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SAFETY LOGISTICS: A CASE STUDY IN THE RISK OF WORK-RELATED MUSCULOSKELETAL DISORDERS IN MANUAL LOGISTICS TASK IN THAILAND

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ABSTRACT

Purpose: This research addresses the critical yet often overlooked aspect of occupational safety within the logistics industry, specifically focusing on safety logistics. While logistics management typically prioritizes cost reduction and operational efficiency, the significant financial and human costs associated with work-related injuries and illnesses are substantial. This study aims to identify and assess ergonomic risks among gas cylinder delivery workers in Thailand to ultimately enhance worker safety and well-being.

Design/methodology/approach: This study employed an observational design to investigate the work behaviors of gas cylinder delivery workers in Thailand. The research focused on tasks involving the manual handling of 15 kg, 30 kg, and 45 kg gas cylinders during loading onto vehicles, offloading, and delivery to customer homes. To evaluate the risk of work-related musculoskeletal disorders (WMSDs), the Rapid Upper Limb Assessment (RULA) tool was systematically applied to observe and analyze the working postures of these employees.

Findings: The RULA assessment effectively identified various postures presenting risks for WMSDs among the gas cylinder delivery workers. The findings indicate specific high-risk movements and body positions frequently adopted during the manual handling tasks. These identified risks highlight the potential for injuries if no intervention measures are taken.

Research limitations/implications: This study's findings are specific to gas cylinder delivery workers in Thailand, utilizing a single ergonomic assessment tool. Future research could benefit from a larger sample size, longitudinal studies to track injury rates, and the incorporation of additional ergonomic assessment tools or physiological measurements to provide a more comprehensive understanding of the risks.

Practical implications: The identified ergonomic risks provide valuable insights for developing targeted intervention strategies. These strategies may include implementing ergonomic training programs for workers, providing appropriate material handling equipment, redesigning work processes, or introducing regular rotation of tasks to reduce repetitive strain. Addressing these risks can significantly reduce WMSDs, leading to fewer injuries, lower healthcare costs, improved worker morale, and increased productivity for logistics companies.

Originality/value: This research contributes to the growing body of knowledge on safety logistics by specifically addressing ergonomic risks in manual handling tasks within the Thai gas delivery sector. By utilizing the RULA tool, it offers a practical and immediate method for identifying specific high-risk postures. The findings provide a strong foundation for developing evidence-based interventions to improve occupational health and safety standards in this physically demanding industry.

Keywords: Safety Logistics, Ergonomics, Manual Handling, RULA, Work Related Musculoskeletal Disorders

1. Introduction

Contemporary logistics research predominantly focuses on enhancing operational efficiency and reducing costs. Key areas include supply chain management, risk-resilient logistics, and the integration of technologies such as automation, robotics, blockchain, and artificial intelligence. Specialized logistics domains—such as green logistics, e-commerce logistics, humanitarian logistics, and cold chain logistics—also receive considerable attention.

However, a crucial aspect often overlooked is **occupational safety**, particularly in labor-intensive logistics tasks. These tasks pose significant risks for long-term health issues, including **Work-Related Musculoskeletal Disorders (WMSDs)**, and may even result in severe injuries or fatalities. Neglecting safety can adversely affect productivity, increase absenteeism, and lead to high medical and compensation costs, ultimately undermining organizational sustainability.

This study focuses on evaluating **ergonomic risks** in manual logistics operations in Thailand, aiming to enhance worker safety and health.

2. Literature Review

2.1 Manual Labor in Logistics and Safety Concerns

Manual handling tasks in logistics are associated with high health and safety risks. According to the International Labor Organization (ILO), manual labor is a leading cause of workplace injuries, especially in industries such as construction and logistics. Common incidents include falls, collisions, and injuries from lifting heavy objects. These accidents result in significant financial losses due to medical expenses, compensation, and lost productivity.

2.2 Impact of Manual Work on Musculoskeletal Health

WMSDs encompass injuries to muscles, tendons, bones, and joints caused by repetitive tasks, awkward postures, heavy lifting, and vibrations. In logistics, workers frequently face these risks, such as lifting heavy gas cylinders or transporting parcels in unnatural postures. Common symptoms include lower back pain, carpal tunnel syndrome, tendonitis, and neck or shoulder pain.

2.3 Risk Reduction Strategies

Risk mitigation follows the **Hierarchy of Controls**:

- **Elimination:** Avoiding hazardous tasks by using machinery.
- **Substitution:** Replacing heavy materials with lighter alternatives.
- **Engineering Controls:** Redesigning workspaces or using equipment like conveyors or adjustable carts.
- **Administrative Controls:** Job rotation and scheduled breaks.
- **Personal Protective Equipment (PPE):** Items like back support belts and safety shoes—used as a last resort.

2.4 Ergonomic Risk Assessment Tools

Ergonomic risks can be assessed through observational and physiological methods:

- **Heart Rate Monitoring:** Indicates workload and fatigue.
- **Body Discomfort Surveys:** Identifies pain and discomfort areas.
- **Motion Analysis:** Tracks movement angles, speed, and force.
- **Posture Analysis Tools:** Includes RULA, REBA, and OWAS.
- **Electromyography (EMG):** Measures muscle activity.
- **Oxygen Consumption:** Assesses overall physiological workload.

