Work Posture Analysis of Warehouse Workers with Rapid Upper Limb Assessment Methods at Electronic Manufacturer

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Abstract. The primary objective of this study is to ascertain the characterization of musculoskeletal illnesses, identify the risk variables associated with these complaints, and assess the occupational postures adopted by warehouse workers employed at an Electronic Manufacturer.The employed data gathering methods encompassed the utilization of questionnaires, specifically the Nordic Body Map Questionnaires, as well as observations. The present study employs a descriptive quantitative research design, utilizing the Rapid Upper Limb Assessment (RULA) technique for data analysis. The Ergofellow 2.0 application is utilized to conduct the RULA assessment, while the AutoCAD application is employed to measure body angles. The findings of this study revealed that a significant proportion of workers, up to 100%, were within the low risk group for musculoskeletal disorders (MSDs) as determined by the Nordic Body Map questionnaire. The regions of the body that exhibited the highest number of reported symptoms were the waist, trunk, and calf. Workers across various categories experienced complaints of musculoskeletal disorders (MSDs). These categories include workers with static, dynamic, neutral, and awkward work postures, workers carrying a load ranging from 0 to 10 kg, workers with both high and low repetition frequency, workers engaged in work for more than 2 hours per day, workers aged below 35 years, both male and female workers, workers with normal body mass index as well as those who are thin, workers with a work period ranging from less than 1 year to more than 5 years, workers who actively smoke, and workers with low to moderate physical fitness levels. According to the findings of a study utilizing the Rapid Upper Limb Assessment (RULA) method, it was determined that 31% of individuals engaged in occupations involving static work postures are exposed to a combination of low and moderate risks in relation to the development of musculoskeletal problems.

Keywords: Musculoskeletal Disorders, Biomechanical Risk Factors,Individual Risk Factors, RULA

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1. Introduction

The warehousing and storage sector of the industry employs an estimated 705,000 individuals who are engaged in a diverse range of activities. These include but are not limited to the following: inventory control, light assembly, order entry and fulfillment, packaging, pick and pack, price marking, ticketing, and transportation arrangement [10]. Employment also exhibits diversity, encompassing positions such as stock clerks and order fillers, industrial vehicle and tractor operators, laborers (including those who manually transport materials, freight, and stock), and shipping and receiving clerks. However, they all share a significant prevalence of strains and injuries.

Based on data from the Bureau of Labor Statistics, the warehousing and storage subsector in the United States documented a cumulative rate of 5.5 injuries per 100 full-time employees in 2012. Serious injuries, which encompassed work absences, job limitations, or transfers, transpired at an incidence rate of 3.9 injuries per 100 employees. Musculoskeletal injuries transpired with a frequency that was twice as high in the warehousing and storage sector compared to the general private industry: 78.1 versus 35.5 injuries per 10,000 workers, respectively. Additionally, in 2012, the warehousing and storage industry had a higher incidence of injuries in exposure categories such as accidents, slips, and trips, as well as overexertion (including overexertion in lifting or lowering), compared to the general private sector. In the warehousing and storage sector, strains, sprains, and injuries occurred at a rate of 80 per 10,000 full-time employees.

Work posture refers to the natural work posture that is formed when workers interact with the work equipment used. In some types of work, there are some work postures that are not normal and are carried out for a long time. This can cause body pain, product defects and even complaints of body defects [1] .

Ergonomics is a "science" or multidisciplinary approach that aims to optimize the human system - work, so that healthy, safe, comfortable and efficient tools, methods and work environments are achieved [3]. Musculoskeletal Disorders (MSDs) are diseases of the musculoskeletal system that cause pain symptoms due to damage to nerves and blood vessels in various parts of the body (such as the neck, shoulders, wrists, hips, knees, heels, and ankles) [6]. MSDs are skeletal muscle complaints that are felt by a person, characterized by skeletal muscle complaints, ranging from very mild to very severe complaints [7]. Complaints of musculoskeletal disease are caused by a heavy load on the muscles and for a long time [8]. One of the tools to measure the symptoms of MSDs is the Nordic Body Map (NBM) questionnaire which maps the complaints experienced by workers [9]. Based on the results obtained from the preliminary study of four workers who were a group of respondents in the preliminary study, they experienced various complaints in different parts of the work. To analyze the work posture of workers, there are various choices of methods suggested by experts. These method is Rapid Upper Limb Assessment (RULA). RULA is used to determine the level of risk of musculoskeletal disorders based on the worker's work posture.

