

# Ergonomic Risk Assessment of Manual Material Handling in a Logistic Warehouse

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Warehouse

## Abstract

Manual Material Handling (MMH) is a primary cause of musculoskeletal disorders in the logistics industry. This study aimed to identify the prevalence of musculoskeletal discomfort, classify ergonomic risk levels using the IERA Guideline, and propose control measures at a warehouse in Malaysia. Data was collected from experienced workers through musculoskeletal surveys and the Initial Ergonomic Risk Assessment (IERA) checklist. The results revealed a high prevalence of discomfort in the neck, shoulders, upper back, lower back, knees, and feet, despite 90% of the workforce being young (18– 35 years old). This strain is attributed to extreme working shifts exceeding 8 to 12 hours per day, particularly for those in the sorting department (62.5%). The IERA results identified critical risk factors, with Awkward Posture scoring an 8 and Forceful Exertion scoring a 5, both surpassing the minimum thresholds for safety. Consequently, the study classifies these MMH tasks as High Risk, necessitating a mandatory Advanced Ergonomic Risk Assessment. To mitigate these risks, the study proposes engineering controls such as height-adjustable workstations and administrative measures including job rotation and stretching breaks. These interventions are vital to prevent long-term physical injury and improve the overall safety of the warehouse environment.

## 1. Introduction

This research investigates the ergonomic risk factors associated with Manual Material Handling (MMH) tasks within the logistics sector, specifically focusing on warehouse operations at Ninja Van Malaysia. This chapter establishes the research framework by providing the study's background, identifying the core problem, and defining the research objectives and significance. Through a systematic application of the Initial Ergonomic Risk Assessment (IERA) guideline, this study aims to bridge the gap between theoretical safety standards and practical warehouse operations.

### 1.1 Background of the Study

Manual Material Handling (MMH) activities such as; lifting, carrying, pushing, and pulling are remains a cornerstone of the logistics and warehousing sector. While technological advancements have introduced automation, human intervention remains critical for maintaining the expertise of the global supply chain. However, the repetitive nature of these tasks often necessitates awkward postures and high-force exertions, which significantly increase the risk of physical strain (Waters et al., 1993). In Malaysia, the prevalence of WMSDs in labor-intensive industries has prompted specific regulatory action. The Department of Occupational

Safety and Health (DOSH) Malaysia released the *Guidelines on Ergonomic Risk Assessment at the Workplace (2017)* to provide a standardized framework for identifying and mitigating risks.

## 1.2 Problem Statement

Manual Material Handling (MMH) remains a fundamental but high-risk component of operations at Ninja Van Malaysia warehouses. The current operational environment necessitates repetitive lifting, carrying, and pushing under significant time constraints to meet high-volume parcel demands. These tasks frequently force workers into non-neutral postures which is specifically bending, twisting, and overreaching also place biomechanical stress on the lumbar region, shoulders, and upper extremities. Despite the inherent risks, a critical gap exists in the integration of ergonomic design within the warehouse workflow. Current layouts and equipment are not fully optimized for safe handling, and productivity demands often lead workers to prioritize speed over ergonomic safety. This is compounded by a lack of specialized training, resulting in the adoption of unsafe lifting techniques. Without a formalized Ergonomic Risk Assessment (ERA), these risks remain unquantified, making it difficult for management to implement data-driven interventions. This study is necessary to analyze the existing MMH tasks performed in a 3 logistics warehouse, assess their ergonomic risk levels, and propose practical solutions to mitigate the occurrence of musculoskeletal disorders. By doing so, it aims to enhance workplace safety, promote employee health, and improve overall productivity within the warehouse setting.

## 1.3 Research Objectives

- To identify the prevalence of musculoskeletal discomfort among experienced workers involved in Manual Material Handling (MMH) tasks in the logistics warehouse.
- To propose feasible control measures based on the final risk classification.
- To classify the level of ergonomic risk (Low, Medium, or High) for all identified MMH tasks in the logistics warehouse using the IERA Guideline.

## 2. Methodology

To ensure the validity and reliability of the study's conclusions, the methodology provides a structured framework for data collection, analysis, and interpretation specifically centered on the Manual Material Handling (MMH) duties at Ninja Van Malaysia. The research employs a mixed-method design to capture the dynamic nature of logistics work, combining quantitative data from standardized ergonomic checklists with qualitative insights gained through systematic site visits. This dual approach allows for a more comprehensive understanding of ergonomic risks, as self-reported pain and discomfort from workers can be statistically analyzed and then contextualized by direct observations of postures, movement frequency, and workplace design. The study is grounded in national safety standards, particularly the "Guideline on Ergonomics Risk Assessment at the Workplace 2017" issued by Malaysia's Department of Occupational Safety and Health (DOSH).

