywords Chronotype, Hypersomnia, Shift work, Sleep quality

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1 Introduction

Sleep is a fundamental biological necessity, crucial for maintaining physical health, cognitive function, and psychological well-being.[1,2] Adequate sleep quality and duration are essential for restorative processes, memory consolidation, emotional regulation, and overall performance.[2,3] However, modern lifestyles and various occupational demands often lead to insufficient sleep or disruptions in sleep patterns, with a significant portion of the adult population reporting inadequate sleep.[4] Poor sleep quality and chronic sleep deprivation are associated with a myriad of adverse health consequences, including an increased risk of cardiovascular diseases, metabolic disorders, impaired immune function, and mental health problems such as depression and anxiety.[3,5]

Individual differences in sleep-wake patterns are significantly influenced by an internal biological clock, known as the circadian rhythm, which regulates various physiological processes over a roughly 24-hour cycle.[1] Chronotype refers to an individual's natural predisposition toward morningness (larks), eveningness (owls), or an intermediate pattern of activity and sleep.[6,7] This trait can affect preferred sleep and wake times, alertness levels throughout the day, and even vulnerability to specific health conditions.[6,8] Misalignment between an individual's chronotype and societal or work-related schedules, often termed social jetlag, can lead to sleep disturbances and negatively impact health and well-being.[1]

Municipal street sweepers form an essential occupational group responsible for maintaining urban cleanliness and hygiene, a task vital for public health.[9,10] Their work is often characterized by early morning schedules, significant physical exertion, and prolonged exposure to a variety of occupational hazards.[10,11] These hazards include ergonomic stressors from repetitive movements, prolonged standing, and manual handling of waste; environmental exposures such as dust, vehicular emissions, noise, and temperature extremes; and contact with chemical and biological agents present in street refuse.[12–15] Furthermore, street sweepers, often belonging to lower socio-economic strata, may have limited access to healthcare, and frequently work without adequate personal protective equipment (PPE), exacerbating their vulnerability to occupational health problems.[9,16] The early starting hours common in this profession can impose a rigid sleep-wake cycle that may conflict with individual chronotypes, potentially leading to circadian disruption similar to that experienced by shift workers.[9,13]

The demanding nature of street sweeping, coupled with diverse occupational exposures, is likely to significantly impact the sleep quality and daytime alertness of these workers. Musculoskeletal pain is a common complaint among sweepers.[11,17] Respiratory ailments from dust and pollutant inhalation,[18,19] as well as general physical fatigue, can lead to difficulties in initiating and maintaining sleep, resulting in non-restorative sleep and increased daytime sleepiness.[10,20] Exposure to traffic noise and working under varying light and temperature conditions can further disrupt sleep patterns.[9,15] Studies across various occupational groups, particularly those involving shift work or physically demanding tasks, have consistently documented high prevalences of poor sleep quality, insomnia symptoms, and excessive daytime sleepiness, which are linked to compromised health, reduced work performance, and increased safety risks.[21–23] While the health of street sweepers has been investigated concerning specific hazards like musculoskeletal disorders [17,24] or respiratory problems,[18,19] a comprehensive understanding of their sleep characteristics, including quality, sleepiness, and chronotype distribution, is less developed.

While extensive research exists on sleep patterns and chronotypes in shift workers, particularly in healthcare and industrial sectors,[21,25] there is a noticeable gap in the literature concerning municipal street sweepers. This occupational group faces a unique constellation of early work schedules, high physical demands, and continuous environmental exposures that may distinctly affect their sleep and circadian rhythms.[9,10] The interplay between their specific job demands, individual chronotypes, sleep quality, and daytime sleepiness has not been thoroughly investigated. Understanding these relationships is crucial for developing targeted interventions to improve the health, safety, and well-being of this essential workforce. Most research on workers' sleep has focused on traditional shift work; however, even daytime workers with very early start times, like many street sweepers, can experience significant circadian challenges. [7,8]

