Ergonomic Assessment for a Convenience Store Assistant

Nor Suhada Abdullah, Koay Mei Hyie, Siti Nur Amalina Mohd Halidi, Hamid Yusoff, Ahmad Sufian Abdullah, Halim Ghafar, Aliff Farhan Mohd Yamin
Faculty of Mechanical Engineering,
Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh
Pulau Pinang, Malaysia
norsuhada2319@uitm.edu.my, koay@uitm.edu.my, sitinur6182@uitm.edu.my, hamidyusoff@uitm.edu.my, ahmadsufian@uitm.edu.my, halim4346@uitm.edu.my, aliff.farhan6205@uitm.edu.my

Abstract

Nowadays, many workers were faced with the increasing incidence of Work-related Musculoskeletal Disorders (MSD); the industries had taken multiple initiatives to reduce the risk by design the mechanical machine or supportive tool based on ergonomic criteria. In this context, the current study has been carried out in groceries shop at where most of workers were continuously exposed to MSD risk factors (e.g. repetitive manual tasks and awkward postures) and suffering from some kind of musculoskeletal complaint. The main objective of the current study was to evaluate ergonomic risk referred manual handling. In addition, the goal for this study is designing a specific tool to ease the workers and reduce risk. The methods used to evaluate the risk are RULA and REBA assessment. The scores of REBA for all the workers are 10, 9 and 8 respectively while the RULA score is 7 for all workers. Besides, the intensity of work related injury was assessed using NIOSH Lifting Index. The workers score higher values for lifting index. The results showed that the ergonomic interventions are essential to reduce the mismatch between workers and workstations physical conditions, contributing to the postural correction and, consequently, to the MSD prevention.

Keywords
RULA, REBA, NIOSH Lifting Index

1. Introduction

Ergonomic is one of the significant aspect should be focus by all the employer and employee. Many industries overlook the seriousness of the ergonomic risk, which may cause a long term disability. In order to know the ergonomic risk, the definition of ergonomic must be comprehended. The definition of ergonomic is scientific understanding of interface among humans and other elements such as the way of work and technology of a system, the career that utilizes theory, principles, data and methods to design in order to improve human well-being and overall system performance (International Ergonomic Association, 2019). Ergonomic is also known as human factor.

Ergonomic are needed to accomplish the law of Occupational Safety and Health Act (OSHA) and maximize the productivity of industry. Ergonomic had been focused by OSHA to reduce the occupational injury and risk among workers related to the ergonomics. It gives many benefits to the workers, production line and the company itself. Many organizations had conducted training for employer and employee to make them realized the present of occupational injury and ergonomic risk.

Ergonomic risk had been taken seriously in the other countries. The statistic of the workers that had been affected by ergonomic risk is increasing rapidly every year among the workers. The specific organization was formed to make a

research on the consequences of ergonomic risk, the way to overcome it and monitoring the risk for the benefit of future generation, such as OSHA and International Labor.

Ergonomic risks in Malaysia are popular among workers. Every year shows the increasing pattern for musculoskeletal Disorder (MSD) and Occupational Diseases (OD) due to the unbalance posture body of worker and uncomfortable workplace for the worker. According to Social Security Organization (SOCSO), Figure 1 shows number of MSDs and cases related to manual handling activities increase from 2009 to 2014. This contributes to the increase of total compensation cost to the employees (Department Occupational Safety and Health Ministry of Human Resources, 2018).

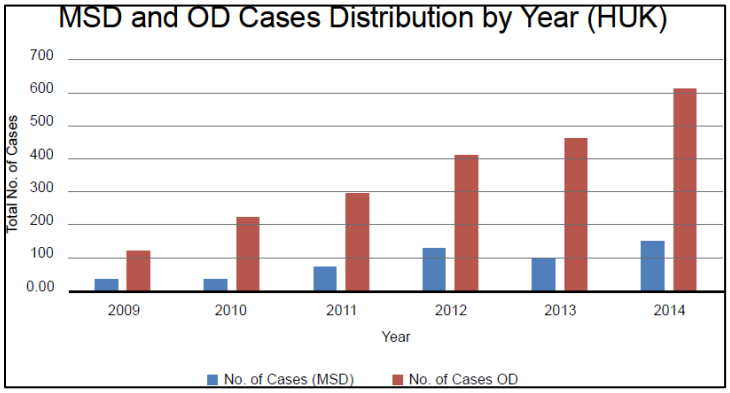

Figure 1: Statistic of MSD and OD cases in Malaysia according to SOCSO

The industry requires innovate solutions. The best solution is to redesign and reconstruct the workplace based on ergonomic act and guideline developed by OSHA. Thus, it can reduce the case for the problem. The data to be gathered in this study may provide a solution on how to reduce, overcome or avoid ergonomic risk.