Assessment Type	Tools	Purpose
Observational	RULA, REBA, OWAS	Posture-related WMSD risks
Physiological	Heart Rate Monitor, Oxygen Consumption	Physical workload and fatigue
Biomechanical	Motion Analyzer, EMG	Force and muscle activity
Subjective	Body Discomfort Questionnaire	Pain and discomfort levels

2.5 Rapid Assessment Tools

Rapid ergonomic assessment tools are widely used due to their efficiency and simplicity. These tools evaluate working posture and assign risk scores:

- **RULA:** Focuses on upper limbs.
- **REBA:** Assesses the entire body.
- **OWAS:** Uses coding for posture analysis.

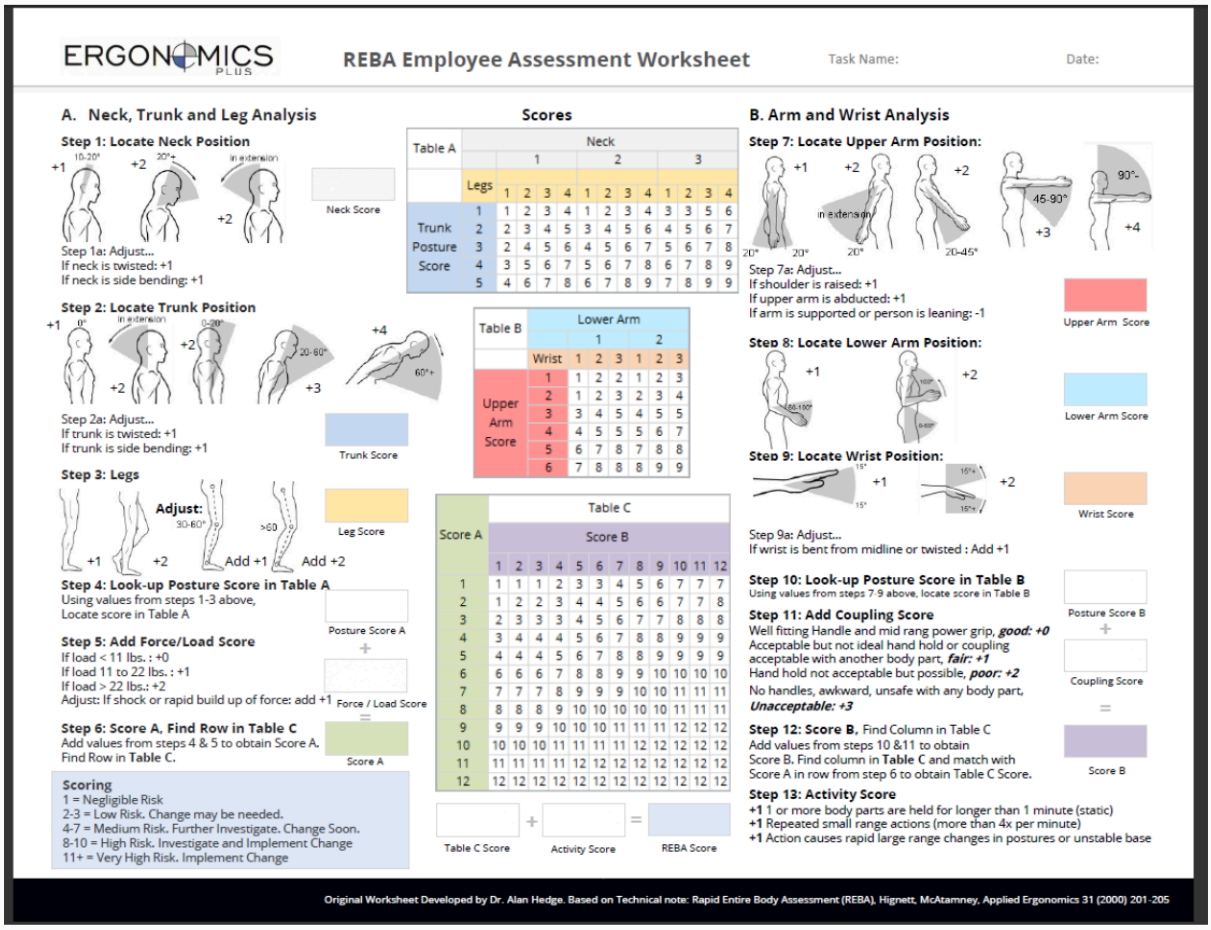
REBA (Rapid Entire Body Assessment) REBA assessment is performed by dividing the analysis into two main groups:

- **Group A:** Analyzes the posture of the **neck, trunk, and legs**.
- **Group B:** Analyzes the posture of the **arms and wrists**.

The scores from each group are combined with scores for

Force/Load and Coupling to get a final score. The final score indicates different risk levels:

- Score 1: Negligible risk, acceptable.
- Score 2-3: Low risk, needs monitoring and improvement.
- Score 4-7: Medium risk, should be improved.
- Score 8-10: High risk, requires immediate improvement.
- Score 11 or more: Very high risk, requires immediate action.