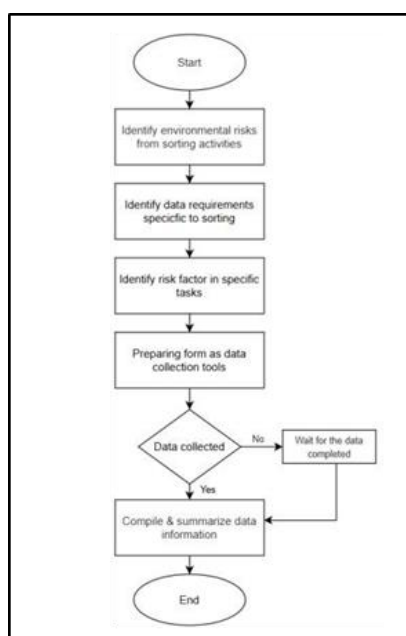


Fig. 1 **Data Collection Flowchart**

The study was conducted at the Ninja Van Central Warehouse, a high-volume logistics hub where workers are frequently exposed to physical strain during sorting and distribution activities. Data collection involved a purposive sample of 40 experienced workers from the sorting department, chosen because their daily tasks such as lifting, carrying, and pushing parcels represent high-risk MMH activities. Two primary instruments were utilized for data gathering: the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), which uses body maps and frequency scales for workers to report physical strain, and direct site observations recorded on systematic sheets to capture real-time postural hazards and lifting techniques.

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.



|              |         | During the last work week, how often did you experience ache, pain, discomfort in: |                          |                          |                          |                          | If you experienced ache, pain, discomfort, how uncomfortable was this? |                          |                          | If you experienced ache, pain, discomfort, did this interfere with your ability to work? |                          |                          |
|--------------|---------|------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------------------------------------------------------|--------------------------|--------------------------|------------------------------------------------------------------------------------------|--------------------------|--------------------------|
|              |         | Never                                                                              | 1-2 times last week      | 3-4 times last week      | Once every day           | Several times every day  | Slightly uncomfortable                                                 | Moderately uncomfortable | Very uncomfortable       | Not at all                                                                               | Slightly interfered      | Substantially interfered |
| Neck         |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Shoulder     | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Upper Back   |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Upper Arm    | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Lower Back   |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Forearm      | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Wrist        | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Hip/Buttocks |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Thigh        | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Knee         | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Lower Leg    | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Foot         | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |

Fig. 2 CMDQ for Male

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.



|              |         | During the last work week, how often did you experience ache, pain, discomfort in: |                          |                          |                          |                          | If you experienced ache, pain, discomfort, how uncomfortable was this? |                          |                          | If you experienced ache, pain, discomfort, did this interfere with your ability to work? |                          |                          |
|--------------|---------|------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------------------------------------------------------|--------------------------|--------------------------|------------------------------------------------------------------------------------------|--------------------------|--------------------------|
|              |         | Never                                                                              | 1-2 times last week      | 3-4 times last week      | Once every day           | Several times every day  | Slightly uncomfortable                                                 | Moderately uncomfortable | Very uncomfortable       | Not at all                                                                               | Slightly interfered      | Substantially interfered |
| Neck         |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Shoulder     | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Upper Back   |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Upper Arm    | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Lower Back   |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Forearm      | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Wrist        | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Hip/Buttocks |         | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Thigh        | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Knee         | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Lower Leg    | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| Foot         | (Right) | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |
|              | (Left)  | <input type="checkbox"/>                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>                                                                 | <input type="checkbox"/> | <input type="checkbox"/> |

Fig. 3 CMDQ for Female

For the final analysis, the study employs data triangulation to cross-reference self-reported discomfort with observed risk factors, ensuring the findings accurately pinpoint the root causes of ergonomic hazards. Quantitative data from the Initial Ergonomic Risk Assessment (IERA) checklists are processed using descriptive statistics to calculate the frequency and percentage of discomfort in specific body regions like the lower back and neck. Simultaneously, qualitative data from site observations undergo thematic analysis to categorize environmental and operational issues, such as poor workstation layout or excessive repetitive motions. This integrated analysis ultimately serves to classify tasks as Low, Medium, or High risk, providing a data-driven basis for proposing practical engineering and administrative control measures.