In a recent study on the awareness of ergonomics and the identification of frequently used ergonomics programs in manufacturing industries using quality functions in Malaysia (Shaliza, 2009), the researcher discovered that:
• 35.6% of Malaysian manufacturing industries have a high level of ergonomic awareness.
• 51.1% moderate level.
• 13.3% having low level of ergonomic awareness.
• 62.2% of respondents agreed that organized ergonomics team will help to improve the awareness of ergonomics.

Previous study (Hemani, 2017) stated that it is not just poor local educational emphasis but also poor corporate education and training that contribute to the low ergonomic awareness in Malaysia. In order to enhance the awareness among workers, ergonomic programs should be implemented in manufacturing industry. Ergonomics program is a systematic process for anticipating, identifying, designing, developing, analyzing and controlling ergonomic risk factors to ensure the health and safety of the workers.

This study is focusing on manual handling among groceries shops' worker. Normally, the workers at the groceries shops having a trouble when involve lifting heavy object. The body posture and the technic they use are leading to the risk related work. Back and neck pain is the product of ineffective procedures, as it puts so much tension on the muscles and joints of the body. A worker has been advised to take a break to prevent accidents and other health problems because overworking puts excessive stress on the heart and wears out muscles, leading to injuries. The weight of object they lifted in conducting manual handling tasks does not follow the weight lifting guideline.

1.1 Objectives

This study is being conducted based on the following objectives:

a) To evaluate the ergonomic risk of worker at groceries shop.
b) To design a new tool that can reduce ergonomic risk of worker.

2. Literature Review

Ergonomic is a significant aspects that should be focus by industries to make sure their workers safe and comfortable at the workplace. Occupational Safety and Health Association (OSHA) has considered ergonomic of worker at workplace and create an act as a guideline for industries to make a safer and friendly workplace. The definition of ergonomic is scientific knowledge of the interaction between humans and other components, such as the device technologies used or the working methods. It is also scientific understanding of career that uses theory, concepts, data and design methods to enhance human well-being and the overall performance of the system (International Ergonomic Association, 2019). According to the definition, it is clearly shows that ergonomic aspect covered from the beginning of work until the end of work for a day.

The ways of work by a worker and interface among human and technology can lead to occupational injury or ergonomic risk. All industries should not take it for granted about the risks and injuries happened for the workers at a workplace. The industries should take it as a serious matter and overcome it at any cost for the beneficial of workers and industries. By trying to remove or at least reduce the risk factors involved, the adverse health consequences of manual handling may be avoided.

In other study shows that workers in different industries and occupations can be exposed to risk factors at work, such as lifting heavy item, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures and performing the same or similar tasks repetitively (United States Department of Labor, 2013). Awkward postures also contribute to musculoskeletal disorder (MSD) where MSD affects industry workers about 1% of the U.S. population chronically disabled as a result of lower back, neck or shoulder pain (Ardalan, 2016). Besides that, monotonous repetitive task is one of the factors that led to MSD (Alwain, 2003).Twisting body during working lead to injuries and contribute to discomfort. Muscle twitch force showed a significant fatigue after standing work persisted beyond 30 minutes after the end of the work (Bernard et. al, 2015).

RULA is the best method to identify and evaluate the risk injury of workers at workplace. This method is focusing on upper body and risk injuries related to upper body of workers. The main way to conduct this method is through an observation of worker while they doing their job at the workplace. The survey form was filled base on the worker's posture when doing their job. Based on the journal, RULA is a tool in survey form to identify occupations, which can cause cumulative trauma disorder (CTD) through body posture, muscle load and muscle exertion. This tool is a detailed platform for testing worker's tendency to risk injuries posture, muscle load, muscle exertion and movement when doing their job. This method uses posture body diagram in determining the evaluation of injury risk factors (Ken, 2019).

RULA form (as shown in Figure 2) should be filling according to the working style of the worker to observe the postures during working. The main analysis in this method is arm and wrist analysis at table A (as shown in Figure 2) and trunk posture score at table B (as shown in Figure 2) in RULA Assessment form. The final score can be determined by using table C (as shown in Figure 2). If the final score is 1 or 2(as shown in Figure 3), the workplace can be acceptable and safe for the workers. For 3 or 4 total score (as shown in Figure 3), the company may investigate further to reduce the risk at workplace. The industries should investigate further and change soon for 5 and 6 (as shown in Figure 3) score but for the total score more than 6, the industries must implement change for a better workplace and low risk working postures.

