



Implementation of A Total Ergonomics Approach To Improve the Quality of Life of Freight Workers In 16 Ilir Market, Palembang City, South Sumatera Province

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Abstract. The results of preliminary observations of the working conditions and environment of freight workers in the 16 Ilir Market, Palembang City, South Sumatera Province are categorized as less ergonomic in physical, work environment, psychological, organizational and management aspects. Freight workers work by placing baskets on their heads, on their backs and even some without tools directly on their shoulders which load basic food items, and loading-unloading warehousing goods, weighing ± 35 kg, a distance of ± 500 meters with a low level of productivity. After finishing work, freight workers experience aches all throughout the body, particularly in the legs and neck, as well as waist and back pain. Based on work pulse frequency, the workload was determined to be 131.25 ± 14.10 beats per minute, and it was categorized as heavy work. The fatigue score reached 69.10 ± 15.29 and the musculoskeletal disorder score was 61.25 ± 7.44 . The method used is a total ergonomics approach, to enhance work productivity by reducing workload, fatigue, and musculoskeletal system issues. Thirty research samples were chosen by simple randomization of freight workers for this same-subject experimental study. The Wilcoxon Signed Rank Test and the t-paired test were used to evaluate the data at a 5% significance level. Workload, weariness, and musculoskeletal complaints significantly decreased, and productivity increased ($p < 0.05$), according to the data. In conclusion, the total ergonomics approach reduced workload as seen from the decrease in: work pulse rate by 15.61%, fatigue by 58.97%, musculoskeletal system complaints by 28.78%. Consequently, there was a 21.00% increase in productivity. The total ergonomics approach can improve the quality of life and work productivity of freight workers in 16 Ilir Market, Palembang City, South Sumatera Province.

Keywords: Freight Workers, Total Ergonomics, Workload, Fatigue, Musculoskeletal Complaints, Productivity.

INTRODUCTION

Freight workers at the 16 Ilir Market in Palembang City, South Sumatera Province work during market operating hours and the loading-unloading process of warehoused goods in the market area and operate from 07:00 am to 17:00 pm. Physical working situations and conditions, namely work position, workload, and repetitive movements are not ergonomic. The work environment is not ergonomic as measured by temperature conditions, and humidity and lighting. Psychological aspects of labour with stress, low job satisfaction and ineffective communication. Organisational and management aspects with inflexible work schedules, ineffective supervision, and lack of training. Freight workers work based on tasks assigned by the employer, lifting and transporting basic food items, market needs, and loading-unloading warehoused goods. Lifters carry out their work starting from putting goods into baskets or even without tools, lifting baskets over their heads or backs. After the basket is full, it is then carried on the head or back and then transported to the final place according to the customer's work order with a distance of ± 500 metres, The slope of the land in the market area and warehousing area varies from 10° - 25° , and there are no steps for freight workers to walk on.

The work starts from 07:00 am to 17:00 pm, with one meal and prayer break at noon for ± 1 hour and 30 minutes at food stalls in the market area. While working, there are no quick breaks, and snacks are provided after two hours of labor. Typically, each freight employee moves products for 15 transport intervals. In a preliminary study of 15 freight workers, it was found that the average working pulse rate when lifting and transporting goods was 131.25 ± 14.10 beats/minute, including in the heavy work category (Darma et al., 2023; Rahayu, 2020). Adiga (2023) revealed that The key challenges encountered in moving goods within primary industries include: lifting mechanisms like unnatural working positions, ill-suited equipment design, poor time management, and relying solely on financial and technical factors when addressing issues. The International Labour Office (ILO) (in (Yuliani, Adiatmika, et al., 2021) recommends that the weight lifted by male workers for light category ≤ 10 kg (for work that does not require great physical strength), medium category 11-20 kg (for work that requires moderate physical strength), and heavy category 21-50 kg. (for work that requires great physical strength), and must be decreased by 25% if the tasks are done regularly. Rinamurti and Setiawan (2023) suggested that for employees between the ages of 20 and 35, the permissible load of items is 25 kg. Meanwhile, Susihono & Adiatmika (2021) suggest that the weight of goods transported by placing on the head for Asian men is in the range of 20 to 25 kg. Consequently, due to the weight they handle and Heri Setiawan
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their technique for lifting and transporting, along with their posture, rest periods, snacks, the design of their baskets, the distance they cover, and the state of the market and storage area in Pasar 16 Ilir, Palembang City, South Sumatera Province, the male laborers who transport goods appear drained, breathless, perspiring, and frequently take breaks along their path.