Investigating sleep and chronotype in municipal street sweepers is crucial due to the physically demanding nature of their job, exposure to various occupational hazards, and the known connection between occupational factors, sleep, and circadian rhythms.[10,20] This is especially relevant in places like Urmia, Iran, where most municipal street sweepers work night shifts, a pattern that significantly disrupts sleep and circadian health. Given their demanding work, often in challenging environmental conditions and at night, this group likely faces a high risk of sleep disturbances and excessive daytime sleepiness. Therefore, understanding the prevalence and severity of these issues, the distribution of individual circadian preferences (chronotypes), and how these factors interact with various job-related and demographic variables is essential for a complete health assessment. To address these points, this study had several key objectives: to assess the quality of sleep among municipal street

sweepers in Urmia, to evaluate their level of daytime sleepiness, to determine the distribution of chronotypes (morningness, intermediate, and eveningness) within this workforce, and to examine potential links between these sleep-related factors and socio-demographic and occupational characteristics such as work shift patterns, experience, and marital status.

This research is expected to offer valuable, specific insights into the sleep challenges encountered by street sweepers, particularly those working night shifts in Urmia. The results will be vital for guiding the creation of specific occupational health interventions and policies designed to enhance their overall well-being and job performance

2 Methods

Study design and participants

This cross-sectional descriptive study was conducted in 2022 among municipal street sweepers employed by the Urmia Municipality, Iran. At the time of the study, 135 sweepers were working under the municipality. A census sampling method was employed, and all 135 individuals were invited to participate. All completed the survey and were included in the final analysis.

Data collection procedure

Data were collected using face-to-face interviews conducted by trained interviewers at the participants' workplace during working hours. Interviewers explained each item of the questionnaire to the participants and recorded their responses. This method was employed to ensure clarity, minimize potential literacy-related biases, and reduce missing data. Written informed consent was obtained from all participants before data collection.

Instruments

Data were gathered using three standardized questionnaires: the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS), and the Morningness-Eveningness Questionnaire (MEQ).

The PSQI is a self-assessment tool designed to evaluate sleep quality over the past month, initially developed by Buysse et al. (1989).[26] This questionnaire comprises 19 items, which are grouped into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The global PSQI score ranges from 0 to 21, with higher scores indicating poorer sleep quality. A global PSQI score greater than five is typically used to differentiate poor sleepers from good sleepers, suggesting significant difficulty in at least two components or moderate difficulty in more than three. The validity and reliability of the PSQI have been well-established in numerous studies across various populations.[27-29] Specifically for the Persian context, Farrahi Moghaddam et al. reported a sensitivity of 93% and an internal consistency (Cronbach's alpha) of 0.89 for the Persian version of the PSQI.[30]

The ESS measures an individual's general level of daytime sleepiness. It is an eight-item questionnaire that captures an individual's propensity to fall asleep during commonly encountered situations, rated on a scale from 0 to 3. The total ESS score ranges from 0 to 24, and in adults, a score of 10 or higher is considered indicative of excessive daytime sleepiness. This scale was initially developed by Johns [31], and its Persian version has been validated by Sadeghniiat Haghighi et al. [32]

The third instrument employed was the MEQ, developed by Horne and Ostberg [33], which aims to ascertain an individual's peak activity propensity within their daily temporal span. Most of its 19 questions are preferential, asking respondents about their desired, rather than actual, wake-up and sleep onset times. Each question offers four Likert-scale responses. While the original MEQ scoring often delineates five circadian types (definite morning, moderately morning, intermediate, moderately evening, and definite evening), for the present study's analysis, participants were categorized into three broader groups based on their total MEQ score: morning type (score: 59 to 86), intermediate type (score: 42 to 58), and evening type (score: 16 to 41). Various studies have reported the reliability of this questionnaire as acceptable.[34,35]

Statistical analysis

All collected data were analyzed using SPSS software 16. The normality of data distribution for the total scores of the PSQI and the ESS was assessed using the One-Sample Kolmogorov–Smirnov test before parametric analyses. Levene's test was used to evaluate the assumption of homogeneity of variances before performing ANOVA and ANCOVA. Descriptive statistics, including frequencies, percentages, means, and standard deviations (SD), were computed to summarize the socio-demographic characteristics of the participants and their scores on the sleep-related questionnaires. To investigate the influence of various demographic factors and chronotype on sleep quality and daytime sleepiness, independent samples t-tests and one-way Analysis of Variance (ANOVA) were employed. Where the assumption of equal variances was violated, Welch's ANOVA and Games–Howell post hoc tests were applied. Bonferroni correction was used to adjust for multiple comparisons when necessary. Furthermore, Analysis of Covariance (ANCOVA) was utilized to assess the effect of chronotype on PSQI and ESS scores while statistically controlling for the potential confounding effects of age and work experience as covariates. A p-value of less than 0.05 was considered

statistically significant for all analyses.