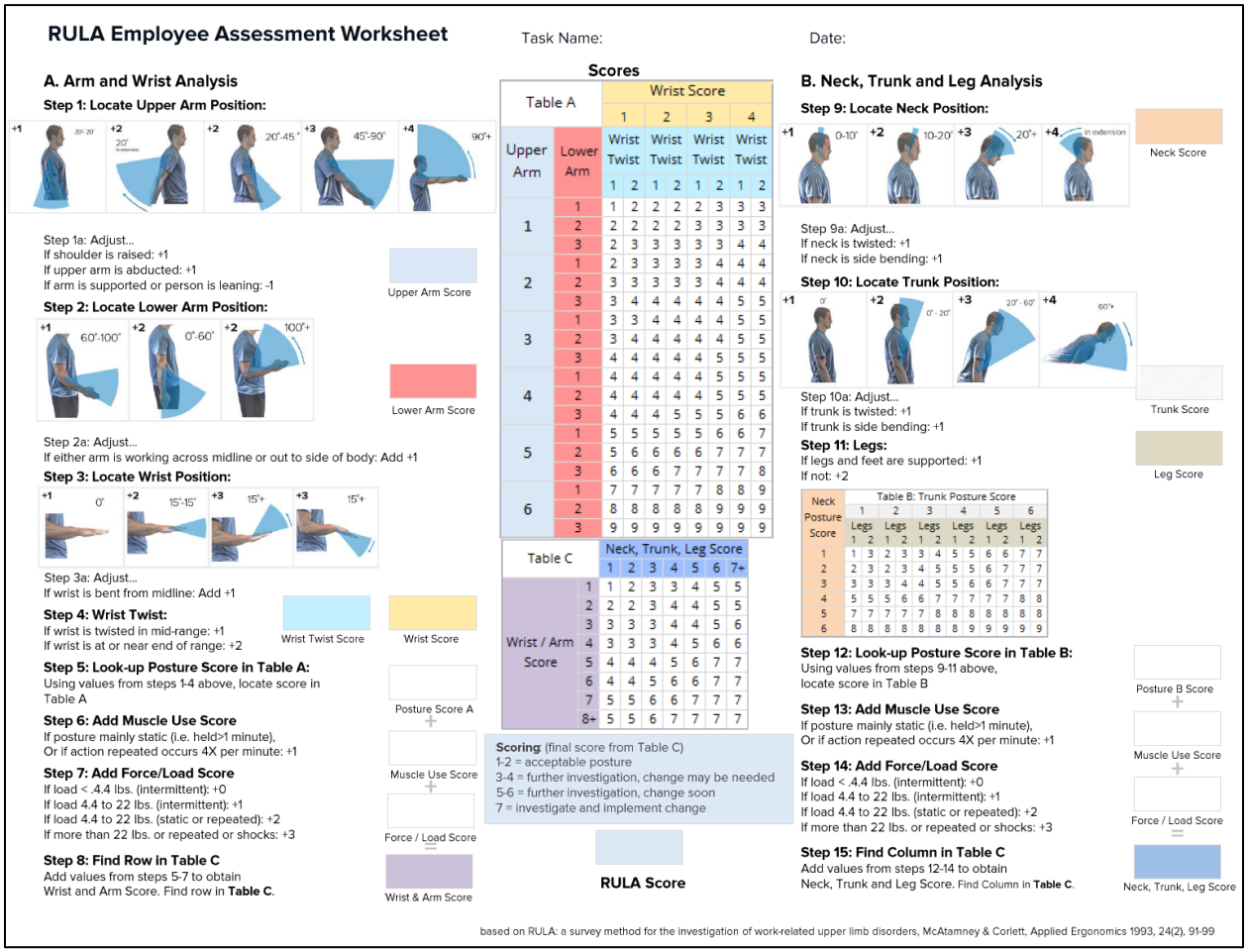

Figure 2. RULA Assessment Worksheet

Score	Level of MSD Risk
1-2	neglibible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

Figure 3. RULA score that represents the level of MSD risk

REBA is a common tool used for various occupation and work. REBA is a method more focusing on the whole body of a worker. It has been developed to fill a perceived need for a researcher's and practitioner's field tool. It is developed specifically designed to be sensitive to the type of unbalanced working posture found in health care and other services industries. REBA assessment sheet (as shown in Figure 4) is used to ease the measurement and evaluation of the risks associated with working posture as a part of ergonomic workload (Adam, 2019).