2. Method

2.1 Population and Sample

The population in this study were all workers in the warehouse department at X company as many as four people. The sample in this study will use a saturated sample, i.e the entire population will be sampled because the population is relatively small or less than 30 people. So that the sample in this study amounted to four warehouse department workers namely Assistant Manager Warehouse, Senior Leader Warehouse, Leader Warehouse and Data Entry Warehouse.

Table 1. Worker Activities and Work Posture

No	Worker	Activities	Work Posture
1	*Assistant Manager Warehouse*	- Make a report - Supervision	
2	*Senior Leader Warehouse*	- Make a report - Supervision	
3	*Leader Warehouse*	- Make a report - Supervision	
4	*Data Entry Warehouse*	Input data	

2.2 Data Analysis Method

This research is a quantitative descriptive study with a cross sectional research design, namely research that aims to explain phenomena in the form of numbers that indicate the characteristics of the research object using data obtained from observations and surveys.

Data collection techniques using observation and questionnaires in the form of multiple questionnaires, namely open and closed questionnaires. The open questionnaire contains questions related to individual factors that cause MSDs complaints (age, gender, body mass index, years of service, smoking habits and physical fitness) where this data is only as supporting information for the study and closed questionnaire using the Nordic Body Map questionnaire [11]. Observational data are related to biomechanical factors that cause MSDs complaints (work posture, transport load, frequency of repetitive work and duration of work) [13]. [19] The data analysis method uses descriptive statistics and specifically the

observation data of biomechanical factors will be analyzed using Rapid Upper Limb Assessment (RULA) methods with the help of the Ergofellow 2.0 application.

2.3 Rapid Upper Limb Assessment (RULA)

The Rapid Upper Limb Assessment (RULA) is an observational tool to assess the impact of posture on the upper extremity and spine, as well as the assistance required from the lower extremities to cope with the extra load during work [12]. The RULA score ranges from one to seven, with higher scores indicating a greater likelihood of a musculoskeletal problem. If the RULA score is five or higher, it is recommended to change posture during work to avoid potential health issues. [19] The RULA worksheet consists of two sections labeled A and B, which correspond to different body segments. Section A (located on the left side) covers the arm and wrist, while Section B (located on the right side) covers the neck, trunk, and legs. This division ensures that any awkward or constrained postures of the neck, trunk, or legs that may affect the arm and wrist postures are taken into account during the assessment.

When evaluating the RULA worksheet, it's important to score Group A (Arm & Wrist) postures first, followed by Group B (Neck, Trunk & Legs) postures for both left and right. For each body area, there is a posture scoring scale and additional adjustments outlined on the worksheet that should be considered and factored into the final score.

