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Evaluation of worker body posture in the ice block moving process using the Rapid Entire Body Assessment (REBA) method

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Abstract

Ergonomics is an important aspect in the industrial work environment, especially in maintaining worker well-being and increasing productivity. One of the main factors in ergonomics is the worker's posture during work activities, which has the potential to cause musculoskeletal disorders (MSDs). CV XYZ, which is engaged in ice block production in Lhokseumawe, has a production capacity of up to 1,200 ice blocks per day with a work process that is still dominated by manual activities. Based on the results of initial observations, complaints of pain were found in the workers' waist and right shoulder, which indicates an ergonomic risk. This study aims to analyze the relationship between work posture and MSD complaints using the Rapid Entire Body Assessment (REBA) method. The study was conducted descriptively, qualitatively through direct observation, interviews, and literature studies. The REBA assessment was carried out by measuring the body angles at the neck, back, arms, wrists, and legs during work activities. The results showed that for the first worker, the activity of removing ice blocks from the mold received a REBA score of 10 (high risk), while the process of arranging ice into vehicles received a score of 7 (moderate risk). For the second and third workers, each work activity received a score of 7 (moderate risk). These results are supported by Standard Nordic Questionnaire (SNQ) data, which indicated that the dominant complaints were in the shoulders and waist due to repetitive movements and non-ergonomic work postures. It can be concluded that several work activities pose ergonomic risks that require immediate improvement, particularly the process of removing ice cubes from the mold. Improvements can be made through the use of more ergonomic tools and improved work methods to reduce the risk of injury to workers.

Evaluasi postur tubuh pekerja dalam proses pemindahan es balok dengan Metode Rapid Entire Body Assessment (REBA)

Abstrak_ Ergonomi merupakan aspek penting dalam lingkungan kerja industri, terutama dalam menjaga kesejahteraan pekerja dan meningkatkan produktivitas. Salah satu faktor utama dalam ergonomi adalah postur tubuh pekerja saat melakukan aktivitas kerja, yang berpotensi menimbulkan gangguan musculoskeletal disorders (MSDs). CV XYZ yang bergerak di bidang produksi es balok di Lhokseumawe memiliki kapasitas produksi hingga 1200 es balok per hari dengan proses kerja yang masih didominasi oleh aktivitas manual. Berdasarkan hasil observasi awal, ditemukan adanya keluhan nyeri pada bagian pinggang dan bahu kanan pekerja, yang mengindikasikan adanya risiko ergonomi. Penelitian ini bertujuan untuk menganalisis hubungan antara postur kerja dengan keluhan MSD menggunakan metode Rapid Entire Body Assessment (REBA). Penelitian dilakukan secara deskriptif kualitatif melalui observasi langsung, wawancara, serta studi literatur. Penilaian REBA dilakukan dengan mengukur sudut tubuh pada bagian leher, punggung, lengan, pergelangan tangan, dan kaki selama aktivitas kerja. Hasil penelitian menunjukkan bahwa pada pekerja pertama, aktivitas mengeluarkan es balok dari cetakan memperoleh skor REBA sebesar 10 (risiko tinggi), sedangkan proses penyusunan es ke kendaraan memperoleh skor 7 (risiko sedang). Pada pekerja kedua dan ketiga, aktivitas kerja masing-masing memperoleh skor 7 (risiko sedang). Hasil ini diperkuat dengan data Standard Nordic Questionnaire (SNQ) yang menunjukkan keluhan dominan pada bagian bahu dan pinggang akibat gerakan berulang dan postur kerja yang tidak ergonomis. Dapat disimpulkan bahwa beberapa aktivitas kerja memiliki risiko ergonomi yang perlu segera diperbaiki, terutama pada proses pengeluaran es balok dari cetakan. Perbaikan dapat dilakukan melalui penggunaan alat bantu yang lebih ergonomis serta perbaikan metode kerja untuk mengurangi risiko cedera pada pekerja.
Kata kunci: Ergonomi; postur kerja; musculoskeletal disorders (MSDs); metode REBA; industri es balok.