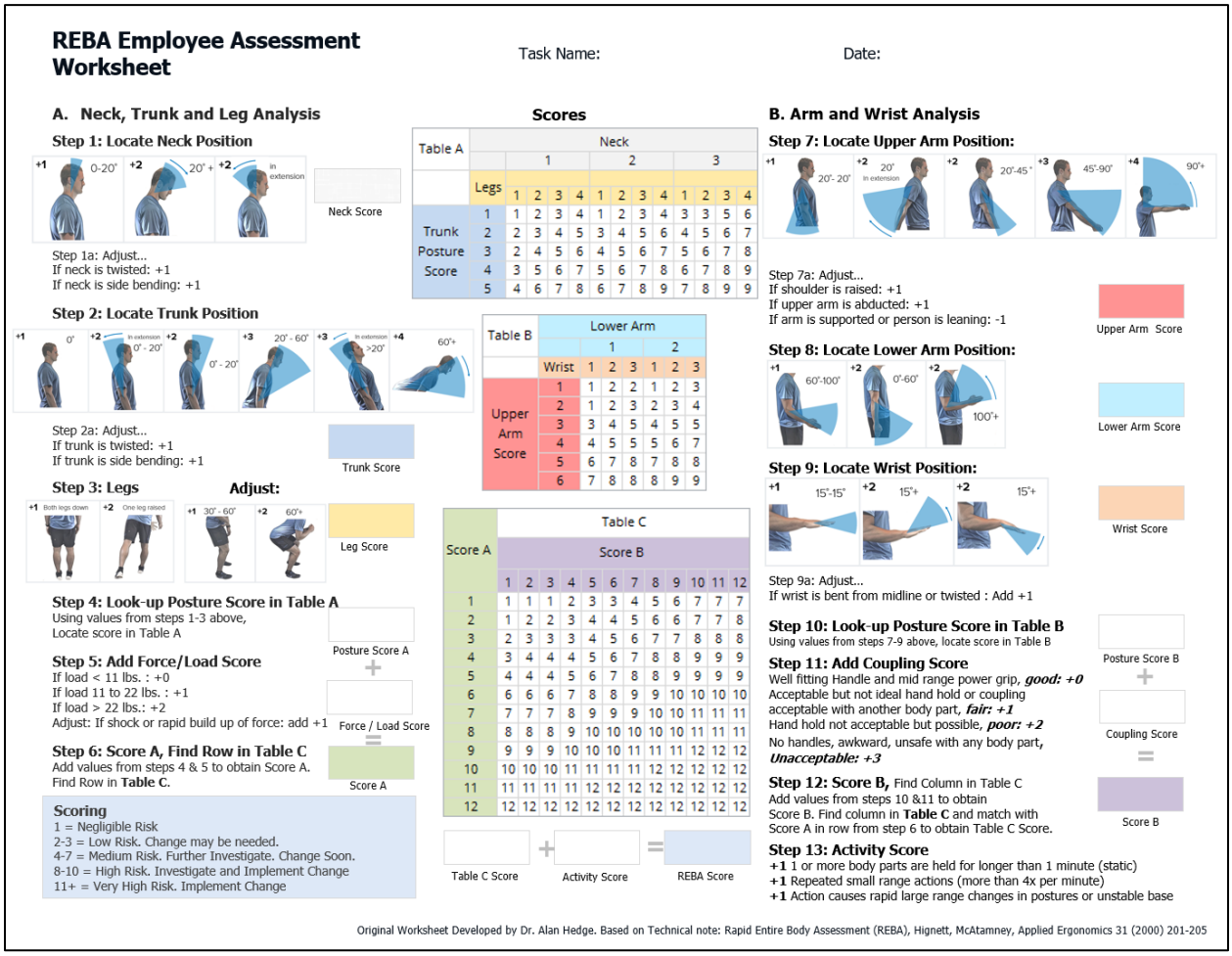

Figure 4. RULA Assessment Worksheet

Observation made based on the working pattern of the workers. The main analysis for this method is neck, trunk and leg analysis at table A (as shown in Figure 4) and arm and wrist analysis at table B (as shown in Figure 4). From the score at table A and table B, the score for table C (as shown in Figure 4) can be determined. Table C score and activity score must be sum up to get a final score (as shown in Figure 5) in order to determine next action taken by the organization or industries.

Score	Level of MSD Risk
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7	medium risk, further investigation, change soon
8-10	high risk, investigate and implement change
11+	very high risk, implement change

Figure 5. REBA score that represents the level of MSD risk

The final score of RULA and REBA shows the rate of ergonomic risk could happen. According to Annual Report by (Social Security Organization, 2016), the workers that had faced occupational injury in manufacturing industry are 12401 for male and 3367 for female. This statistic shows high rate of ergonomic risk in manufacturing industry in Malaysia.

Furthermore, the OSHA used NIOSH Lifting Equation as a tool to assess the manual material handling risks associated with lifting and lowering tasks safe lifting practices and guidelines (Middlesworth, 2012). The Weight Limit recommended is the primary product for this tool. In other words, for all safe employees the maximum allowable weight (load) could lift during an 8-hour shift without raising the risk of MSD to the lower back. The lifting index value indicates the level of reduced risk of damage to the back. The value of less than 1 shows the workers the nominal risk. If the values are more than 1, the workers can be at high risk from the activities.

CATIA demonstrates the importance and coherence of emerging technology, materials, equipment, innovative methods and information resources that allow the use of starting materials more effective to achieve lower costs (Rozmarina, 2014) where the tools to aided the workers designed.