3 Results

A total of 135 municipal street sweepers participated in this study. The participants' ages ranged from 24 to 64 years, with a mean age of 44.13 years (SD = 8.56). Their work experience varied from 1 to 25 years, with an average of 13.01 years (SD = 5.50).

The demographic characteristics of the participants, including marital status and work shift, as well as their sleep quality, daytime sleepiness, and chronotype, are presented in Table 1. As shown in this table, the majority of participants were married (91.1%). Regarding their work schedule, 92.6% worked the night shift, while 7.4% were assigned to the day shift.

Key findings related to sleep characteristics, also detailed in Table 1, indicate that a significant proportion of sweepers (94.1%) experienced poor sleep quality. Furthermore, 93.3% reported daytime sleepiness, with a mean score on the ESS of 19.40 (SD = 6.4). The distribution of chronotypes, as determined by the MEQ and presented in Table 1, revealed that 72.6% of sweepers were classified as intermediate types, 16.3% as morning types, and 11.1% as evening types.

Table 1 The demographic characteristics of municipal street sweepers, sleep quality, and chronotypes

Variables		Mean (SD)	N (%)
Age		44.13 (8.56)	
work experience		13.01 (5.50)	
Marital status	Single		12 (8.9%)
	Married		123 (91.1%)
Shift work	Day		10 (7.4%)
	Night		125 (92.6%)
Sleep quality	Good (PSQI ≤ 5)		8 (5.9%)
	Poor (PSQI > 5)		127 (94.1%)
Daytime sleepiness	Yes (ESS ≥ 10)		126 (93.3%)
	No (ESS < 10)		9 (6.7%)
Chronotype	Morning type (MEQ Score: 59 - 86)		22 (16.3%)
	Intermediate type (MEQ Score: 42 - 58)		98 (72.6%)
	Evening type (MEQ Score: 16 - 41)		15 (11.1%)

The One-Sample Kolmogorov-Smirnov test revealed that total scores for the PSQI did not significantly deviate from a normal distribution (Z = 1.15, p = 0.13). Similarly, total scores for the ESS were also found to be consistent with normality (Z = 0.77, p = 0.58).

Table 2 presents the comparisons of mean sleep quality (PSQI) and daytime sleepiness (ESS) scores across various demographic and chronotype groups. Statistically significant differences in PSQI scores were observed between work shifts. Night shift workers (Mean = 10.63, SD = 3.33) reported significantly poorer sleep quality compared to day shift workers (Mean = 8.40, SD = 2.37; t (133) = -2.07, p = 0.04). No other demographic variables, including categorized age group (participants < 30 years vs. ≥ 30 years), categorized work experience (≤10 years vs. >10 years), marital status, or education level, showed a statistically significant association with mean PSQI scores. Furthermore, the unadjusted analysis showed that chronotype was not significantly associated with overall PSQI scores (F(2,132) = 0.12, p = 0.88).

Regarding daytime sleepiness (ESS scores), analyses revealed significant differences based on categorized work experience and marital status. In contrast, no significant differences were observed for categorized age groups, work shifts, education levels, or chronotypes. Participants with more than 10 years of work experience (Mean = 20.27, SD = 6.32) reported significantly higher daytime sleepiness compared to those with 10 years or less of work experience (Mean = 17.67, SD = 7.01; t (133) = -2.17, p = 0.03). Single participants (Mean = 24.33, SD = 7.16) also reported significantly higher daytime sleepiness than married participants (Mean = 18.92, SD = 6.42; t (133) = 2.76, p = 0.007). No significant differences in mean ESS scores were found based on categorized age group, work shift, education level, or chronotype in these unadjusted comparisons (F (2,132) = 2.67, p = 0.073 for chronotype).

