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Ergonomic Risk Assessment and Fatigue of Solid Waste Collectors Chombueng District, Ratchaburi Province,Thailand

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ABSTRACT

This study investigates ergonomic risks and physical fatigue among 22 sanitation workers in Chom Bueng District, Ratchaburi Province. Using a descriptive cross-sectional design, data were collected via structured questionnaires, body discomfort maps, and the Rapid Entire Body Assessment (REBA). The results indicated that while workers possessed high levels of safety knowledge (mean = 8.31), a significant correlation existed between knowledge and safety practices ($p = 0.009$). Ergonomic analysis revealed that 100% of waste collectors (attendants) were at a "Very High Risk" level (REBA Score ≥ 11), primarily due to repetitive lifting, twisting, and awkward postures. In contrast, drivers faced a "Moderate Risk" level. Significant fatigue was reported in the lower back (72.7%), shoulders (68.2%), and legs. The study suggests that administrative controls and ergonomic modifications are urgently required to mitigate long-term musculoskeletal disorders.

Keywords: Ergonomic risk, Municipal solid waste collectors, Significant fatigue

INTRODUCTION

The management of municipal solid waste (MSW) is a critical urban service that is inherently labor-intensive and hazardous. In Thailand, the annual volume of waste has escalated to nearly 27 million tons, placing an immense burden on the waste management infrastructure. Sanitation workers, particularly those in local administrative organizations, serve as the backbone of this system. Despite their essential role, they are routinely exposed to diverse occupational hazards, ranging from biological pathogens and chemical residues to severe ergonomic stressors.

In the Chom Bueng District of Ratchaburi Province, community expansion and shifting consumption patterns have significantly intensified the workload. The physical demands—repetitive lifting, jumping on and off moving vehicles, and maintaining awkward postures—are primary contributors to musculoskeletal disorders (MSDs). However, the complexity of these risks extends beyond physical strain, involving work-related fatigue, occupational health literacy, and safety behaviors.

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Fatigue Assessment: Prolonged exertion under challenging conditions leads to cumulative fatigue, which diminishes physical capacity and impairs cognitive reaction times.

Occupational Health Literacy: This refers to the workers' ability to access, process, and understand health information necessary to make appropriate safety decisions.

Safety Behavior Measurement: Crucially, this study focuses on quantifying safety behaviors, assessing the frequency and consistency with which workers adhere to safety protocols, use Personal Protective Equipment (PPE), and implement correct ergonomic techniques. Measuring these behaviors allows for a clearer understanding of the gap between theoretical knowledge and actual practice.

Consequently, this research aims to provide a multidimensional analysis by quantifying ergonomic risks, evaluating subjective fatigue, and measuring both occupational health literacy and safety behaviors. This integrated approach serves as a robust evidence base for developing targeted health interventions for waste collectors in Chom Bueng.

LITERATURE REVIEW

Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system. For sanitation workers, the primary concern is "Manual Material Handling" (MMH). According to the National Institute for Occupational Safety and Health (NIOSH), lifting heavy waste bins without mechanical aid significantly increases intra-abdominal pressure and spinal stress.

The Rapid Entire Body Assessment (REBA) is a postural analysis tool specifically sensitive to unpredictable work tasks. It evaluates Group A (trunk, neck, and legs) and Group B (upper arms, lower arms, and wrists) to provide a final score indicating the level of urgency for corrective action.

METHODOLOGY

The study population consisted of 22 sanitation workers (drivers and attendants) from four local government agencies in Chom Bueng. The research instruments were divided into four parts:

1. **Socio-demographic data:** Age, BMI, and work experience.
2. **Safety Knowledge and Behavior:** Evaluated via a 10-item structured questionnaire.
3. **Physical Fatigue Assessment:** Using a body discomfort map to identify pain points.
4. **Ergonomic Observation:** Using the REBA worksheet to analyze two main tasks: lifting bins and dumping waste into the compactor.

RESULTS AND DISCUSSION

The analysis of personal factors showed that the majority of workers were male with an average of 5-10 years of experience. Interestingly, while the

knowledge score was high, the practical application of safety measures was only at a "Fair" level.

Ergonomic Risk Assessment Using the REBA Method

The ergonomic risk assessment of waste collectors in Chom Bueng District, Ratchaburi Province, was conducted using the Rapid Entire Body Assessment (REBA) method. This tool evaluates whole-body working postures, including the neck, trunk, legs, upper arms, lower arms, and wrists. The job positions were categorized into two groups: waste truck drivers and rear-end waste collectors. Due to the differences in tasks and physical movements between these roles, their respective levels of ergonomic risk vary.