3. Methods

There are several methods used to obtain data and information also the dimensions of the workspace used by the convenience store assistants.

3.1 Observation

This method is necessary to observe the environment of workplace. There are many aspects should be considered at the workplace related to the ergonomic. The following are the aspects we need to know by observation:

a) The area of workplace.
b) The length between to rack
c) The length of route during restock stuff
d) The arrangement of workplace
e) Workplace condition
f) The heavy goods or item at the shop

3.2 Measurements

Measurements were recorded in centimeter (cm). The following are the descriptions of tools used for measurements:

a) Masking tape: used as a guide to measure the longest route for the worker from store to rack.
b) Tape rule: a flexible tape rule made of steel and calibrate in centimeter with a maximum capacity of the scale was 300 cm.

3.1 RULA

RULA assessment form is a form to evaluate the value of their working style. RULA assessment form is focus on upper body posture. In order to use this method, the guideline should be known at the first place. The different scoring of their working style gives different result. The scoring of 1 or 2 point means acceptable posture and the working style can be used in future. This working style do not has high risk and difficult to get injured related ergonomic for a long term period. The point of 3 or 4 needs further investigation on working style or workplace. Some changes in working style or workplace may be needed to prevent long term risk. The scoring of 5 or 6 is just like the point of 3 or 4. The investigation is needed and the changes should be applied soon. However, the point of 7 means the investigation needs to be done as soon as possible and implement changes immediately.

3.1 REBA

REBA assessment form is quite similar with RULA assessment form. REBA assessment focused on the entire body posture. It consists of three tables to evaluate the body posture. The final score can be determined based on the values of table 1 and 2 of REBA assessment form. The value of final score of 1 means the risk can be negligible. The score of 2 or 3 is at small risk while, 4 to 7 means medium risk. Both categories need to change workplace or working style soon. The score more than 8 point are at a high risk and need to change immediately.

3.1 Lifting Index

This method is used when the worker involve in lifting an object. There are a few parameters should be considered in order to use it. The following are the parameters to be determined:

a) H: Horizontal location of the object to body (length)
b) V: Vertical location of the object to the body (length)
c) D: Distance the object move vertically
d) A: Asymmetric angle or twisting requirement

All the parameters can be measured from the worker's working postures. Besides, the value is the beginning step to used NIOSH Lifting Index. The value get from the measurement can be used to determine the following values:

Horizontal multiplier (HM): (25/H)
Vertical multiplier (VM): (1 – (0.003|V – 75|))
Distance multiplier (DM): (0.82 + (4.5/D))
Asymmetric multiplier (AM): (1 – (0.0032A))
Frequency multiplier (FM): refer table
Coupling multiplier (CM): refer table

Recommended Weight Limit (RWL) is the primary product for this tool. In other words, the maximum acceptable weight (load) for all the healthy workers could lift during an 8 hour shift. The equation for RWL is:

$$RWL = LC \times HM \times VM \times DM \times AM \times FM \times CM$$

Lifting index can be identified using the formula:

$$LI = \text{Weight} / RWL$$

Lifting Index value shows the level of the lower back injury. The value of less than 1 indicates the nominal risk to the workers. If the values are more than 1, the tasks may cause high risk for the workers.

4. Results and Discussion

4.1 Observations and Interviews

The statistical of the workers presented in Table 1. The age of the worker at shop A is the youngest among them. The other shop workers is more than 40 years old. The working experience of worker at shop A is in the range of 1 to 2 years while the workers at shop B and C are more than 5 years. The numbers of workers in each shop are 1, 2 and 3 respectively. Shop A usually restocks their product 1-2 times in a week and the other shops take 3-4 times in a week to restock their product. All the workers at each shop has experience injuries or diseases at the workplace but they did not realize the causes of their injuries or discomfort.

Table 1. Data from observation and interview

Shop	A	B	C
Age	20-29 years old	40-49 years old	50-59 years old
Working period	1-2 years	>5 years	>5 years
Worker/s per shop	1	2	3
Restock goods per week	1-2 times	3-4 times	3-4 times
Experienced injury	Yes	Yes	Yes
The causes of the injury	No	No	No

4.2 Body Postures

The lifting technique of the workers can affects their entire body. The wrong technique can easily got injured-work injury. Awkward posture will lead to MSD. The results from the observation shown in Figure 6. All three workers from three convenience store shows awkward postures during lifting and arranging the goods in the store.

(a) (b) (c)

Figure 6. The working posture of worker from (a) shop A, (b) shop B and (c) shop C.

According to Health Safety Executive, 2016, the correct technique to lift an object is starting from the below then lift it. The leg must be bending according to the level of load. If the load is at the floor, the leg should bend with comfortable to the worker to avoid awkward posture. Then, the leg will slowly rise with the load. The load will support more on leg than arm. The load must be close to body while lifting it.

