

IRDH International Journal of Technology, Agriculture & Natural Sciences

<https://irdhjournals.com/ijtans>

Vol 1, No 2 (2024) : July

Manual Material Handling

Moch. Ilman Fauzi

* Correspondence Author: ilman875@gmail.com

* Islamic University of Raden Rahmat, Malang, Indonesia

INDEXING	ABSTRACT
Keywords: Keyword 1; Manual Keyword 2; Material Keyword 3; Handling	Biomechanics is a science that uses the laws of physics and engineering mechanics to be able to examine movements in the body and the effects of forces and moments that occur. Among biomechanical studies, manual material handling (MMH) activities are still considered critical. This research is a research using the method of literature study or literature review. Manual material handling (MMH) is an activity that is done everyday by humans. The use of human labor in various activities that are done manually is still very dominant. MMH activities that include lifting, lowering, pushing, pulling have the potential to cause work accidents.

Article History

Received 10 June 2024; Revised 21 June 2024; Accepted 01 July 2024

INTRODUCTION

Ergonomics is the science of work about the people who do it and how it is done, the tools and equipment they use, where they work and the psychosocial aspects of the work situation. The purpose and purpose of the ergonomics discipline is to gain a complete knowledge of the problems of human interaction with the work environment, as well as a multi-disciplinary approach between humans and work, work tools, work environment and in order to create an efficient, comfortable, safe, healthy and effective work dimension space (Miswari *et al.*, 2021).

One of the branches of ergonomics is biomechanics. Biomechanics is a science that uses the laws of physics and engineering mechanics to be able to examine movements in the body and the effects of forces and moments that occur. So that the load received by a person's body can be identified and measured so that the strength and balance and physical ability of a person in carrying out work remains at the permitted limit. Loading that exceeds tolerance and is repetitive results in reduced resistance in the tissue structure and results in injury or disease. Therefore, procedures and equipment must be designed to adjust the capabilities of the human body during activities (Wijaya and Muhsin, 2018).

Among biomechanical studies, manual material handling (MMH) activities are still considered critical. Despite the development of modern industries that have applied machines or equipment in facilitating material handling work, there are still some work criteria that must be done manually relying on human physical strength, limited space for movement, and worker acceleration (Affa and Putra, 2017).

The use of manual labor in production process activities in a company is still required, especially in the process of moving materials or products to the next workstation. This activity is often referred to as Manual Material Handling (MMH), where the activities carried out include handling, moving, packaging, storing, and monitoring materials or products. Nowadays, in modern industry, machines have been widely used as aids in material transfer,

however, manual material transfer activities are still needed because it has several advantages compared to using tools, such as manual material transfer can be carried out in a limited space. When carrying out activities, workers rely heavily on their physical ability to lift goods, but moving materials manually if not done ergonomically will cause work accidents. The flexibility of movement is the reason why human power is still used in the industry. Improper posture can cause a dangerous injury to the safety of a worker. This is exacerbated by the lack of knowledge of workers and some employers ignore the job risks of their employees. In addition, there are many manual material handling activities that exceed the recommended lifting limits (Chandra, 2023).

MMH activities that are often encountered are lifting and carrying. Manual material handling (MMH) activities are still widely encountered in everyday life when carrying out a job. One of the MMH activities is lifting and carrying drinking water in gallon containers. However, it should be underlined that MMH activities in inappropriate conditions and ways will cause a number of impacts on these activities such as high levels of injury or accidents can cause pain or complaints in workers / operators (Sanjaya *et al.*, 2018), work accidents, occupational diseases, musculoskeletal complaints, risk of low back injury (LBP) and fatigue, as well as described by Miswari *et al.*, (2021).

RESEARCH METHOD

This research is a research using the method of literature study or literature review. Literature review is a comprehensive overview of research that has been done on a specific topic to show readers what is already known about the topic and what is not yet known, to show readers what is already known about the topic. What is known about the topic and what is not yet known, for to find a rationale for research that has already been done or for ideas for future research (Denney and Tewksbury, 2013). Literature studies can be obtained from various sources including journals, books, documentation, the internet and literature library. The literature study method is a series of activities with regard to methods of collecting library data, reading and recording, as well as recording, and processing writing materials (Nursalam, 2016). The type of writing used is a literature review study that focuses on the results of writing related to the topic or variable. focuses on the results of writing related to the topic or variable writing.