REBA Ergonomic Risk Assessment Results for Waste Truck Drivers (n = 7) the assessment was conducted by observing working postures and assigning scores according to the REBA criteria. The results indicated that 100% of the waste truck drivers (7 individuals) were at Level 3: Medium Risk. This suggests that further analysis is required and corrective actions should be implemented, as shown in Table 1.

Table1: Results of REBA ergonomic risk assessment for waste truck drivers, categorized by risk level (n = 7).

Risk Level	Number of Personnel (n)	Percentage (%)
Level 1 (Negligible)	0	0.00
Level 2 (Low)	0	0.00
Level 3 (Medium)	7	100
Level 4 (High)	0	0.00
Level 5 (Very High)	0	0.00

Ergonomic Risk Results The REBA assessment showed a stark difference between job roles. Drivers faced "Moderate Risk" due to prolonged sitting and vehicle vibrations. However, 100% of the attendants scored between 11-15, categorized as "Very High Risk" as shown in Table 2. The most hazardous movements included twisting the trunk while lifting bins weighing over 15 kg and jumping from the truck's rear platform.

Table 2: Ergonomic risk assessment results using the REBA method for waste collection crew members (rear-loaders), categorized by risk level (n = 15).

Risk Level	Number of Personnel (n)	Percentage (%)
Level 1 (Negligible)	0	0.00
Level 2 (Low)	0	0.00
Level 3 (Medium)	0	0.00
Level 4 (High)	0	0.00
Level 5 (Very High)	15	100.00

Assessment of Physical Fatigue Levels

Fatigue Analysis Data from the discomfort maps indicated that the lower back (72.7%), shoulders (68.2%), and knees (54.5%) were the areas with the highest fatigue levels. This correlates with the REBA findings, suggesting that awkward lifting postures directly lead to localized muscle fatigue.

Table 3: Physical fatigue levels among waste collection (n = 22).

Variables / Body Parts	Left Side	Left Side	Right Side	Right Side
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage(%)
Neck				
Very High Fatigue	0	0.00	0	0.00
High Fatigue	8	36.40	9	40.9
Moderate Fatigue	9	40.90	9	40.9
Low Fatigue	5	22.70	4	18.2
No Fatigue	0	0.00	0	0.00
Total	22	100.00	22	100.00
Shoulder				
Very High Fatigue	3	13.60	4	18.20
High Fatigue	8	36.40	8	36.40
Moderate Fatigue	10	45.50	9	40.90
Low Fatigue	1	4.50	1	4.50
No Fatigue	0	0.00	0	0.00
Total	22	100.00	22	100.00
Upper Back				
Very High Fatigue	1	4.50	1	4.50
High Fatigue	6	27.30	5	22.70
Moderate Fatigue	14	63.60	15	68.20
Low Fatigue	1	4.50	1	4.50
No Fatigue	0	0.00	0	0.00
Total	22	100.00	22	100.00
Lower Back Region				
Very High Fatigue	2	9.10	12	9.10
High Fatigue	6	27.30	7	31.80
Moderate Fatigue	11	50.00	10	45.50
Low Fatigue	3	13.60	3	13.60
No Fatigue	0	0.00	0	0.00
Total	22	0.00	22	100.00

Table **4**: Relationship analysis between personal factors, knowledge levels, fatigue levels, ergonomic risk levels, and safety preventive behaviors of waste collection workers.

Variables	Safety Preventive Behaviors	
	Chi-Squared	**p-value**
Age (years)	14.037	0.868
Height	0.073	0.995
Weight	0.545	0.909
Job Position	1.586	0.662
Educational Level	5.744	0.452
Underlying Disease / Chronic Illness	1.513	0.679
Smoking Habit	2.245	0.523
Years of Experience in Waste Collection	31.778	0.062
Daily Working Hours	3.060	0.382
Knowledge Level of Safety Prevention	54.217	0.009*
Fatigue Level	3.46	0.177

*$p<0.05$

Table 4 indicates that most personal factors, including gender, age, height, weight, job position, educational level, underlying diseases, smoking status, and duration of daily working hours, were not significantly associated with the hazard prevention behaviors of waste collection workers. The p-values for these variables exceeded the predetermined significance level, suggesting that individual physical characteristics and personal habits did not exert a direct influence on workers' safety prevention behaviors in this sample. In contrast, the variable representing knowledge of hazard prevention showed a statistically significant association with safety prevention behavior, with a Chi-square value of 54.217 and a p-value of 0.009. This finding implies that employees with higher levels of safety-related knowledge tend to demonstrate safer and more appropriate work practices, underscoring the pivotal role of knowledge in promoting safe work behavior among waste collection workers.

CONCLUSION

This research confirms that sanitation workers in Chom Bueng are operating under severe ergonomic strain. The high correlation between safety knowledge and behavior suggests that training programs are effective, but physical and environmental constraints often prevent workers from following safe protocols.

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