The workers have difference in ages and working experiences. Usually, increasing in age can easily get injured. However, for manual handling, the age did not affect much. The wrong technique and exceed weight limit of the worker capability will lead to risk injury. The good technique can reduce the risk faced by the worker. Besides, it will decrease the time duration on working and increase the productivity for production company.

In this study, it will reduce time consume by the worker on manual handling task. Wrong technique will lead to risk with long term disability. The workers say once they got injured-related work; it will easily get the injury again.

4.3 Evaluation of REBA Assessment

REBA assessment is used to evaluate the risk at workplace and working style. REBA assessment will focus on the upper body posture of the participant. The result of REBA assessment was presented in Figure 7.

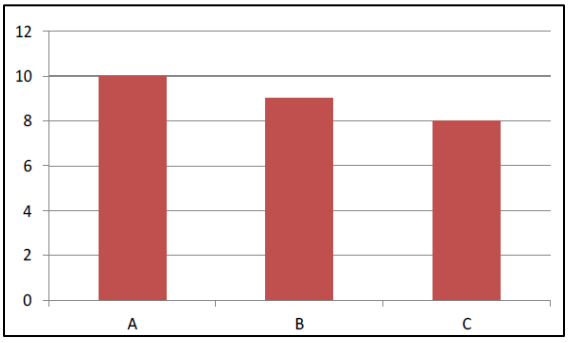

Figure 7. REBA result for all shops

The score of all shops for REBA assessment form are 10, 9 and 8 respectively. Based on figure, it shows the worker at shop A has the highest risk. Based on the REBA assessment scoring method, the values of 8 to 10 is not suitable

place for the worker. The workers will expose to the high risk and get injury easily. The workplace needs to be investigated and implement change for the better condition to make sure the workers are in good environment at workplace.

The high value of the REBA assessment is affected from the position of trunk and leg. These two body parts are in awkward body posture during lifting the load. The trunk position is bending with the range of 20 to 60 degree of angle. Hence, the back body of the worker will suffer from pain. Besides, the load does not have handle. Thus, it will give a bad handling posture for the worker to carry the load in long distance.

The workers do not take serious about on the technique of lifting and carrying the load. Good technique can reduce lower back pain. When lifting the load, the leg should bend to get a comfortable posture. The leg is push upward to reduce the risk.

4.4 Evaluation of RULA Assessment

The result of RULA assessment was presented in Figure 8.

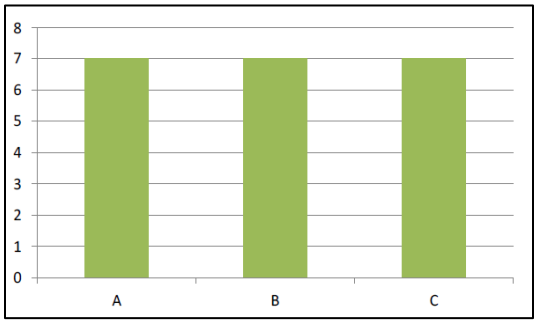

Figure 8. RULA result for all shops

All shops got the same value which is 7. This values show that their workplace and working posture are exposed to risk. The investigation on ergonomic aspect needs to carry out to know the root of the problem and solution. They need to implement some changes to their working posture.

The high value of the workers in RULA assessment form is affected from position of arm and trunk. The position of upper and lower arm for those workers got the same score based on the current body posture. The awkward body posture can lead to muscle pain with the load exceed the standard limit.

In manual handling task, the weight limit for the worker whether men or women should understand the standard weight guideline. According to Health Safety Executive, 2016, the maximum weight for man is 25 kg with knuckle height and minimum is 5 kg at mid lower leg and shoulder height. The maximum weight for woman is 10 kg at knuckle height and 3 kg at mid lower leg and shoulder height. The wrong perspective of people is they lift the object from bottom with 25 kg in weight for a man and 10 kg for a woman. Because of that, they will easily get injured. The maximum weight they should lift from the floor is 5 kg for man and 3 kg for woman even though they lift at knuckle height or elbow height.

4.5 NIOSH Lifting Index

NIOSH Lifting Index can be applied to know the risk in manual handling. Before applied the NIOSH Lifting Index Equation, there are several variables should be measure. Figure shows the measurement that need to be determined. All the variables' length for the three shops is presented in Table 4.2. Some equations need to be applied using the values before using RWL equation. Table 4.2 shows the result that can be used in RWL equation. For LC value, it will be a constant which is 23 kg. The values of FM and CM can be determined using the table provided.

The values of those parameter can be applied in RWL equation. The results of lifting index were presented in Figure 9.