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1. Introduction

Ergonomics has become an increasingly important field in the workplace, particularly in the industrial sector, where worker well-being and company productivity are primary concerns [1][2]. The proper implementation of ergonomics can minimize the risk of occupational injuries and improve both efficiency and comfort at work [3]. One of the key aspects of ergonomics is workers' body posture, which refers to the position of the body while performing tasks [4]. Inappropriate working postures that do not align with the body's physiological conditions can lead to high ergonomic risks, which in the long term may cause health problems, especially disorders of the musculoskeletal system or musculoskeletal disorders (MSDs) [5][6].

MSDs are often caused by repetitive work activities, excessive force, and non-ergonomic postures such as bending, twisting, or prolonged stooping [7][8]. One of the most common complaints among workers is low back pain, an indicator of physical fatigue caused by an improper workload [9]. If not properly addressed, this condition can reduce work productivity and increase the risk of workplace accidents [10][11].

CV XYZ is a company engaged in the production and distribution of ice blocks, with a production capacity of up to 1,200 ice blocks per cycle, requiring approximately 24 hours for processing. Although some processes have been mechanized, such as the use of cranes to lift ice molds, several stages still require manual labor, particularly in the ice block handling process.

The ice block handling process involves three workers and one crane operator. The process begins with lifting the ice molds from the cooling tank using a crane and transferring them to the immersion tank. The ice blocks are then removed from the molds using a tool called a hook. Afterward, the ice blocks are manually transported to a delivery vehicle and then to a storage room (cold room). These activities involve various movements such as bending, stooping, and repetitive arm and hand motions, which can potentially lead to MSD complaints.

Based on field observations, workers frequently experience pain in the lower back and right shoulder. This indicates the presence of ergonomic risks caused by improper working postures, repetitive movements, and high physical workloads. These ergonomic risks can be analyzed using the Rapid Entire Body Assessment (REBA) method, which is used to quickly evaluate working postures by assessing body positions such as the neck, trunk, arms, wrists, and legs.

Based on these problems, this study aXYZ to analyze the relationship between working posture and musculoskeletal disorder (MSD) complaints among workers at CV XYZ using the REBA method. The results of this study are expected to provide an overview of the level of ergonomic risk experienced by workers and serve as a basis for improving work methods or introducing more ergonomic tools to reduce the risk of occupational injuries.

2. Research Methods

This study used a qualitative descriptive approach to analyze the level of ergonomic risk based on workers' work postures during the ice block transfer process at CV XYZ. The study was conducted during the production process, focusing on activities involving physical labor.

The study subjects consisted of three workers directly involved in the ice block transfer process and one crane operator, with the analysis focusing on workers performing manual activities. Data collection was conducted through direct observation, interviews, documentation, and the use of the Standard Nordic Questionnaire (SNQ) to identify musculoskeletal disorders (MSDs).

Observations were conducted to observe workers' work postures at several stages of the activity: removing ice blocks from the mold, transferring the ice blocks to the transport vehicle, and cutting the ice. Photographic and video documentation was used to aid the analysis of work postures. Interviews were conducted to obtain information regarding physical complaints experienced by workers during work.

Data analysis was conducted using the Rapid Entire Body Assessment (REBA) method to assess the level of ergonomic risk based on workers' body posture. The assessment is conducted by measuring body angles at the neck, back, upper arms, forearms, wrists, and feet, then assigning a score to each area based on the REBA table. These scores are then combined to obtain a final score indicating the ergonomic risk level, as low, moderate, or high.

Furthermore, the REBA analysis results are linked to worker complaint data obtained from the SNQ questionnaire to determine the relationship between work posture and MSD complaints. The analysis results

are then used as the basis for providing recommendations for improving work posture or using more ergonomic assistive devices to reduce the risk of work injuries.

3. Results and Discussion

The study showed that the activity of moving ice blocks at CV XYZ poses significant ergonomic risks. Based on data processing using the Standard Nordic Questionnaire (SNQ), it was discovered that workers experienced musculoskeletal complaints, particularly in the right shoulder and waist. The scores obtained indicated that worker 1 was in the high-risk category with a score of 72, while workers 2 and 3 scored 69 and 70, respectively, which fall into the moderate-risk category. This indicates that repetitive work activities involving significant physical exertion contribute to the emergence of musculoskeletal complaints.