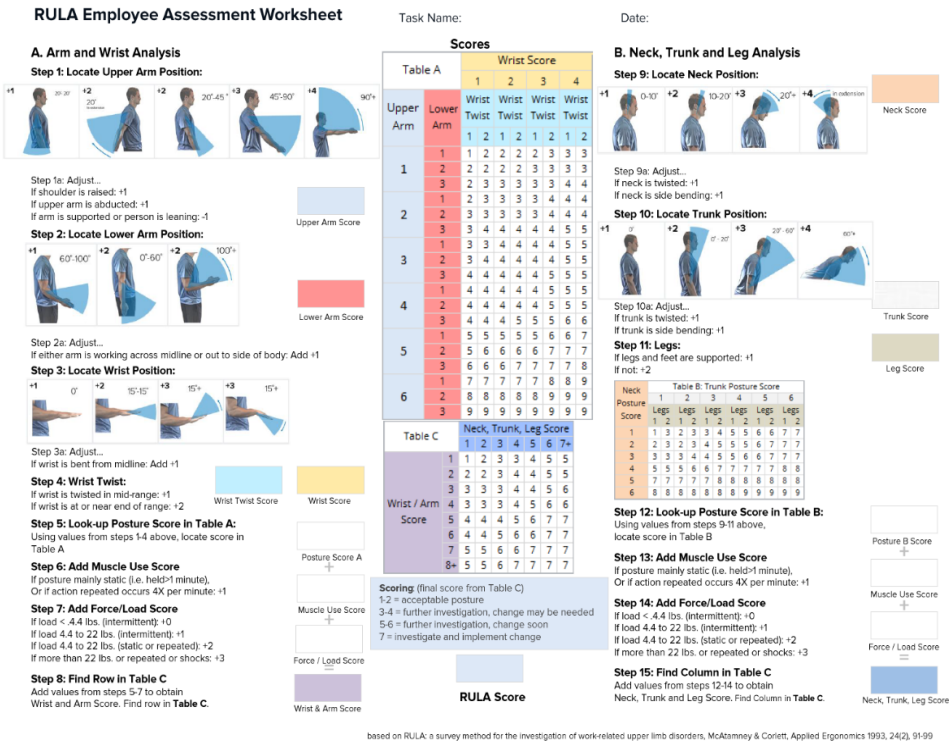


Figure 1. RULA Assessment Worksheet

This assessment comprises three sections that require completion (Figure 1): Tables A, B, and C [5]. Each table is responsible for calculating the score of the various components of the upper body [14]. The analysis is carried out in three sections, with each section focusing on a different part of the body to provide a comprehensive view of the worker's posture. . To complete the RULA worksheet, please follow the steps outlined below. [20] The first section, Section A, takes into account the upper arm, forearm, and wrist, which are adjusted to the picture above. The angle of the worker's activity is then analyzed, and the resulting score is grouped according to the score table A in the worksheet. This section provides crucial insights into the worker's upper body posture and the potential risks associated with it. The second section, Section B, focuses on the neck, back, and trunk. The same process is followed as in Section A, whereby scores are analyzed through worker activities and angles obtained through the activities carried out by workers. The resulting scores for the neck, back, and trunk are placed in table B in the worksheet. This section sheds light on the worker's spinal alignment and the potential risks associated with it.

Once the analysis of Sections A and B is complete, the information from both tables can be combined to arrive at the results of the Rapid Upper Limb Assessment (RULA) analysis. This analysis provides a comprehensive view of the worker's posture and identifies any areas where ergonomic improvements could be made to reduce the risk of workplace injuries. It should be noted that for sections A and B it is necessary to add the load lifted in the work activity, and the repetition of the activity [5],

If load <.4.4 lbs. (intermittent): +0

If load 4.4 to 22 lbs. (intermittent): +1

If load 4.4 to 22 lbs. (static or repeated): +2

If more than 22 lbs. or repeated or shocks: +3

In conclusion, by following the steps outlined above and conducting a thorough analysis of worker posture and body angles, it is possible to create a safer and more comfortable working environment for employees. The insights gained from this analysis can inform strategies for improving workplace ergonomics, reducing the risk of workplace injuries, and ultimately improving the overall health and well-being of workers.

Table 2. RULA MSDs Risk Level

Scor	RULA MSD Risk Level
1-2	Negligible risk, no action require
3-4	Low risk, change maybe Needed
5-6	Medium Risk, further investigation, change soon
6+	Very high risk, implement change now

3. Results and Discussion

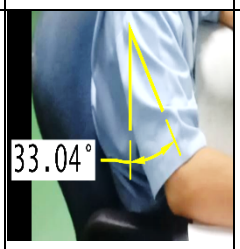
3.1 Rapid Upper Limb Assessment (RULA)

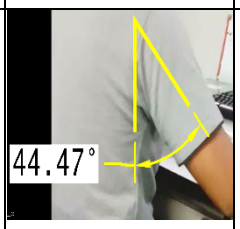
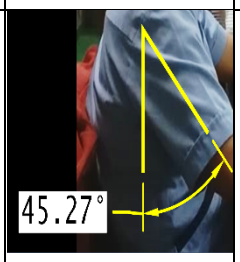
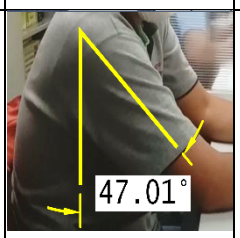
Ergonomic assessment is an important component to ensure worker safety and health. For this reason, Rapid Upper Limb Assessment (RULA) is used to conduct a thorough evaluation of biomechanical factors that can cause musculoskeletal disorders in workers. These factors include work posture, transportation load, repetitive work frequency, and work duration [2]. The Ergofellow 2.0 application was used to facilitate this assessment. The assessment focused on four workers who were observed working with static postures. The upper body of each worker was evaluated using RULA and Ergofellow 2.0. The results of the assessment were used to identify potential risk factors for musculoskeletal disorders. It is important to emphasize the importance of conducting ergonomic assessments to improve worker safety and health. The use of RULA and Ergofellow 2.0 is a prominent approach to identify and prevent musculoskeletal disorders in the workplace.