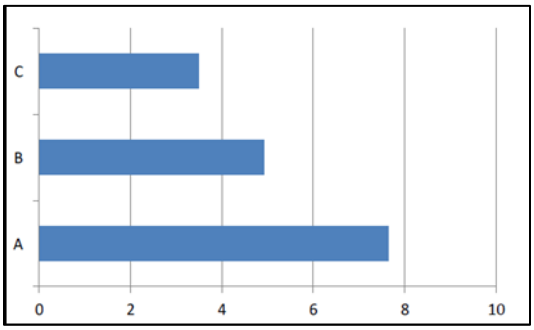

Figure 9. NIOSH Lifting Index result

According to NIOSH Lifting Index guideline, the ideal value for lifting index is less than or equal to 1. Based on the chart 3, the value clearly showed that the workers for each shop are exposed with high risk. The value of lifting index is relying on load and RWL. The workers should know the RWL to identify the weight limit to avoid the risk. However, RWL can be changed based on the ways their position in lifting the object.

For example, worker A can limit the load to 2 kg to maintain the lifting index below 1. 2 kg is too light for adult capability. He can adjust the position between body and load during lifting load to get highest value for RWL and lower value for lifting index. Lifting index can be a medium and simplest guideline for us to refer in order to reduce the risk. The risk need to be reduced to make the worker feel comfortable in doing their job. Risk related ergonomic is not been effected at the time but, it is long term disability which will threaten the worker for a lifetime if action do not been taken. There are several alternatives can be taken to reduce the risk in manual handling which is:

a) Provide more training
b) Has knowledge about ergonomic
c) Using supportive tool

From the training, the worker will know the good technique to lift the object. It will reduce the risk on awkward body posture as well. The workers will exposed more on ergonomic if the employer or specific organization make a campaign or practice. They will know the standard weight limit from OSH for men and women. Supportive tool will reduce their task as well as reduce their risk. The alternative for manual handling is supportive tool which trolley, conveyor and forklift. Those tools can be used for the worker which involve in lifting heavy object.

4.6 Design tools

There are several ways that can help to eliminate or reduce the risk for manual handling. The ways should also depend on the risk and the situation at the workplace. There is guideline for manual handling from several existing study for men and women. In this study, the alternative that suitable for grocery shop is by using tool or machine that can help them in manual handling. Figure 10 shows the suitable tool in those three groceries shops.

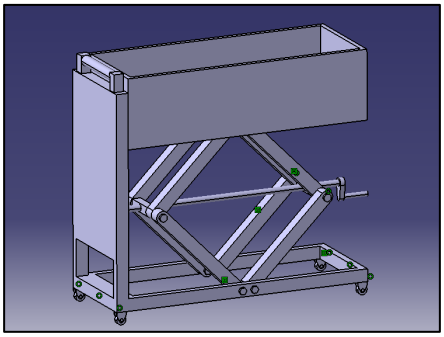

Figure 10. Trolley for shop workers

The design has a unique characteristic to reduce the risk. The main feature is the trolley can be adjusted suitable to the worker's desire. It also can be adjusted according to the existing rack at the groceries shop. The function of the trolley is to reduce the load for the worker in manual handling. This is the alternative to reduce the back pain and muscle pain faced by the worker.

The dimension of the trolley is based on the size of the workplace. The width of the trolley is 40 cm which is one of the shops has 60 cm in length between racks to rack. The length of the trolley is 100 cm which is suitable to fill with things in the groceries shops. The maximum height of the trolley is 80 cm, same height with the worker waist. They do not have to bend their body to arrange the product from trolley to the top level rack.

The trolley designed to meet the needs of the workers and it helps to reduce awkward posture during reloading stock or good to the rack. They can fill the weight more than 50 kg and the task to restock the product will be take less time than before. The trolley also can reduce repetitive work of the worker regarding weight limit and capability of the worker.

5. Conclusion

It was found that majority of groceries shop and small company did not know about ergonomic and risk related work. Specific organization should focus more on company in rural area and take immediate action for high risk. The worker of the groceries shop had been experienced in injury related to their work; muscle pain and back pain. Their working posture may be lead back pain and muscle pain.

The role of the study was characterized by a length route for the worker to lift the load, frequent bending forward, lifting loads at awkward postures and exceed the standard load limit resulting in high degree of manual handling-related injuries. The future study can focused on the arrangement of the workplace or workplace layout. Workplace condition can be the source of risk to the worker. The enough space for the worker is necessary to ensure the worker feel comfortable and avoid hazardous at workplace.

Acknowledgement

The authors are highly indebted to their friends, family and most importantly staffs of Universiti Teknologi MARA Cawangan Pulau Pinang, Kampus Permatang Pauh for their kind co-operation and encouragement which greatly assisted in the study.