RESULT AND DISCUSSION

Manual material handling (MMH) is an activity that is done every day by humans. The use of human labor in various activities that are done manually is still very dominant. Work related to MMH is often seen in carpentry work, loading and unloading goods, market activities and other business activities. MMH activities include lifting, pushing, shouldering, carrying, pulling and other material handling activities without mechanical aids (Adiyanto *et. al.*, 2019).

The advantage of MMH compared to material handling using tools is the flexibility of the movements performed. However, behind these advantages there are shortcomings, namely in terms of occupational safety and health. MMH activities have a considerable potential for accidents, because in this activity there will be direct contact between the load and the human body (Syarifuddin *et al.*, 2023).

Manual transfer if not done ergonomically will cause accidents. Work accidents that occur due to damage to body tissue caused by overloading the lift. Reality shows that humans have limits to their abilities, both regarding cognitive, physical, and psychological observation abilities (Dick *et al.*, 2016).

Manual handling activity is an activity of moving loads by the body manually within a certain time span. The Occupational Safety and Health Administration (OSHA) classifies manual material handling activities into five (Karlman and Sarvia, 2019), namely:

- a. Lifting/lowering.
- b. Pushing/pulling.
- c. Twisting.
- d. Carrying.
- e. Carrying (holding).

Occupational Accident Risks in Manual Material Handling

MMH activities that include lifting, lowering, pushing, pulling have the potential to cause work accidents. Divides the factors that cause MMH work accidents into two factors (Triyono, 2006):

- a. Physical Factors

This factor when described consists of temperature; noise; chemicals; radiation; visual disturbances; work posture; joint disorders (repetitive movements and displacements); vibration of machines and tools; conveyance; floor surfaces.

- b. Psychosocial Factors

This factor consists of working time characteristics such as shift work; work rules; unfair pay; duplicate work; work stress; consequences of work errors; short breaks; and being distracted at work. Both of the above factors affect work accidents in the musculoskeletal department. For physical factors, the risk factors for musculoskeletal disorders are work posture/attitude and joint disorders due to repetitive work.

Research conducted by Abdillah (2013) stated that the BLS (Bureau Labor Statistics) reported the number of musculoskeletal accidents during weight lifting on work reach up to 52%, pushing or pulling 13%, carrying things 10%, repetitive movement 13%, and 12% of other activities. Punnett and Wegman (2004) stated that musculoskeletal disorders involve variety and degenerative of injury conditions that affect muscle, tendon, ligament, joints, peripheral nerve, and blood vessels support. Parts of human body that often exposed by musculoskeletal disorders are back, neck, arms, and hands (Wahyudi *et al.*, 2015).

Musculoskeletal disorders are disorders of pain in the joints, muscles, bones, and ligaments in the body part (Sirisawasd *et al.*, 2018). Musculoskeletal disorders are caused due to high physical work demands (Oestergaard *et al.*, 2022). The disorder is influenced by age, especially in the elderly (Zhao *et al.*, 2020). Thus, it can be said that the demands of physical work and the age of the worker influence musculoskeletal disorders. Musculoskeletal disorders cause workers to experience continuous pain in parts of their body, and one of these factors is the length of working time. A long duration of work increases musculoskeletal disorders. The long working time factor also affects musculoskeletal disorders; the longer you work, the higher the risk of musculoskeletal disorders (Siddiqui *et al.*, 2021). The disorder is caused by excessive work conditions (Asuquo *et al.*, 2021). Musculoskeletal factors are influenced by the individual and society, where the individual is related to age, while social is related to conditions and work. The risk factor of musculoskeletal disorders related to work are bent position incorrectly and lifting heavy loads

(Laithaisong *et al.*, 2022). Musculoskeletal disorders include some pain in the body. Cause of that, musculoskeletal disorders can affect work efficiency and cause accumulating pain for a long period (Clari *et al.*, 2019).

Handling the Risks of Manual Material Handling

Below are some actions to reduce the risk of musculoskeletal disorders in MMH work: Job redesign (Triyono, 2006).

a. Mechanization

The use of mechanical systems to eliminate repetitive work. So with the use of mechanical equipment is able to accommodate a lot of work into a little work.

b. Job rotation

Workers do not only do one job, but several jobs can be done by the worker. The purpose of this step is the recovery of muscle tension through different workloads.

c. Group work

Work done by several people is able to divide the workload on the muscles evenly. This is because group members are free to do the work performed.

d. Workplace design

The principles implemented are (1) Work design takes into account the abilities and limitations of workers. (2) Design of equipment and supplies. (3) Providing workers with assistive devices can reduce incorrect work attitudes, thereby reducing muscle tension.

e. Job training

This program needs to be carried out on the job, because workers do work as a habit. Workers must know about dangerous work and need to know how to do safe work.