a. Assessment of workers' upper arm posture

Categories of upper arm posture assessment using the RULA method, namely: score 1 if the position of the upper arm is 20-20 ° forward or backward, score 2 if the position of the upper arm is 20-45 ° forward or backward, score 3 if the position of the upper arm is 45-90 ° forward, score 4 if the position of the upper arm is> 90 ° upwards +1 if the shoulder rises or the arm rotates and bends and -1 if the worker's position supports the weight of the arm. The results of measurements using AutoCAD of workers' upper arm posture are in Table below:

Table 3. Assessment of workers' upper arm posture

No.	Workers	Upper Arm Posture	Documentation	Upper Arm Complaints
1	Assistant Manager Warehouse	20-45° forward		No

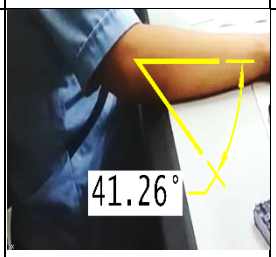
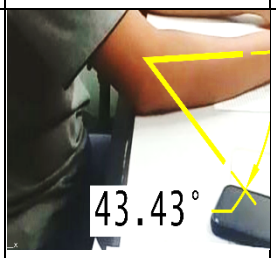
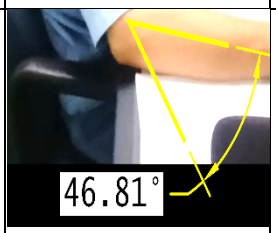
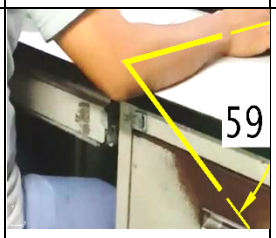
No.	Workers	Upper Arm Posture	Documentation	Upper Arm Complaints
2	Leader Warehouse	20-45° forward		No
3	Data Entry Warehouse	45-90° forward		No
4	Senior Leader Warehouse	45-90° forward		No

From the available data, it appears that there were no reported cases of musculoskeletal ailments among the workers, despite their upper arm posture ranging from 20-90° forward. This leads us to believe that such arm positions within that range may not have a significant impact on the development of musculoskeletal issues in the upper arm among the workers observed.

b. Assessment of workers' lower arm posture

The categories of lower arm posture assessment with the RULA method, namely: score 1 if the position of the forearm is 60-100° upwards, score 2 if the position of the forearm is 0°-60° upwards or >100° and + 1 if the forearm is working across in front of the body or next to the body. The results of measurements using AutoCAD of workers' forearm posture are in Table below:

Table 4. Assessment of workers' lower arm posture

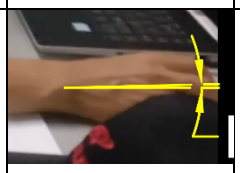
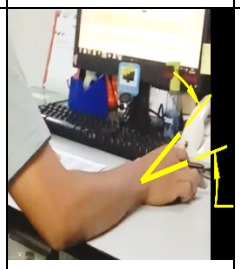
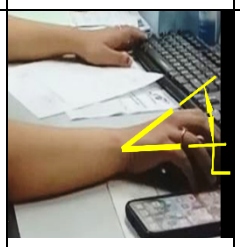
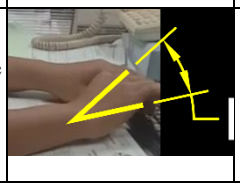
No.	Workers	Lower Arm Position	Documentation	Lower Arm Complaints
1	Assistant Manager Warehouse	0°-60° upward		No
2	Senior Leader Warehouse	0°-60° upward		No
3	Data Entry Warehouse	0°-60° upward		No
4	Leader Warehouse	0°-60° upward		No

All of the workers, without exception, maintained a consistent forearm posture within the range of 0° to 60° above horizontal. This indicates a complete lack of variation in the position of their forearms, which were held in the same manner by each worker.