Furthermore, analysis using the Rapid Entire Body Assessment (REBA) method revealed variations in risk levels across each work activity. For worker 1, removing ice blocks from the mold resulted in a REBA score of 10, which falls into the high-risk category. This condition is caused by a hunched working posture with a torso angle of approximately 58°, as shown in Fig. 1, which increases the load on the back and increases the risk of injury. In addition, the use of less ergonomic tools forces workers to work in unnatural positions, thus accelerating muscle fatigue.

(a) (b)

Fig. 1. Analysis of worker 1's work posture in the process of moving ice blocks using the REBA method. (a) posture when pulling ice blocks from the mold; (b) posture when positioning ice blocks for transfer.

Fig. 1 shows an analysis of worker 1's working posture during two key activities in the ice block transfer process: removing the ice block from the mold and positioning the ice block for transfer. Fig. 1(a) shows the worker performing the activity with a fairly extreme bent body position, with the torso angle reaching approximately 58°, the neck angle approximately 23°, and the knee angle reaching 94°. This posture indicates unergonomic working conditions due to the significant load placed on the lower back (lumbar), potentially leading to musculoskeletal disorders (MSDs).

Meanwhile, Fig. 1(b) shows an improvement in the working position, with the torso angle increasing to approximately 89° (more upright), the arm angle approximately 19°, and the wrist angle approximately 14°. Although this posture is relatively better than the previous condition, the worker is still performing the activity in a semi-bent position and using pulling forces, thus still posing a moderate ergonomic risk.

The difference between these two postures indicates that body position significantly influences the level of ergonomic risk. Extremely hunched postures tend to increase REBA scores and the risk of injury, while a more upright posture can reduce stress on the spine. Therefore, improved work methods or the use of more ergonomic tools are needed to minimize the risk of injury to workers.

In the activity of stacking ice blocks into a transport vehicle, the REBA score was 7, which falls into the moderate risk category. Although the working posture was relatively better compared to the previous activity, the load factor exceeding 10 kg and the repetitive work frequency remained the main causes of increased ergonomic risk. This indicates that in addition to working posture, load and repetition factors also have a significant influence on risk levels, as shown in Fig. 2.

Fig. 2. Analysis of work posture in the process of moving ice blocks using the REBA method: (a) initial posture when pulling ice blocks; (b) continued posture when moving ice blocks to the transport area..

Fig. 2 shows an analysis of a worker's work posture while moving ice blocks using a hook. In Fig. 2(a), the worker is seen pulling the ice block with a slightly bent body, with a torso angle of approximately 30° and a neck angle of approximately 27°. This posture is relatively safe compared to extreme postures, but it still places stress on the back due to the pulling force and static position.

In Fig. 2(b), the worker is in the advanced stage of moving the ice block with a torso angle of approximately 19.79°, an arm angle of approximately 19.92°, and a wrist angle of approximately 10°. This

posture demonstrates a more ergonomic position because the body is more upright and the load is more evenly distributed. However, repetitive activities and the use of pulling forces still have the potential to cause muscle fatigue and musculoskeletal disorders in the long term.

The results of this analysis align with the REBA method calculation for worker 2, which showed a score of 7 (moderate risk category). This indicates that although the working posture was relatively better than that of worker 1, ergonomic risks remained due to the repetitive work and physical stress experienced during the ice block transfer process.

For worker 2, the activity of transferring ice blocks from the mold to the transport vehicle resulted in a REBA score of 7, categorized as moderate risk. The worker's posture was relatively stable, with a torso angle of approximately 20°, as shown in Fig. 3. However, continuous activity without adequate rest breaks still has the potential to cause muscle fatigue and musculoskeletal disorders in the long term.

Fig. 3. Analysis of the second worker's working posture during the ice block transfer process using the REBA method: (a) posture while lifting/pulling the ice block; (b) posture while walking while carrying the ice block to the transport area.

Fig. 3 shows the second worker's activities during the process of moving the ice block from the production area to the transport area. In Fig. 3(a), the worker is seen in a bent position with a torso angle of approximately 20°, indicating a load on the lower back during the lifting or pulling of the ice block. This posture is relatively light compared to extreme postures, but it still has the potential to cause fatigue if repeated.