Throughout every phase of lifting and moving items, there are unplanned pauses where individuals rest extensively at the final collection spot, reduce their speed while heading to that location, and during the process of transporting goods. Upon finishing these tasks, freight handlers experience discomfort in their waist and back, as well as aches all over, particularly in the neck and legs. To overcome these problems it is necessary to take a comprehensive approach and consider all aspects. An approach that addresses a problem as a whole in ergonomics is known as a Total Ergonomics approach which consists of the concepts of Appropriate Technology and SHIP (Systemic, Holistic, Interdisciplinary, Participatory) which are carried out consequently and continuously (Suparti et al., 2023; Setiawan, 2021; Susihono & Adiatmika, 2021).

Appropriate Technology is a method where any technology selected must undergo thorough evaluation based on six standards: it should be technically sound, economically viable, user-friendly, socially acceptable, energy-efficient, and environmentally friendly. In its implementation, the entire procedure should be examined with SHIP, indicating that any issue resolution is investigated in an organized manner. This approach encompasses multiple interconnected systems, taking a comprehensive view while employing the different academic fields related to the matter. Moreover, individuals such as consumers, or those affected by the challenges being tackled, need to be involved right from the planning stages (Setiawan, H., 2021; Susihono & Adiatmika, 2021; Fan & Smith, 2020). Based on this description, it is deemed necessary to carry out a study with a Total Ergonomics approach, so that later freight workers (a) the workload becomes lighter, (b) fatigue decreases, (c) complaints of the musculoskeletal system decrease, and (d) if all of these elements can be achieved, it is anticipated to enhance overall work efficiency.

METHODS

The structure of this research involves treating each participant individually, carried out sequentially with a three-day washout period. The number of participants needed was determined using the Colton formula (Kurniawansyah et al., 2021; Setiawan & Rinamurti, 2020), the result of which was 30 freight workers at 16 Ilir Market, Palembang City, South Sumatera Province aged 25-45 years, who were selected by simple random sampling. With

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a Total Ergonomics approach (Suparti et al., 2023; Ida Mulyati, 2022; Setiawan H., 2021), improvements were made with the following pattern: improving the way baskets are lifted, reducing the amount of goods lifted to a maximum of 25 kg, adding rattan twists and foam to the edges of the basket, making ergonomic steps on trails with sharp slopes, providing information about occupational health and safety (Fam et al., 2023; Adiga, 2023).

Work starts from 07:00 am until 17:00 pm with a brief pause of 15 minutes accompanied by the offering of sweet tea after two hours of work, specifically at 9:00 am in the morning and 2:00 pm in the afternoon as well as 1 time of prayer and lunch from 12:00 am until 13:30 pm Data was collected on the condition of the subjects to determine the age, stature, mass, blood pressure levels, and physical measurements of the freight workers. Throughout the study, the surrounding temperature was noted hourly from 7:00 am to 5:00 pm, which included logging: wet temperature, dry temperature, and globe temperature (radiation). Before and after the completion of the lifting-carrying of goods, the Nordic Body Map questionnaire and fatigue questionnaire were completed (Wijaya, 2019; Negara et al., 2019; Abarghouei & Nasab, 2012), carried out 10 minutes before starting work, and carried out in a sitting posture.

When transporting goods, the resting and working pulse rates were calculated just before unloading the goods at the final destination according to the customer's request and in the warehousing area according to the employer's instructions, which were carried out three times and the results were averaged, using the ten-beat method, in this case looking for the difference between the score before work and the average working pulse rate. The recovery pulse was calculated for minutes 1, 2, 3, 4, 5, respectively, based on the radial pulse at the left wrist in under half a minute and the outcome was doubled, which occurred after completing the task.

DISCUSSION

The identification of a total ergonomics problems related to freight workers in Pasar 16 Ilir Palembang City, South Sumatera Province includes physical aspects; the work position of freight workers is often bent over, or squatting for a long time, workload exceeds standard limits, repetitive movements of lifting, lowering and moving goods (Tetteh & Mirka, 2021; Oppici et al., 2021). Aspects of the work environment; crowded, noisy environmental conditions. Aspects of high temperature and humidity affect work comfort (Setiawan & Rinamurti, 2020; Rinamurti & Setiawan, 2023). Aspects of inadequate lighting cause eye fatigue and difficulty seeing (Suparti et al., 2023; Setiawan, 2021). Psychological aspects;

stress due to time pressure and workload. Aspects of low job satisfaction affect motivation and productivity. Aspects of ineffective communication with colleagues or employer consumers causing misunderstandings. Organisational and management aspects with flexible work schedule redesign to balance work and personal life (Setiawan H., 2017; Setiawan H., 2014). The aspect of ineffective supervision leads to mistakes and work accidents and lack of training affects work ability and safety (Suparti et al., 2023; Fam et al., 2023).