c. Assessment of workers' wrist posture

The assessment categories of wrist posture with the RULA method, namely: score 1 if the wrist position is 0 °, score 2 if the wrist position is bent 0-15 ° up or down, score 3 if the wrist position is bent > 15 ° up or down and +1 if the wrist deviates. The results of measurements using AutoCAD of workers' wrist posture are in table below:

Table 5. Assessment of workers' wrist posture

No.	Workers	Wrist Posture	Documentation	Wrist Complaints
1	Assistant Manager Warehouse	0-15° upward		No
2	Leader Warehouse	>15° upward		Yes
3	Data Entry Warehouse	>15° upward		No
4	Senior Leader Warehouse	Deviating form the center line		No

From the information provided, there were variations in workers' wrist positions. Two out of four workers (50%) had a wrist position that was considered the most risky, which was more than 15° upwards. One worker (25%) had a wrist

position between 0-15° upward, and another worker (25%) had a position that deviated from the center line. Of the four workers, only two of them experienced MSDs complaints in the wrist. Both workers have wrist positions that are more than 15° upwards. Interestingly, this complaint was felt by the Warehouse Leader. The conclusion that can be drawn is that the wrist position that is considered the most risky (>15° and above) is in fact associated with MSDs complaints in the wrist. In fact, of the two workers who experienced the complaint, both had wrist positions in that category. In addition, the fact that this complaint was felt by the Warehouse Leader may indicate that her position or work activities may have contributed to the complaint.

d. Assessment of workers' wrist rotation

Categories of wrist rotation assessment with the RULA method, namely: score 1 if the wrist rotation is in the middle of the rotation and score 2 if the hand rotation is at or near the rotation. The results of observations of workers' wrist rotation are in Table below:

Table 6. Assessment of workers' wrist rotation

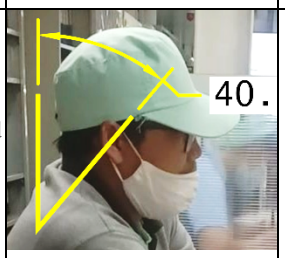
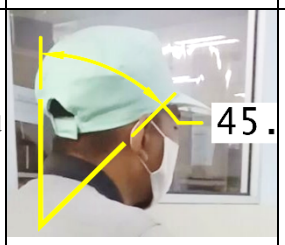
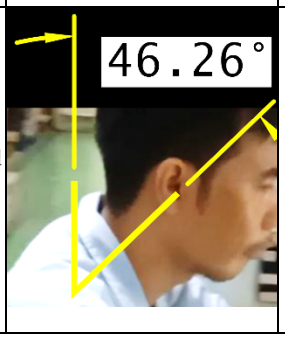
No.	Workers	Wrist Twist	Wrist Twist Complaints
1	Assistant Manager Warehouse	Wrist twist at the middle of the twist	No
2	Senior Leader Warehouse	Wrist twist at the middle of the twist	No
3	Leader Warehouse	Wrist twist at the middle of the twist	Yes
4	Data Entry Warehouse	Wrist twist at the middle of the twist	Yes

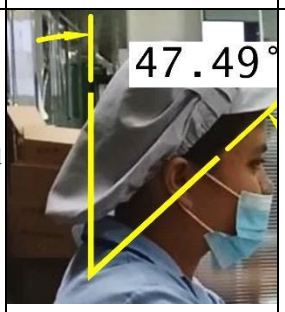
In the observed group of workers, it was consistently observed that each individual exhibited wrist rotation positioned precisely in the middle of the rotation, accounting for a 100% occurrence across all four workers. Out of the total four workers, it was noted that two of them experienced musculoskeletal disorder (MSD) complaints specifically related to the position of the wrist rotation in the middle of the rotation. Interestingly, both the Warehouse Leader and Warehouse Data Entry personnel reported these complaints.

e. Assessment of workers' neck posture

Neck posture assessment categories with the RULA method, namely: score 1 if the neck position forms an angle of 0-10 ° forward, score 2 if the neck position is 10-20 ° forward, score 3 if the neck position is> 20 ° forward, score 4 if the neck position looks back and +1 if the neck position rotates or tilts. The results of measurements using AutoCAD of workers' neck posture are in table below:

Table 7. Assessment of workers' neck posture

No.	Workers	Neck Posture	Documentation	Neck Complaints
1	Senior Leader Warehouse	>20° forward		Yes
2	Leader Warehouse	>20° forward		No
3	Assistant Manager Warehouse	>20° forward		No

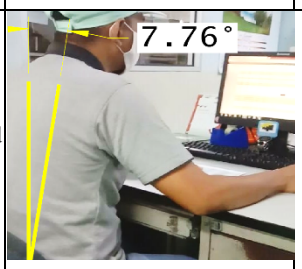
No.	Workers	Neck Posture	Documentation	Neck Complaints
4	Data Entry Warehouse	>20° forward		Yes

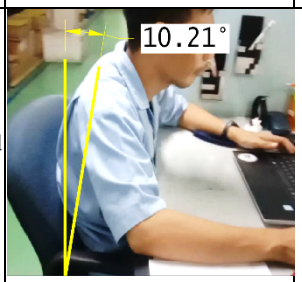
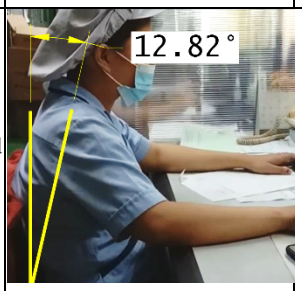
Based on the assessment above that all four workers had neck postures that tended to be more than 20° forward, creating consistency in this position among them. Of the total four workers, two of them, namely Senior Leader Warehouse and Data Entry Warehouse, experienced MSDs complaints related to neck postures that exceeded 20° forward.

f. Assessment of workers' back / torso posture

Back posture assessment categories with the RULA method, namely: score 1 if the back position is straight 0 °, score 2 if the back position is 0-20 ° forward, score 3 if the back position is 20-60 ° to the dezpan, score 4 if the back position is> 60 ° forward and +1 if the back position rotates or tilts. The results of measurements using AutoCAD of workers' back posture are in Table 8 below.

Table 8. Assessment of workers' back / torso posture

No.	Workers	Back Posture	Documentation	Back Complaints
1	Leader Warehouse	0-20° forward		Yes

No.	Workers	Back Posture	Documentation	Back Complaints
2	Assistant Manager Warehouse	0-20° forward		No
3	Data Entry Warehouse	0-20° forward		Yes
4	Senior Leader Warehouse	0-20° forward		Yes

The postures of all four workers were observed to be in the range of 0° to 20° forward, indicating consistency in their back position. However, two of the workers reported experiencing Musculoskeletal Disorders (MSDs) associated with this posture. These complaints were reported by the Senior Leader Warehouse, Leader Warehouse, and Data Entry Warehouse.

g. Assessment of worker foot posture

Foot posture assessment categories with the RULA method, namely: score 1 if the foot position is supportive and score 2 if the foot position is not supportive. The results of observations of workers' foot postures are in Table 9 below:

Table 9. Assessment of worker foot posture

No.	Workers	Leg Posture	Leg Complaints
1	Senior Leader Warehouse	Supportive position (relaxation)	Yes
2	Senior Leader Warehouse	Supportive position (relaxation)	Yes
3	Data Entry Warehouse	Supportive position (relaxation)	No
4	Assistant Manager Warehouse	Unsupportive position	No

Assessment revealed that 75% of them had a supportive foot posture, indicating a state of relaxation, while the remaining 25% had an unsupportive foot posture. Among the four workers, two of them reported experiencing musculoskeletal disorders (MSDs) associated with a supportive, relaxed foot posture. Specifically, the Senior Leader Warehouse and the Leader Warehouse complained of such disorders. These findings are of great significance as they highlight the need for employers to take measures to ensure that their workers maintain a healthy posture and avoid the risk of work-related injuries.

h. Addition of muscle usage values

Muscle use assessment categories with the RULA method, namely: score 1 if the posture is static, holding > 1 minute or repetition of movements 4 times / minute. The results of observations of workers' muscle use are in Table 10 below:

Table 10. Addition of muscle usage values

No.	Workers	Muscles Use	MSDs Complaints
1	Assistant Manager Warehouse	Static Posture	No
2	Senior Leader Warehouse	Static Posture	Yes
3	Leader Warehouse	Static Posture	Yes
4	Data Entry Warehouse	Static Posture	Yes