In Fig. 3(b), the worker is in the advanced phase, walking while carrying the ice block to the transport area. His posture appears more upright, with a torso angle of approximately 16°, and arm and wrist angles of approximately 14° each. This condition indicates a more ergonomic posture, but manual load-carrying still places stress on the musculoskeletal system, particularly the arms, shoulders, and back.

This activity falls under the manual material handling category, where ergonomic risks are influenced not only by working posture but also by the weight of the load and the frequency of lifting. Based on the REBA analysis, this activity falls into the medium risk category, requiring improved work methods or the use of assistive devices to reduce the physical workload. Meanwhile, worker 3, who was cutting ice blocks, received a REBA score of 5 to 7, which falls into the medium risk category. The working posture showed a torso angle of approximately 62°, indicating an unergonomic posture. If this condition persists, it increases the risk of musculoskeletal disorders, particularly in the back.

Fig. 4. Analysis of the third worker's working posture during the ice block cutting process using the REBA method: (a) initial posture when cutting the ice block; (b) continued posture during the cutting process.

Fig. 4 shows the third worker's activities during the ice block cutting process before feeding it into the crusher. In Fig. 4(a), the worker is seen cutting with a hunched body position, with a torso angle of approximately 62°, a neck angle of approximately 25°, and a knee angle of approximately 30°. This posture indicates unergonomic working conditions because it places significant pressure on the lower back and increases the risk of muscle fatigue.

In Fig. 4(b), the worker remains in a hunched position with a torso angle of approximately 83°, an arm angle of approximately 35°, and a wrist angle of approximately 14°. This posture indicates an increased load on the arms and shoulders due to the use of cutting tools that require propulsion. Furthermore, the activity is performed repeatedly over a considerable duration, increasing the potential for musculoskeletal disorders (MSDs).

Based on the REBA analysis, this activity falls into the medium risk category. Although not considered a high risk, the combination of a bent posture, force exertion, and repetitive activity still has the potential to cause muscle fatigue and long-term injury. Therefore, improvements in work methods, such as adjusting the

height of the work surface or using more ergonomic tools, are needed to reduce ergonomic risks for workers. Overall, the analysis results indicate that the highest risk activity occurs in the process of removing ice from the mold. This is caused by a combination of an extreme bent posture, the use of non-ergonomic tools, and a heavy, repetitive workload. This finding aligns with ergonomic theory, which states that awkward postures and repetitive activities are the main factors causing musculoskeletal disorders (MSDs).

The correlation between the SNQ and REBA results shows strong consistency, with the most common body parts experiencing complaints, namely the right shoulder and waist, receiving the greatest workload during the ice block removal activity. Thus, although some activities fall into the moderate risk category, the accumulated workload and long work duration, approximately 8 hours per day, still have the potential to increase the risk of occupational injuries.

Based on these results, it can be concluded that ergonomic improvements are essential, particularly in the design of assistive devices and work methods. Without appropriate ergonomic interventions, continuous work activities have the potential to cause health problems for workers and reduce work productivity.

5. Conclusion

Based on the results of data processing using the Rapid Entire Body Assessment (REBA) method and supported by Standard Nordic Questionnaire (SNQ) data, it can be concluded that workers in the process of moving ice blocks experience musculoskeletal disorders (MSDs), especially in the right shoulder and waist. These complaints are caused by repetitive work activities, high physical workloads, and the use of non-ergonomic work tools. Therefore, immediate improvements are needed both in terms of work tool design and work posture improvements to reduce the risk of injury. The results of the REBA analysis show that the activity with the highest level of risk occurs in the process of removing ice blocks from the mold, with a score of 10, which is included in the high risk category. This condition is caused by a hunched work posture and the use of inappropriate tools, which increases the load on the workers' backs. Meanwhile, in the activity of moving ice blocks to the transport vehicle, the risk level is in the medium category with a REBA score of 7. This indicates that although the work posture is relatively better and the tools used are more appropriate, repetition and workload factors still contribute to ergonomic risks. Overall, efforts are needed to improve ergonomics to increase work safety and comfort and reduce the potential for musculoskeletal disorders in workers.

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