An examination of the impact of chronotype on sleep quality and daytime sleepiness, with age and work experience as covariates, was conducted using ANCOVA to assess the effects after accounting for these potential confounding variables. Table 3 presents the adjusted mean scores for the PSQI and the ESS across the identified chronotype classifications.

Following the adjustment for covariates, the ANCOVA results indicated a statistically non-significant effect of

chronotype on global sleep quality, as indexed by PSQI scores (F (2,130) = 0.12, p = 0.88). The adjusted mean PSQI scores were 10.14 (SE = 0.71) for the morning chronotype group, 10.53 (SE = 0.33) for the intermediate chronotype group, and 10.51 (SE = 0.86) for the evening chronotype group.

Regarding daytime sleepiness, the adjusted mean ESS scores were 16.89 (SE = 1.39) for morning types, 19.64 (SE = 0.66) for intermediate types, and 21.54 (SE = 1.69) for evening types. Although these adjusted means suggest a trend of increasing daytime sleepiness across the chronotype spectrum from morning to evening, the overall effect of chronotype on ESS scores did not reach statistical significance at the alpha level of 0.05 (F (2,130) = 2.491, p = 0.08).

findings reveal a workforce predominantly engaged in night shift work, experiencing alarmingly high rates of poor sleep quality and excessive daytime sleepiness. While night shift work was significantly associated with poorer sleep quality, and factors such as longer work experience and being single were linked to increased daytime sleepiness, chronotype did not emerge as a significant predictor of overall sleep quality or daytime sleepiness in this specific cohort.

The findings of this study, indicating that 94.1% of municipal street sweepers in Urmia experience poor sleep quality (PSQI > 5) and 93.3% suffer from excessive daytime sleepiness (ESS ≥10), with a mean ESS score of 19.40, paint a stark picture of sleep health in this occupational group. These prevalence

Table 2 Comparison of mean PSQI and ESS scores across demographic characteristics and chronotype groups

Characteristic	Group	N	PSQI score mean (SD)	Test Statistic (df), p-value for PSQI	ESS score mean (SD)	Test Statistic (df), p-value for ESS
Age	< 30 years	8	11.13 (3.91)	t (133) = 0.57, p = 0.56	19.88 (7.68)	t (133) = 0.20, p = 0.83
	≥ 30 years	127	10.43 (3.28)		19.37 (6.61)	
Work experience	≤ 10 years	45	11.13 (3.80)	t (133) = 1.66, p = 0.09	17.67 (7.01)	t (133) = -2.17, p = 0.03
	> 10 years	90	10.13 (3.00)		20.27 (6.32)	
Work shift	Day	10	8.40 (2.37)	t (133) = -2.077, p = 0.04	17.90 (4.48)	t (133) = -0.74, p = 0.46
	Night	125	10.63 (3.33)		19.52 (6.79)	
Marital status	Single	12	12.17 (3.74)	t (133) = 1.882, p = 0.06	24.33 (7.16)	t (133) = 2.76, p = 0.007
	Married	123	10.30 (3.23)		18.92 (6.42)	
Chronotype	Evening type	15	10.33	F (2,132) = 0.12, p = 0.88	21.93	F (2,132) = 2.67, p = 0.07
	Intermediate type	98	10.55		19.56	
	Morning type	22	10.18		16.95	
Education level	Illiterate	29	10.69	F (3,131) = 0.12, p = 0.94	20.62	F (3,131) = 2.17, p = 0.09
	Elementary	63	10.46		18.86	
	Middle school	12	10		15.75	
	Diploma	31	10.45		20.77	

Table 3 Effect of chronotype on sleep quality and daytime sleepiness, adjusted for age and work experience

	Chronotypes			ANCOVA	
	Morning type (N = 22)	Intermediate type (N = 98)	Evening type (N = 15)	F-test (dfeffect, dferror)	P-value
PSQI score Mean (SE)	10.14 (0.71)	10.53 (0.33)	10.51 (0.86)	0.128 (2, 130)	0.88
ESS score Mean (SE)	16.89 (1.39)	19.64 (0.66)	21.54 (1.69)	2.491 (2, 130)	0.08

Notes: SE = Standard Error. Means are adjusted for age (mean = 44.13 years) and work experience (mean = 13.01 years).