It is known that all workers have a static posture, namely 4 workers (100%). One of them are having MSD's complaints.

i. Addition of transport load values

Categories of load and force assessment with the RULA method, namely: score 0 if the transport load is <2 kg, score 1 if the transport load is 2-10 kg, score 2 if the transport load is 2-10 kg with repetition and score 3 if the transport load is >10 kg with repetition. The results of observations of worker loads and forces are in Table 11 below:

Table 11. Addition of transport load values

No.	Workers	Loads /	MSDs Complaints
1	Assistant Manager Warehouse	<4.4 lb	No
2	Senior Leader Warehouse	<4.4 lb	Yes
3	Leader Warehouse	<4.4 lb	Yes
4	Data Entry Warehouse	<4.4 lb	Yes

It has been observed that among a group of four employees, three of them have reported complaints of MSDs while carrying a load of less than 2 kg. Specifically, the Senior Leader Warehouse, Warehouse Leader, and Data Entry Warehouse employees have reported these complaints. This information may be of importance to the business or academic setting for the purpose of addressing workplace safety concerns.

j. Final score of worker assessment

After going through a series of biomechanical factor assessments using the RULA method, the following assessment results are in the form of a final score for each worker in Table 12 below.

Table 12. RULA score results on workers

No.	Workers	Result RULA Score	Risk Level	Action
1	Leader Warehouse	4	Low	Changes may be required
2	Data Entry Warehouse	4	Low	Changes may be required
3	Assistant Manager Warehouse	5	Moderate	Investigate further and make changes immediately

No.	Workers	Result RULA Score	Risk Level	Action
4	Senior Leader Warehouse	6	Moderate	Investigate further and make changes immediately

The collected data reveals that the risk levels among workers in different work sections vary significantly. Workers in the Leader and Data Entry work sections have been identified as having a low-risk level while those in the Assistant Manager and Senior Leader categories have been placed in the medium risk level category. During the RULA assessment, two workers, accounting for 50% of the workers, scored in the low-risk level category with a score of 3-4. However, the other two workers, also accounting for 50% of the workers, scored in the medium risk level category with a score of 5-6, indicating an immediate need for further investigation and changes. This report highlights the importance of identifying risks in the work environment to minimize potential risks to workers' health and safety. The discrepancies in risk levels between work sections emphasize the need for appropriate measures to reduce risks for workers with higher risk levels. The data from the assessments are clear indicators of the need to take action to reduce the risk of injury and illness among workers in order to create a safer and healthier work environment. Complaints related to MSDs have been reported by male employees, specifically the Senior Leader and Leader of the Warehouse team. On the other hand, female employees working in the Data Entry Warehouse have filed any complaints. It is important to note that women have less muscle strength than men, with only about two-thirds of the muscle strength and capacity of men. This factor is relevant when assessing the risk of MSDs. It is essential to address the risk of MSDs in the workplace, particularly in relation to the physical demands of the job. Moreover, workers who have MSDs complaints with neutral body position and static posture as many as 3 workers namely Senior Leader Warehouse, Leader Warehouse and Data Entry Warehouse, workers who have a neutral body position and dynamic posture. MSDs complaints were owned by workers with normal body mass index, namely Senior Leader Warehouse, Leader Warehouse, Data Entry Warehouse.

Table 13 Result of RULA and Nordic Body Map Questionnaire

Job Position	Body Mass Index	Repetitive Work	MSDs Symptom	RULA Results	Nordic Body Map Results
Assistant Manager Warehouse - 43 years old - Male - Working experience : 12 years	Normal	3 times	No Evidence	**Moderate**	**Low (28)**

Job Position	Body Mass Index	Repetitive Work	MSDs Symptom	RULA Results	Nordic Body Map Results
Senior Leader Warehouse - 36 years old - Male - Working experience : 9 years	Normal	3 times	- Neck - Back - Waist - Knee	**Moderate**	**Low (32)**
Leader Warehouse - 32 years old - Male - Working experience : 8 years	Normal	4 times	- Waist - Wrist - Calf	**Low**	**Low (33**
Data Entry Warehouse - 24 years old - Female - Working experience : 11 months	Normal	50 times	- Neck - Back - Waist - Hand	**Low**	**Low (33)**