Reba worksheet

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3. Methodology

This observational study evaluates ergonomic risks among workers at a Thai LPG distribution company. The focus is on **manual material handling** tasks from receiving customer orders to delivering gas cylinders.

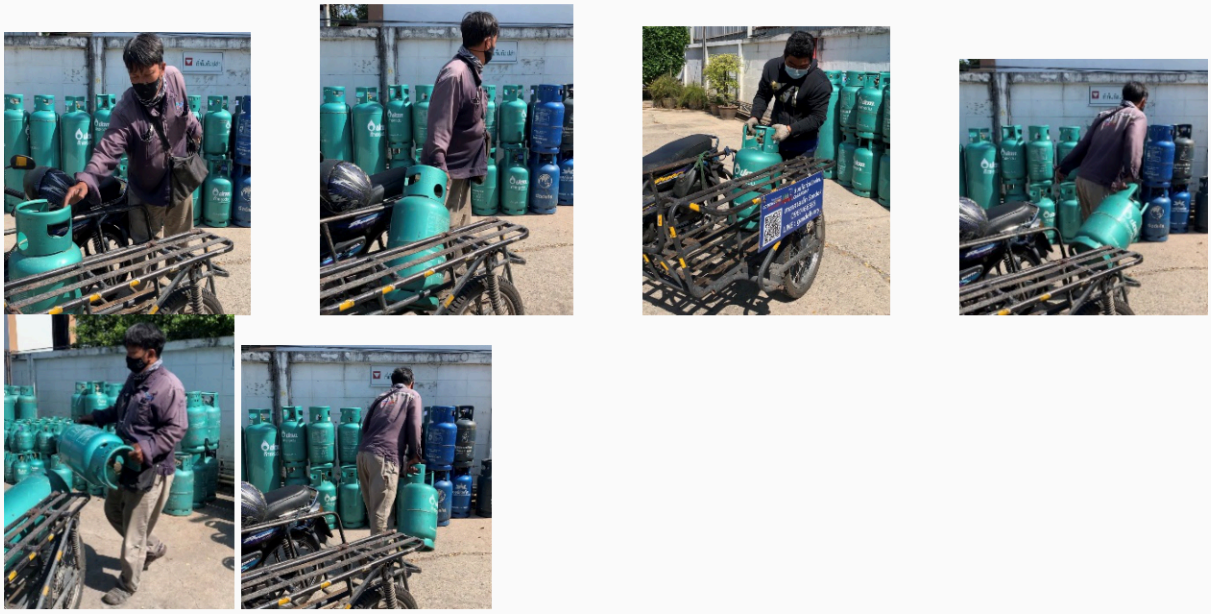
3.1 Sample and Scope

The study targets workers handling 15-kg gas cylinders which is the most frequently transported size. These tasks involve lifting, dragging, and rolling cylinders manually.

3.2 Assessment Tool

The **REBA** tool was selected for its speed and comprehensiveness in evaluating posture-related risks across the entire body.

3.3 Example of manual material handling in gas cylinder delivery



3.4 REBA assessment table

REBA (Rapid Entire Body Assessment) worksheet					
worker	Gas cylinder delivery	task	Carry 15 kg gas cylinder to the deliver car		
reference: Hignett and McAtamney (2000) Rapid Entire Body Assessment (REBA). Applied Ergonomics (31), Page 201-205					
A. Neck, Trunk and Leg Analysis		**B. Arm and Wrist Analysis**		left	right
Step 1 Neck	**2**	Step 7 Upper Arm		**0**	**2**
Step 2 Trunk	**1**	Step 8 Lower Arm / Fore Arm		**0**	**1**
Step 3 Legs	**4**	Step 9 Wrist		**0**	**2**

Step 4 Score from table A	4	Step 10 Score from table B	0	2
Step 5 Force/load score	2	Step 11 Coupling score	0	0
Step 6 Score A to find row in table C	6	Step 12 Score B to find column in table C	0	2
		Step 13 Score C	0	6
		Step 14 Activity score	0	+1
		Step **15 Final REBA Score**	0	7

Score level from step 15	
1: Neglectable risk	
2 or 3 : Low risk, change may be needed	
4 to 7 : Medium risk, further investigation, change soon	X
8 to 10 : High risk, investigate and implement change	
11+ : Very high risk, implement change	

The assessed posture

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4. Findings

4.1 Overall Results

The REBA assessment for a worker lifting a 15-kg gas cylinder yielded a **Grand Score of 7**, indicating a **moderate risk level**. This suggests that the task requires improvement to reduce ergonomic risks.

4.2 Body Regions with Highest Risk

The **Group A** scores (neck, trunk, legs) were significantly higher than **Group B** (arms, wrists):

- **Neck:** Score 2
- **Legs:** Score 4
- **Group A Total:** 6
- **Group B Total:** 2

This indicates that postures involving bending knees, leaning forward, and maintaining balance contribute most to the overall risk.

5. Conclusion