4 Discussion

This study aimed to assess the quality of sleep, daytime sleepiness, and chronotype distribution among municipal street sweepers in Urmia, Iran, and to explore associations with socio-demographic and occupational factors. The

rates are exceptionally high, even when compared to other demanding professions or similar worker groups in different regions. For instance, a study on Iranian hospital nurses reported that 74% experienced poor sleep quality, and their mean ESS score was 9.5 (23,36), which, while high, is notably lower than that observed

in the Urmia street sweepers. Similarly, studies on street sweepers and waste collectors in Ethiopia and Nigeria, while focusing on a range of health problems including fatigue and injuries, often imply significant burdens that could contribute to sleep disruption, though direct PSQI/ESS comparisons might be limited.[9,13,37] Even among correctional workers in Canada, a group known for high stress and shift work, the prevalence of clinically significant insomnia symptoms (ISI >10) was around 64.9%.[22] The severity of daytime sleepiness in the Urmia sweepers (mean ESS 19.40) is particularly concerning, as scores in this range suggest a pathological level of sleepiness that can severely impair daily functioning and increase safety risks significantly.[21] This underscores a critical public health issue within this specific cohort of workers.

A crucial finding of this study is the significant association between night shift work and poorer sleep quality. This aligns with a vast body of literature demonstrating the adverse effects of night shift work on circadian rhythms and sleep patterns across various professions, including nurses and other healthcare workers. [25,38] Working during the body's natural sleep phase disrupts the endogenous circadian pacemaker, leading to difficulties in initiating and maintaining sleep during the day, and consequently, reduced total sleep time and efficiency.[1,21] Given that 92.6% of the surveyed sweepers in Urmia worked night shifts, this work schedule is likely a primary contributor to the widespread poor sleep quality observed among them. The demanding physical nature of street sweeping, often performed under challenging environmental conditions, further compounds the impact of night work.[10,11]

Interestingly, while night shift work directly impacted sleep quality, it was not significantly associated with the overall level of daytime sleepiness in this cohort when compared directly with the small group of day shift workers. However, longer work experience (>10 years) and being single were associated with significantly higher daytime sleepiness. The association with longer work experience could suggest a cumulative effect of chronic sleep disruption and physical strain over years of night shift work, leading to persistent fatigue and sleepiness. [39] This contrasts with some findings, where experience might lead to better coping or adaptation; however, the nature of this physically demanding night work may override such potential adaptations.[37] The finding that single participants reported higher sleepiness warrants further investigation; it may be related to differences in social support structures, lifestyle factors, or domestic responsibilities compared to their married counterparts.

The distribution of chronotypes in this study, with a majority (72.6%) classified as intermediate type, followed by morning (16.3%) and evening (11.1%) types, reflects a typical pattern seen in various working populations, though the exact proportions can vary (6,36). A particularly noteworthy finding from this research was the lack of a statistically significant association between chronotype and overall sleep quality (PSQI scores) or daytime sleepiness (ESS scores) among the Urmia street sweepers, even after adjusting for potential confounders like age and work experience. This finding is somewhat divergent from a notable body of literature, which often suggests a link between chronotype and sleep outcomes, particularly highlighting that evening chronotypes may struggle more with conventional work schedules or report poorer sleep quality when faced with early starts or shift work.[8, 23, 38, 40, 41] For example, studies among nurses have indicated that evening types working shifts may experience a higher risk of poor sleep quality compared to morning types [41], and other research in general populations or specific worker groups has linked eveningness to issues like insomnia or depressive symptoms which are often comorbid with sleep disturbances. [7, 40]

Several factors could contribute to this observed lack of direct association in the Urmia sweeper cohort. The overwhelming impact of the predominant night shift schedule (92.6% of the sample) combined with the physically demanding nature of their work might create such a profound and uniform challenge to sleep regulation that it overshadows the more nuanced influences of individual chronotypes. In essence, the extreme sleep deprivation and circadian disruption imposed by consistent night work could lead to similarly poor sleep outcomes across different chronotype groups, minimizing detectable differences. Additionally, the relatively smaller sample sizes within the morning (n = 22) and evening (n = 15) chronotype categories might have limited the statistical power to identify more subtle associations. It is also plausible that a degree of self-selection occurs over time, where individuals whose chronotypes are highly incompatible with sustained night work may leave the profession, leading to a workforce that, although still experiencing difficulties, may not exhibit substantial chronotype-dependent differences in the measured sleep variables. This lack of association, in a group experiencing such severe sleep issues, suggests that while chronotype is an important individual characteristic, its predictive power for sleep quality and sleepiness might be diminished under conditions of extreme and chronic occupational sleep stress, such as mandatory night shift work in a physically strenuous job.