MSD complaints have been reported by male employees such as the Senior Leader and Leader of the Warehouse team, while female employees, particularly those working in Data Entry Warehouse, have not filed any complaints. It is important to note that women have less muscle strength than men, with only about two-thirds of the muscle strength and capacity of men. This is a relevant factor when assessing the risk of MSDs. To evaluate the risk of MSDs, the RULA method was used to measure the work posture of the employees. According to the results, 50% of the workers, including the Leader of the Warehouse team and the Data Entry team, scored 4, indicating a low-risk work posture. The other 50% of workers, comprising the Senior Leader of the Warehouse team and the Assistant Manager of the Warehouse team, scored 5, indicating a moderate level of risk.

It is essential to address the risk of MSDs in the workplace, particularly in relation to the physical demands of the job. This includes ensuring that proper ergonomic practices are in place, taking into account the individual needs and abilities of both male and female employees, to prevent potential injuries and long-term health issues.

4. Conclusion

The conclusions obtained based on the results of the research as follows :

The research conducted on four samples of warehouse workers revealed that three out of four respondents experienced musculoskeletal disorders (MSDs), with the most common complaints being aches or pains in the neck, back, and wrists. The Nordic Body Map questionnaire was used to gather data from each worker, which described the location and severity of their symptoms. The RULA method showed that 50% of the respondents had a moderate risk level for MSDs, indicating the need for further investigation and necessary changes as soon as possible. This was based on the angles of the activities performed by the workers in the warehouse, which highlighted potential risks related to their postures or movements. It is crucial to understand the body angles and positions needed when performing warehouse work. Research shows that repetitive activities can negatively affect workers' physical health, such as prolonged sitting and repetitive movements when using computers for data entry or administrative tasks, which can cause stress on the neck, back, and wrists. In addition, warehouse leaders are also at risk of MSDs, albeit to a different degree.

The nature of their work, which involves moving goods or coordinating activities, may increase their risk. However, workers who have leader duties also exhibit certain symptoms that require ergonomic attention. To reduce the risk of MSDs in the warehouse, a comprehensive approach is necessary, including a review of the warehouse layout, equipment used, and ergonomics training for all workers. Changes in work practices, such as task rotation, scheduled breaks, and equipment that supports better posture, can also reduce the risk of more severe musculoskeletal injuries or disorders in the future [16]. Immediate preventive action is necessary to reduce adverse impacts on worker health and improve productivity and quality of work in the warehouse environment. This emphasizes the importance of paying attention to ergonomics in the design of jobs and the overall work environment. [18]

5. Suggestion

In order to obtain a comprehensive health assessment of employees working in a warehouse environment, it is suggested that the Nordic Body Map Questionnaire and medical check-up methods be augmented with additional elements. Firstly, it is important to include more detailed inquiries in the Nordic Body Map questionnaire pertaining to the intensity, frequency, and duration of the musculoskeletal symptoms experienced by the workers. This can aid in determining the extent to which the symptoms impede their daily activities. [2]Furthermore, to supplement the medical tests, a more extensive physical examination of the body parts that are most commonly affected by symptoms, such as the neck, back, and wrists, should be conducted. This should involve evaluating the posture, joint mobility, and muscle strength, as well as undertaking a more thorough appraisal of any anomalies or injuries that may have occurred. Additionally, in order to expand the research, it would be advantageous to merge the RULA (Rapid Upper Limb Assesment) with the

REBA (Rapid Entire Body Assessment) method. REBA enables a thorough evaluation of the risk of musculoskeletal injury by taking into account the worker's body position, strength, and activity in a more comprehensive manner. As such, the use of REBA can provide greater insight into potential risks that other methods may overlook.[4][5]

The combination of the Nordic Body Map, detailed medical examination, and the use of the REBA method can provide a more comprehensive understanding of the health status of workers in the warehouse. The data gathered from these three methods can be used to develop more precise and measurable recommendations regarding necessary changes in the work environment, task organization, ergonomics training, or modification of work aids.[4]

By integrating these methods, future research will be able to provide a more thorough and detailed view of the risk factors and specific measures that can be taken to reduce the risk of MSDs in the warehouse work environment. This will provide a stronger foundation for companies to implement more effective strategies to maintain the health and well-being of their employees and enhance productivity in the workplace.

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