| Risk factors                      | Total Score | Minimum requirement for advanced assessment | Result of Initial ERA | Any Pain or Discomfort due to risk factors as found in Musculoskeletal Assessment (refer Part 3.1) (Yes/No) | Need Advanced ERA? (Yes/No) |
|-----------------------------------|-------------|---------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------|
| Awkward Postures                  | 13          | $\geq 6$                                    |                       | YES / NO                                                                                                    |                             |
| Static and Sustained Work Posture | 3           | $\geq 1$                                    |                       | If YES, please tick ( <input checked="" type="checkbox"/> ) which part of the body                          |                             |
| Forceful Exertion                 | 1           | 1                                           |                       | Neck <input type="checkbox"/>                                                                               |                             |
| Repetitive Motion                 | 5           | $\geq 1$                                    |                       | Shoulder <input type="checkbox"/>                                                                           |                             |
| Vibration                         | 4           | $\geq 1$                                    |                       | Upper back <input type="checkbox"/>                                                                         |                             |
| Lighting                          | 1           | 1                                           |                       | Upper arm <input type="checkbox"/>                                                                          |                             |
| Temperature                       | 1           | 1                                           |                       | Lower back <input type="checkbox"/>                                                                         |                             |
| Ventilation                       | 1           | 1                                           |                       | Forearm <input type="checkbox"/>                                                                            |                             |
| Noise                             | 2           | $\geq 1$                                    |                       | Wrist <input type="checkbox"/>                                                                              |                             |
|                                   |             |                                             |                       | Hand <input type="checkbox"/>                                                                               |                             |
|                                   |             |                                             |                       | Hip/buttocks <input type="checkbox"/>                                                                       |                             |
|                                   |             |                                             |                       | Thigh <input type="checkbox"/>                                                                              |                             |
|                                   |             |                                             |                       | Knee <input type="checkbox"/>                                                                               |                             |
|                                   |             |                                             |                       | Lower leg <input type="checkbox"/>                                                                          |                             |
|                                   |             |                                             |                       | Feet <input type="checkbox"/>                                                                               |                             |

Fig. 4 Initial ERA Form

### 3. Prevalence of MSD

The initial phase of this study aimed to identify the prevalence of musculoskeletal discomfort (MSD) among warehouse personnel engaged in Manual Material Handling (MMH) activities. The findings reveal a significant level of reported physical strain, which appears to be a direct consequence of the demanding operational schedules and the repetitive nature of sorting tasks. The high prevalence of discomfort persists despite the relatively young demographic profile of the workforce. Approximately 90% of the respondents fall within the 18 to 35-year age bracket, a group typically characterized by higher physical resilience. However, this physiological advantage is countered by the intensity of their work shifts. Data analysis confirms that 100% of the participants work more than 8 hours per day, with a significant subset extending their shifts beyond 12 hours.

The concentration of strain is most evident in the sorting activity, which accounts for 62.5% of the total respondents. This high concentration is attributed to the continuous nature of lifting, carrying, and lowering items where tasks that require consistent biomechanical exertion without adequate recovery intervals.

Table 1 Demographic Data Result

| Category     | Sub-group 1           | Sub-group 2           | Sub-group 3           |
|--------------|-----------------------|-----------------------|-----------------------|
| Age          | 18-25 years old (40%) | 25-35 years old (50%) | 35-45 years old (10%) |
| Working Task | Receiving (7.5%)      | Scanning (30%)        | Sorting (62.5%)       |
| Working Hour | >8hrs                 | <12hrs                | >12hrs                |

### 3.1 Classification of Ergonomic Risk Level

The results of the musculoskeletal assessment indicate that the current workload exceeds the recovery threshold of the participants. Reported discomfort is not isolated but widespread across multiple anatomical regions. The most critical areas identified include:

- **Upper Body:** Significant pain reported in the neck, shoulders, and upper back, likely due to repetitive reaching and overhead sorting.
- **Lower Body & Core:** Widespread discomfort in the lower back, knees, and feet, resulting from prolonged standing and the frequent lifting of heavy loads.

These findings suggest that the cumulative physical load, exacerbated by extended shift durations, leads to a state of chronic fatigue. This not only increases the risk of long-term WMSDs but also indicates that the current operational demands at the warehouse exceed the biomechanical limits of a young workforce.

| Risk Factor                     | Total Score | Min Requirement for advance assessment | Result of Initial ERA | Any pain or discomfort due to risk factors as found in Musculoskeletal Assessment | Need Advance ERA (Yes/No) |
|---------------------------------|-------------|----------------------------------------|-----------------------|-----------------------------------------------------------------------------------|---------------------------|
| Awkward posture                 | 13          | $\geq 6$                               | 8                     | YES / NO<br>If YES, please tick (/) which part of the body                        | Yes                       |
| Static & sustained work posture | 3           | $\geq 1$                               | 1                     | Neck /                                                                            | Yes                       |
| Forceful exertion               | 7           | 1                                      | 5                     | Shoulder /                                                                        | Yes                       |
| Repetition                      | 5           | $\geq 1$                               | 3                     | Upper back /                                                                      | Yes                       |
| Vibration                       | 4           | $\geq 1$                               | 0                     | Upper arm                                                                         |                           |
| Lighting                        | 1           | 1                                      | 0                     | Lower back /                                                                      |                           |
| Temperature                     | 1           | 1                                      | 0                     | Forearm                                                                           |                           |
| Ventilation                     | 1           | 1                                      | 0                     | Wrist                                                                             |                           |
| Noise                           | 2           | $\geq 1$                               | 0                     | Hip / buttocks                                                                    |                           |
|                                 |             |                                        |                       | Thigh                                                                             |                           |
|                                 |             |                                        |                       | Knee /                                                                            |                           |
|                                 |             |                                        |                       | Lower leg                                                                         |                           |
|                                 |             |                                        |                       | Feet /                                                                            |                           |