Suggested improvements include using assistive devices such as trolleys or strollers to reduce workload. Organise a flexible work schedule to reduce fatigue. Improve communication between freight workers, supervisors/employers and co-freight workers. Organise training on work safety and the use of assistive devices. Organise the work environment to improve comfort and safety.

Discussion of subject's condition in lifting-carrying goods by freight workers

The mean weight and height of the study subjects were 59.00 ± 6.26 kg with a range from 51.00 kg to 70.00 kg and the average height was 156.60 ± 3.86 cm stretching from 151.00 cm to 165.00 cm. The participants' height and weight were within the optimal range. The systolic blood pressure measurements of the participants varied between 95.00 mmHg and 125.00 mmHg, averaging at 108.50 ± 9.75 mmHg, whereas the diastolic pressure ranged from 65.00 mmHg to 85.00 mmHg, with an average of 71.00 ± 5.98 mmHg. These blood pressure levels remain within the normal limits, indicating that the participants are healthy enough to perform tasks involving lifting and moving items, as revealed by Vaara et al., (2022) and Korshøj et al. (2020), normal blood pressure for adults systolic ranges from 110.00 mmHg to 125.00 mmHg and diastolic 60.00 mmHg to 70 mmHg.

Environmental conditions in lifting and transporting goods by freight workers

The moist temperature initially recorded was 31.19 ± 0.87 °C, while following the repair it measured at 31.07 ± 0.58 °C. The relative humidity prior to the repair was $77.22 \pm 8.33\%$, and following the repair, it increased to $79.22 \pm 7.26\%$. The average dry temperature before the repairs occurred was 34.11 ± 1.99 °C and decreased to 33.93 ± 1.68 °C afterward. The temperature of radiation before the repair stood at 28.78 ± 1.92 °C, and it dropped slightly to 28.50 ± 2.10 °C post-repair. Environmental conditions did not show any meaningful differences between the periods prior to and following the repair ($p > 0.05$), indicating that the individuals in the study experienced similar levels of humidity before and after the intervention.

Workload in lifting-carrying goods by freight workers

The resting pulse rate of the study subjects before the repair was 79.95 ± 11.12 beats/minute and when carrying out the lifting and carrying of goods the average work pulse rate was 131.24 ± 14.10 beats/minute or an increase of 51.29% from the resting pulse rate. The subject's resting pulse rate after improvement was 79.65 ± 11.61 beats/minute and when lifting and Transporting items, the typical working heart rate measured at 117.85 ± 12.53 beats per minute, reflecting a rise of 38.20 beats per minute or a 67.59% rise compared to the resting heart rate. Therefore, it can be concluded from this research, with a total ergonomic approach can reduce the work pulse from 131.24 beats /minute to 117.85 beats /minute, which is 13.39 beats /minute or 10.61% of the work pulse before improvement. Referring to the classification of workload according to (Fan & Smith, 2020), before the improvement is classified under the heavy workload section, whereas following the enhancement, it falls into the medium category.

Fatigue in lifting-carrying goods by freight workers

Statistical analyses indicated that the levels of fatigue measured prior to and following the repair were notably distinct ($p < 0.05$). Following the repair, fatigue diminished by 58.97% compared to the levels measured beforehand. This means that there is a decrease in the average fatigue between before and after the repair. The decrease in fatigue was possible due to improvements in lifting and transporting methods and adjusting the heaviness of the lifted and moved load in relation to the physical capacity; establishing durations for work and breaks; serving sweet tea following two hours of labor; implementing ergonomic measures in the market area and warehouse area of the freight workers route that has a sharp slope. Health is a vital foundation for effectively completing tasks (Pratikasari et al., 2022; Khairani, 2021). The metabolism of anaerobic energy comes from the decomposition of glycogen reserves in the muscles, serving as a source of energy. This leads to a reduction in glycogen levels in the muscles and a rise in lactic acid levels. A rise in lactic acid levels will cause tiredness, as stated (Brooks et al., 2023; Fitrianto & Maarif, 2020). also emphasised that lactic acid is a metabolite produced during strenuous physical activity and plays a role in causing fatigue. This study showed that increased lactic acid levels correlated with increased fatigue indices, indicating that lactic acid accumulation may impair physical performance. Muscle tiredness rose nearly in line with the decrease in glycogen levels. The fatigue measurement dropped to 58.97%. This indicates that the wellbeing and health of freight workers have improved with the comprehensive ergonomics strategy compared to before this approach was implemented. This situation regarding ergonomics aligns with the national health principle