Manual Material Handling Aids

The main principle of using assistive devices is to maintain worker safety and to increase work productivity. The concept of ergonomics is the main consideration in the use of tools and does not require large costs. The use of assistive devices is expected that workers can avoid work-related injuries or work accidents.

The types of tools include:

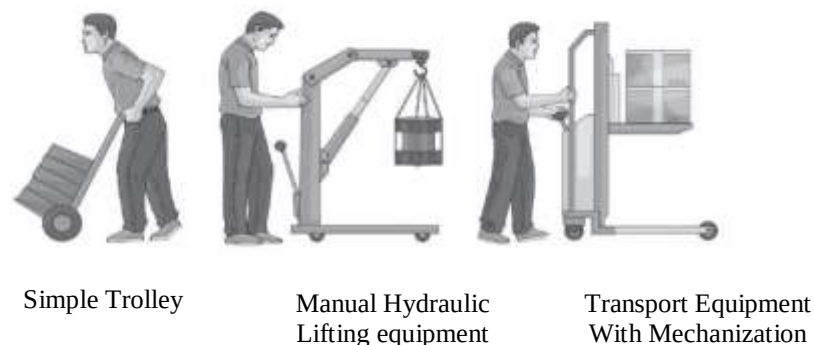


Figure 1. Conveyance (lifting and carrying) for moving goods (Modified from HSE, 2004).

The conveyance tool in figure 1. is very useful for moving objects and operator labor

can be reduced considerably and the risk of injury can be reduced. This tool is categorized as a simple tool with the concept of manual lifting with hydraulic assistance, while the concept of carrying with a stroller. The weakness of this tool is that it still uses human labor in positioning and arranging goods in the storage room. The time required by using the tool is longer, compared to activities without using tools.

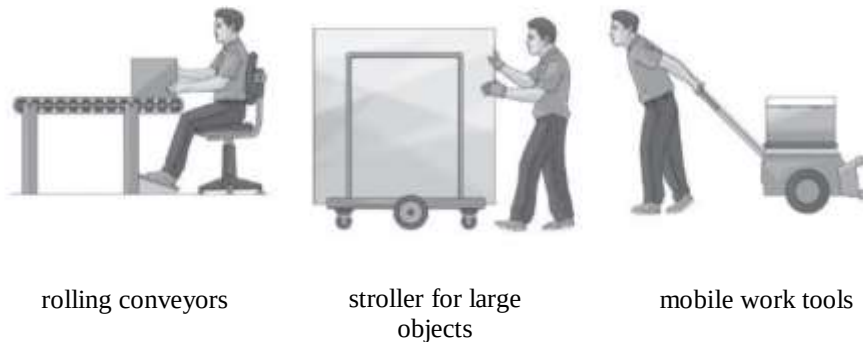


Figure 2. Material transfer aids (Modified from HSE, 2004).

The tool in figure 2., is a tool to move materials in the form of rolling conveyors, strollers and mobile work tools. These moving aids can simplify the process of carrying with little energy expended. The mechanical process of transportation as shown in figure 1 and 2 generally aims to reduce the burden of transportation in an effort to reduce the risk of injury. Moving objects from machine to machine will be flexible if using a conveyor belt. Transportation of very heavy materials is recommended using a power transfer device. The tools used to move materials that use power include:

- a. Conveyors: This conveyance serves to move solid or powdered materials that have been packaged. The conveyor used depends on the weight and shape of the material being moved, track conditions and distance traveled.



Figure 3. Types of conveyors

- b. Cranes and Hoists. Cranes and hoists are material transfer equipment for heavy loads

that are carried out intermittently with a limited area. Cranes move horizontally and hoists vertically and the use of both equipment is in consideration of the limited floor area.



Little Crane



Electric Hoist

Figure 4. Types of cranes and hoists (Modified from HSE, 2004).

Legal Lifting Limits

The following describes some of the legal lifting limits from various states of the Australian continent that are used in industry. These lifting limits are used as international lifting limits. These lifting restrictions (Dick *et al.*, 2016) are:

- a. Males under the age of 16 years, the maximum lift is 14 kg.
- b. Men aged 16-18 years, maximum lift is 18 kg.
- c. Men over 18 years of age, no lifting limit.
- d. Women aged 16-18 years, maximum lift of 11 kg.
- e. Women over 18 years of age, maximum lift of 16 kg.