Fig. 5 Initial ERA Result

### 3.2 Proposed Control Measure

Based on the results of the Initial Ergonomic Risk Assessment (IERA) and the widespread prevalence of physical strain among workers, the following control measures are proposed to mitigate ergonomic risks at the Ninja Van Malaysia warehouse. These interventions follow a hierarchical approach, combining engineering modifications with administrative strategies to ensure long-term sustainability.

#### 3.2.1 Engineering Control Measures

Engineering solutions are prioritized to physically remove or reduce hazards through workstation and equipment redesign:

- **Height-Adjustable Conveyors:** Implementation of height-adjustable conveyor systems to accommodate varying worker heights and package sizes. This reduces the need for frequent reaching above shoulder height and deep bending, which were identified as critical risk factors.
- **Anti-Fatigue Matting:** Installation of anti-fatigue mats in sorting areas to alleviate the strain of prolonged static standing, which currently affects 70% of the workforce.
- **Mechanical Assistance Tools:** Providing hydraulic trolleys, pallet jacks, or step ladders to minimize the manual effort required for lifting and carrying bulky items. Currently, 72.5% of workers operate without any mechanical assistance.

#### 3.2.2 Administrative Control Measures

Administrative strategies focus on changing how work is organized and scheduled to manage fatigue and reduce repetitive strain:

- **Formal Job Rotation:** Implementation of a structured rotation schedule between high-intensity sorting tasks and lower-demand activities to prevent overexertion of specific muscle groups.
- **5S Housekeeping System:** Establishing a 5S system (Sort, Set in order, Shine, Standardize, Sustain) to reduce workplace clutter. This addresses the environmental constraints that currently force 57.5% of workers into awkward postures.
- **Mandatory Recovery Breaks:** Introducing short, scheduled rest periods to allow for muscle recovery, particularly for workers whose shifts regularly exceed 8 to 12 hours.

### 3.2.3 Training and Behavioral Interventions

These measures aim to increase worker awareness and improve individual handling techniques:

- **Formal Ergonomic Training:** Since 60% of workers currently lack formal training, a mandatory program should be introduced focusing on safe lifting techniques and the recognition of early MSD symptoms.
- **Pre-Task Stretching Routines:** Encouraging a 5-minute warm-up and stretching routine before shifts to prepare the musculoskeletal system for the high-intensity demands of warehouse operations.

By integrating these practical and feasible solutions, Ninja Van Malaysia can close the gap between current operational demands and ergonomic safety standards, ultimately reducing absenteeism and enhancing overall productivity.

## 4. Recommendation

To build upon the findings of this research, future studies should focus on several key areas to provide more precise ergonomic solutions. First, it is highly recommended to conduct an Advanced Ergonomic Risk Assessment (ERA) using specialized tools like RULA or REBA, which can provide a more detailed analysis of the specific joint angles involved during the sorting process. Second, the sample size should be expanded to include multiple warehouse locations across the country to determine if these high-risk patterns are consistent throughout the entire logistics industry. Third, future researchers should consider a longitudinal approach, tracking the same group of workers over a 6-month period to measure the actual effectiveness of implementing stretching breaks and job rotation. Finally, the integration of objective technology, such as wearable motion sensors or heart rate monitors, would provide real-time data on physical exertion that could supplement the subjective feedback provided in musculoskeletal surveys.

## 5. Conclusion

This study successfully fulfilled its objectives by identifying a severe prevalence of musculoskeletal discomfort that is directly linked to the intensive work profiles of the warehouse staff. While the research began with a focus on the general risks of Manual Material Handling (MMH), the demographic results in Chapter 4 revealed a more specific crisis that 100% of the workforce is subjected to shifts exceeding 8 to 12 hours, leading to widespread pain in the neck, shoulders, back, and knees. The Initial Ergonomic Risk Assessment (IERA) results confirmed that these physical symptoms are not accidental but are the result of hazardous task designs. Specifically, the high scores for Awkward Posture (8) and Forceful Exertion (5) proved that current sorting and stacking methods are fundamentally unsafe and have triggered the mandatory requirement for an Advanced Ergonomic Risk Assessment. Therefore, the proposed control measures which including engineering changes like spring-loaded pallet levellers and administrative shifts like job rotation are essential interventions to protect the health of this young workforce and ensure the long-term sustainability of warehouse operations.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

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