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and the framework set forth by the Indonesian Ministry of Manpower, which emphasizes enhancing the quality of working life and boosting productivity (Kamala & Robert, 2022; Makhbul et al., 2022; Setiawan H., 2017).

Musculoskeletal system complaints in lifting-carrying goods by freight workers

In this research, the level of musculoskeletal issues prior to any enhancement was 61.25, while after the enhancement it was 32.47, a decrease of 28.78%. This is possible because with the improvement with a total ergonomics approach, there was a change in the subject's work attitude from unnatural to natural, adjusting the weight of the load being transported, providing sweet tea and setting rest periods, improving work tools and making ergonomic steps. All of these improvements accumulated into one unit so that it affected muscle contractions and ultimately musculoskeletal complaints. Prior to the improvements there was a forced posture, which caused excessive loading on parts of the skeletal muscles such as the upper and lower neck, thighs and knees, ankles and dominated by the back and waist. These complaints are related to the weight of the load being carried, poor tool characteristics, and not knowing the correct way to lift and carry. Too much and forced pressure leads to blocked blood circulation, which causes a lack of oxygen for aerobic energy production. This condition results in the build-up of lactic acid and an increase in body temperature, eventually causing skeletal muscle fatigue which is felt as the freight worker's muscle soreness (Fam et al., 2023; Efficacy et al., 2022; Goncharenko et al., 2020), estimates that about 30% of back skeletal muscle injuries are caused by lifting methods that require bending and twisting work attitudes, resulting in the rotation of the spine. Furthermore, according to Kim & Jeong (2024) that unsymmetrical the way individuals position their backs and waists while lifting and moving objects places a strain on that area that is 30% greater than when they use symmetrical body positions, even in the same workers.

Productivity in goods lifting-carrying by freight workers

There was a significant increase in productivity levels before and after the enhancement, with the average productivity recorded at 0.48 ± 0.16 prior to the improvement and 0.69 ± 0.29 following it (representing a 21.00% increase). This rise was achievable due to the improvement in the form of a total ergonomics approach caused workers to lift and transport correctly, use anthropometric work tools, cross the slope of the market area and warehouses that have ergonomic steps to take a rest and enjoy some sweet tea following two hours of labor. By understanding the proper techniques for lifting and transporting items as well as recognizing the weight limits appropriate for the body's strength, issues related to the musculoskeletal system are minimized. Anthropometric work tools cause workers to wear

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their work tools comfortably. Traversing market and warehousing areas with ergonomic steps leads to efficient energy consumption (10 cal/mkg) (Koirala & Nepal, 2022). Providing rest allows muscle cells that experience continuous contraction to experience a period of relaxation. Relaxation will reorganise the distribution of blood flow that was occluded during contraction, leading to a transformation from anaerobic to aerobic metabolism. This will alter the makeup of metabolic waste substances into other compounds that can be reused for metabolism, or excreted through the lungs and kidneys (Pratama Edi, 2021; Yuliani, Tirtayasa, et al., 2021; Cahyadi & Setiawan, 2021). It can be said that with improvements with a total ergonomics approach, it can increase productivity by 21.00%.

CONCLUSION

According to the examination of existing studies, the findings from the research, the analysis of data, and the conversations held, one can infer that a comprehensive ergonomics strategy has the potential to enhance the living standards of cargo workers in the 16 Ilir Market, Palembang City, South Sumatera Province with indicators of decreased workload by 15.61%, decreased worker fatigue by 58.97%, decreased musculoskeletal system complaints by 28.78%. Enhancing the living standards of cargo employees positively affects their productivity. by 21.00%. Implementation of a total ergonomics approach can help improve the safety, health, and productivity of freight workers in Pasar 16 Ilir Palembang City, South Sumatera Province through interventions to improve the physical environment, work environment, psychological, organisation and management harmonised with technology, policies and regulations.

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