These lifting restrictions can help to reduce the pain, soreness of the spine for women (back injuries incidence to women). In addition, it will reduce work discomfort in the spine, especially for operators for heavy work.

Actions to be Taken in Accordance with Lifting Limits

There needs to be a special action when individuals lift a load, to anticipate accidents at work and also to know what to do when the individual has had an accident at work. These actions include (Stephens, 2020) :

Table 1. Actions to be Taken in Accordance with Lifting Limitations

Lifting Limit (Kg)	Action
Under 16	No special measures need to be taken
16 – 34	Administrative procedures are required to identify a person's inability to lift without risking harm except by means of certain aids.

34 – 55	Preferably selected and trained operators. Using a trained material transfer system. Must be under supervision of a supervisor.
Above 55	Must use mechanical equipment. Trained and selected operators. Have attended health and safety training in industry. Must be under close supervision.

Table 2. Actions to be Taken in Accordance with the Lifting Limit

Level	Lifting Limit (Kg)	Action
1	= 16	No special measures required
2	16-25	No tools are required in lifting Emphasized on lifting method
3	25-34	No lifting tools required. Job redesign selected.
4	>34	Must be assisted with mechanical equipment

CONCLUSION

Manual material handling (MMH) is an activity that is done every day by humans. The use of human labor in various activities that are done manually is still very dominant. Work related to MMH is often seen in carpentry work, loading and unloading goods, market activities and other business activities. MMH activities include lifting, pushing, shouldering, carrying, pulling and other material handling activities without mechanical aids (Adiyanto et. al., 2019).

Manual handling activity is an activity of moving loads by the body manually within a certain time span. The Occupational Safety and Health Administration (OSHA) classifies manual material handling activities into five (Karlman & Sarvia, 2019), namely:

- a. Lifting/lowering.
- b. Pushing/pulling.
- c. Twisting.
- d. Carrying.
- e. Carrying (holding).

MMH activities that include lifting, lowering, pushing, pulling have the potential to cause work accidents. (Heran-Le Roy *et al*, 1999 cited by Triyono, 2006) divides the factors that cause MMH work accidents into two factors (Physical Factors and Psychosocial Factors) (Triyono, 2006).

The main principle of using assistive devices is to maintain worker safety and to increase work productivity. The concept of ergonomics is the main consideration in the use of tools and does not require large costs. The use of assistive devices is expected that workers can avoid work-related injuries or work accidents.

Australian continent that are used in industry. These lifting limits are used as international lifting limits. These lifting restrictions (Dick et al., 2016) are:

- a. Males under the age of 16 years, the maximum lift is 14 kg.
- b. Men aged 16-18 years, maximum lift is 18 kg.
- c. Men over 18 years of age, no lifting limit.
- d. Women aged 16-18 years, maximum lift of 11 kg.
- e. Women over 18 years of age, maximum lift of 16 kg.

These lifting restrictions can help to reduce the pain, soreness of the spine for women (back injuries incidence to women). In addition, it will reduce work discomfort in the spine, especially for operators for heavy work.

REFERENCE

Journal Article

- Affa, M. N., & Putra, B. I. (2017). Analisis Manual Material Handling Pada Pekerja Borongan Di PT. JC dengan Metode NBM dan RWL. *PROZIMA (Productivity, Optimization and Manufacturing System Engineering)*, 1(1), 22. <https://doi.org/10.21070/prozima.v1i1.703>
- Chandra, H. (2023). Manual material handling analysis using biomechanics at repair department workers. *JENIUS: Jurnal Terapan Teknik Industri*, 4(1), 108–115. <https://doi.org/10.37373/jenius.v4i1.498>
- Clari, M., Garzaro, G., Di Maso, M., Donato, F., Godono, A., Paleologo, M., Dimonte, V., & Pira, E. (2019). Upper limb work-related musculoskeletal disorders in operating room nurses: A multicenter cross-sectional study. *International Journal of Environmental Research and Public Health*, 16(16). <https://doi.org/10.3390/ijerph16162844>
- Dick, R. B., Hudock, S. D., Lu, M.-L., Waters, T. R., & Putz-Anderson, V. (2016). Manual Materials Handling. *Physical and Biological Hazards of the Workplace*, 33–52. <https://doi.org/10.1002/9781119276531.ch3>
- Karliman, L. L., & Sarvia, E. (2019). Perancangan Alat Material Handling untuk Mereduksi Tingkat Risiko Cedera Tulang Belakang Operator pada Aktivitas Pemindahan Semen di Toko Bangunan X. *Journal of Integrated System*, 2(2), 170–191. <https://doi.org/10.28932/jis.v2i2.1609>
- Laithaisong, T., Aekplakorn, W., Suriyawongpaisal, P., Tupthai, C., & Wongrathanandha, C. (2022). The prevalence and risk factors of musculoskeletal disorders among subcontracted hospital cleaners in Thailand. *Journal of Health Research*, 36(5), 802–812. <https://doi.org/10.1108/JHR-01-2021-0040>
- Miswari, N., Aulia, L., & Wahyudi, R. (2021). Penilaian Postur Kerja Manual Material Handling (Mmh) Pada Gedung Bertingkat Menggunakan Metode Rapid Upper Limb Assessment (Rula). *Sebatik*, 25(1), 262–270. <https://doi.org/10.46984/sebatik.v25i1.1160>
- Siddiqui, L. A., Banerjee, A., Chokhandre, P., & Unisa, S. (2021). Prevalence and predictors of musculoskeletal disorders (MSDs) among weavers of Varanasi, India:

- A cross-sectional study. *Clinical Epidemiology and Global Health*, 12. <https://doi.org/10.1016/j.cegh.2021.100918>
- Sirisawasd, S., Taptagaporn, S., Boonshuyar, C., & Earde, P. (2018). Interventions commonly used to prevent work-related musculoskeletal disorders among healthcare workers. In *Journal of Health Research* (Vol. 32, Issue 5, pp. 371–383). Emerald Group Holdings Ltd. <https://doi.org/10.1108/JHR-08-2018-044>
- Stephens, M. P. (2020). Manufacturing Facilities Design & Material Handling. In *Manufacturing Facilities Design & Material Handling*. <https://doi.org/10.2307/j.ctv15wxptd>
- Triyono. (2006). Analisis sikap kerja pekerja manual material handling UD . Tetap Temangat dengan metode owas (ovako working posture analysis system). *Skripsi*, 1–97.
- Wahyudi, M. A., Dania, W. A. P., & Silalahi, R. L. R. (2015). Work Posture Analysis of Manual Material Handling Using OWAS Method. *Agriculture and Agricultural Science Procedia*, 3, 195–199. <https://doi.org/10.1016/j.aaspro.2015.01.038>
- Wijaya, I. S. A., & Muhsin, A. (2018). Analisa Postur Kerja Dengan Metode Rapid Upper Limb Assessment (Rula) Pada Oparator Mesin Extruder Di Stasiun Kerja Extruding Pada Pt Xyz. *Opsi*, 11(1), 49. <https://doi.org/10.31315/opsi.v11i1.2200>
- Zhao, C. X., Liu, J. N., Li, B. Q., Ren, D., Chen, X., Yu, J., & Zhang, Q. (2020). Multiscale Construction of Bifunctional Electrocatalysts for Long-Lifespan Rechargeable Zinc–Air Batteries. *Advanced Functional Materials*, 30(36). <https://doi.org/10.1002/adfm.202003619>

Authored Book

- Budiman, E., Setyaningrum, R., Studi, P., Industri, T., Tinggi, S., Purwokerto, W., Pendahuluan, I., Perkembangan, S., & Analisis, M. (1995). *Menganalisis Postur Pada Aktivitas Manual Material Handling (Mmh)*. 46–52.
- Dick, R. B., Hudock, S. D., Lu, M.-L., Waters, T. R., & Putz-Anderson, V. (2016). Manual Materials Handling. *Physical and Biological Hazards of the Workplace*, 33–52. <https://doi.org/10.1002/9781119276531.ch3>
- Hignett, S., & McAtamney, L. (2000). Rapid Entire Body Assessment (REBA). *Applied Ergonomics*, 31(2), 201–205. [https://doi.org/10.1016/S0003-6870\(99\)00039-3](https://doi.org/10.1016/S0003-6870(99)00039-3)
- Nursalam. (2016). *Metodologi Penelitian Ilmu: Pendekatan Praktis*. Ed. 4. Jakarta: Salemba Medika

Dissertation From a Database

- Triyono. (2006). Analisis sikap kerja pekerja manual material handling UD . Tetap Temangat dengan metode owas (ovako working posture analysis system). *Skripsi*, 1–97. <https://core.ac.uk/download/pdf/12350961.pdf>