The public health implications of these findings are considerable. The extremely high rates of poor sleep quality and severe daytime sleepiness among Urmia's street sweepers suggest a significant risk for impaired cognitive function, reduced work performance, increased likelihood of accidents both on and off the job, and a

higher susceptibility to long-term health problems such as cardiovascular disease, metabolic syndrome, and mental health disorders.[3, 5] The physically demanding nature of their work, combined with profound sleepiness, places them at a particularly high risk of occupational injuries. [16, 39]

This study has several limitations that are worth considering. First, its cross-sectional design means we can't conclude cause and effect. Second, the reliance on self-report questionnaires for data on sleep quality, sleepiness, and chronotype, while a common practice, might introduce reporting bias. Third, the findings are specific to municipal street sweepers in Urmia and may not apply to other groups of workers or different regions. Additionally, the minimal number of day shift workers (n = 10) limits the strength of direct comparisons between day and night shifts for specific outcomes. For future research, we recommend longitudinal designs to understand better how sleep problems develop and their long-term health effects in this occupational group. Incorporating objective measures of sleep, such as actigraphy, would also provide more detailed and accurate data.

5 Conclusion

This study highlights a significant occupational health issue among municipal street sweepers in Urmia, Iran, revealing an exceptionally high prevalence of poor sleep quality and severe daytime sleepiness, particularly within the predominantly night-shift workforce. The findings demonstrate that working the night shift is significantly associated with poorer sleep quality. Furthermore, longer work experience and being single were identified as factors linked to increased daytime sleepiness among these workers. While individual chronotype did not show a statistically significant direct association with overall sleep quality or sleepiness in this specific, highly challenged cohort, the profound sleep disturbances observed underscore a critical vulnerability. These results emphasize the urgent need for targeted occupational health interventions, including strategies to mitigate the adverse effects of night work and address factors contributing to excessive sleepiness, to improve the overall health, safety, and well-being of this essential workforce.

Limitations

First, the small sample sizes in specific subgroups, such as day-shift workers (n = 10) and participants under 30 years old (n = 8), limit the statistical power of subgroup analyses and reduce the generalizability of findings to broader worker populations. Future studies with larger and more balanced samples are needed to validate these results.

Second, the study relied entirely on self-reported questionnaires (PSQI, ESS, and MEQ), which are subject to reporting and recall bias. Integrating objective sleep measures (e.g., actigraphy or polysomnography) in future research could enhance the reliability of sleep assessments.

Third, potential confounding factors such as socioeconomic status, mental health conditions (e.g., anxiety, depression), and comorbid physical health problems were not measured or controlled for in this study. These variables are known to influence sleep quality and daytime functioning and may have significantly contributed to the observed outcomes.[42-43] Their omission represents a limitation in interpreting the causal pathways of sleep disruption in this occupational group.

Despite these limitations, the findings highlight a critical occupational health concern and suggest the need for interventions targeting shift-related sleep disruption, such as educational programs on sleep hygiene, organizational changes in shift scheduling, and screening for sleep and mental health issues among street sweepers.

Declarations

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Authors' Contributions
M.Hajaghazadeh designed the study. M.Mohammadi collected the data. M.Hajaghazadeh and Z.Moutab Sahihazar analyzed the data and wrote the initial draft. All of the authors revised and approved the paper and supplementary information.

Availability of Data and Materials
The data that support the findings of this study are available from the corresponding author upon request.

Conflict of Interest
The authors have no conflict of interest in this study.

Consent for Publication
All authors have read and approved the final manuscript and have provided their consent for publication.

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Ethical Considerations
The procedure presented in this study was approved by the Ethics Committee of Urmia University of Medical Sciences (UMSU) with approval number IR.UMSU.REC.1401.352.

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