References

International Ergonomic Association. Retrieved from International Ergonomic Association: https://www.iea.cc/whats/index.html#, 2019

Adam H. Schwartz, T. J. Intra-rater and Inter-rater Reliability of the Rapid Entire Body Assessment (REBA) Tool. International Journal of Industrial Ergonomics, 111-116, 2019

Department Occupational Safety and Health Ministry of Human Resources. Guideline for Manual Handling at Workplace. Malaysia, 2018

Ken Erliana, F. K. Solving Office Ergonomics Problem Using Rapid Upper Limb Assessment (RULA). ATLANTIS PRESS, 2019.

Middlesworth, M. ErgoPlus. Retrieved from ErgoPlus Website: https://ergo-plus.com/niosh-lifting-equation-single-task/, 2012, December 5

Shaliza Azreen Mustafa, S. K. Ergonomics Awareness and Identifying Frequently used Ergonomics Program in Manufacturing Industries Using Quality Function Deployment. American Journal of Scientific Research, 2009

Social Security Organization. Annual Report. Social Security Organization, 2016

Hemani Malhotra, A. B. Workstation Assessment for Packaging Department: A Case Study. *International Journal of Home Science*, 227-235, 2017

Alwain Luttman, M. J. Preventing Musculoskeletal Disorder in the Workplace. In M. J. Alwain Luttman, *Preventing Musculoskeletal Disorder in the Workplace* (p. 22). Germany: World Health Organization. 2003

Ardalan Shariat, S. B. Muskuloskeletal Disorders and Their Relationship with Physical Activities among Office Workers: A Review. *Malaysian Journal of Public Health Medicine*, 62-74. 2016

Bernard J. Martin, T. L., & Garcia, M.-G. Long Term Muscle Fatigue after Standing Work. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 1162-1173. 2015

Dubovska, R., Jambor, J. and Majerik, J. *Implementation of CAD/CAM System CATIA V5 in Simulation of CNC Machining Process*. Procedia Engineering, 69, pp.638-645. 2014

Biographies

Nor Suhada Abdullah is currently a fulltime lecturer in Faculty of Mechanical Engineering, Universiti Teknologi MARA Cawangan Pulau Pinang. She obtained her first degree from the Universiti Teknikal Malaysia Melaka, Malaysia and her Master's degree from Universiti Putra Malaysia in Manufacturing System Engineering. Her research areas of interest are ergonomics in systems and product design, work related muscular skeletal disorders, and in Industrial Engineering. She has published journal and conference papers. She also a member of Board of Engineers Malaysia (BEM).

Koay Mei Hyie is currently an Associate Professor at Faculty of Mechanical Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang. She completed her bachelor degree in Materials Engineering (Hons) in 2001 at Universiti Malaya, Malaysia. In 2004, she graduated with Master of Science Engineering and obtained her PhD in 2010 at Universiti Malaya. Her research interests are nanocoating, advanced materials, corrosion and wear technology. Currently, she is a Chartered Engineer under Institution of Mechanical Engineers (UK) and Professional engineer under Board of Engineer, Malaysia.

Halim Ghafar is currently a fulltime lecturer in Faculty of Mechanical Engineering, Universiti Teknologi MARA. He obtained his first degree from Keio University, Japan and his Master's degree from Universiti Teknologi MARA in Master of Science in Mechanical Engineering. His research areas of interest are renewable energy and biomass energy. He also a member of Board of Engineers Malaysia (BEM).

Hamid Yusoff, is currently serving as Senior Lecturer at the Faculty of Mechanical Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang. He received his Bachelor Degree in Aerospace Engineering from Universiti Sains Malaysia. He obtained his Ph.D and M.Sc in Mechanical Engineering from Universiti Sains Malaysia. His research interest is in aircraft design, aerodynamics and micro air vehicles.

Siti Nur Amalina Mohd Halidi is currently a fulltime lecturer in Faculty of Mechanical Engineering, Universiti Teknologi MARA. She obtained her first degree from Vanderbilt University, USA and her Master's degree from Universiti Sains Malaysia in Master of Science in Mechanical Engineering. Her research areas of interest are renewable energy and propulsion. She is also a Graduate Engineer of the Board of Engineers Malaysia (BEM).

Ahmad Sufian Abdullah is currently a fulltime lecturer in Faculty of Mechanical Engineering, Universiti Teknologi MARA. He obtained both of his first degree and Ph.D in Mechanical Engineering from The University of Manchester, United Kingdom. His research areas of interest are structural integrity, structural impact studies, composites & finite element analysis. He is a certified trainer for Abaqus CAE since 2019. He is also a member of Board of Engineers Malaysia (BEM).

Aliff Farhan Mohd Yamin is currently a fulltime lecturer in Faculty of Mechanical Engineering, Universiti Teknologi MARA. He obtained his first degree from Universiti Teknologi Malaysia and his Master's degree from Universiti Teknologi Malaysia in Master of Engineering in Mechanical Engineering. His research areas of interest are damage and fracture mechanics. He is also a Graduate Engineer of the Board of Engineers Malaysia (BEM).