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Identification Of Potential Ergonomic Hazards In The Upper Body Using SNI 9011: 2021 At PT. X

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Abstract. *In a rapidly evolving industry, the focus on the risk of Repetitive Occupational Muscle Disorder (GOTRAK) is increasing. Compliance with Indonesian National Standard (SNI) 9011:2021 on ergonomics in the workplace is essential to identify and control these risks. This study aims to pinpoint ergonomic hazards at PT X associated with GOTRAK, so as to provide important insights to improve worker welfare. The study, conducted using a quantitative approach, involved workers from wet and dry production processes in manufacturing. Primary data collection from 57 rotating shift workers, who each worked for 8 hours each day, showed that 32 respondents (56%) faced high upper body GOTRAK risk with the right shoulder (26.3%), left shoulder (14%), and lower back (12.3%) being the most vulnerable areas. The evaluation showed significant ergonomic risks in wet production work such as pre-breaking, breaking, pressing, and handling rubber blankets, and in dry production work such as transporting blankets, grinding, drying, transferring cakes from trolleys, pressing, and weighing. These conditions are considered hazardous, requiring immediate action to improve working conditions and worker welfare.*

Keywords: *Ergonomic Hazards, GOTRAK, SNI 9011:2021*

INTRODUCTION

One of the common risks experienced by workers is occupational skeletal muscle disorders (OSM), also known as work-related musculosceletal disorders (WMSDs). About 40% of all work-related cases are caused by repetitive overloading (Florensia & Widanarko, 2022). GOTRAK is an ergonomic risk that causes complaints or pain due to injuries and disorders of muscles, tendons, joints, nerves and other soft tissues (Badan Standarisasi Nasional (BSN), n.d.-b). Such complaints include discomfort, sprains, muscle strains, and work-related pain, such as neck, back, and shoulder pain, which can result in decreased performance function. Previous studies on laboratory workers have also shown that they are at risk of GOTRAK (Putera et al., 2023).

To reduce the potential risk of hazards in the workplace and ensure protection for consumers, employers, workers, and society in general, it is necessary to implement measures for safety, security, health, and environmental preservation. These measures have been regulated by the Decree of the Head of the National Standardization Agency (BSN) on 21 December 2021 in Indonesian National Standard (SNI) 9011:2021 which addresses the measurement and evaluation of potential ergonomic hazards in the

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workplace (Badan Standarisasi Nasional (BSN), n.d.-b). SNI 9011:2021 serves as a guide for identifying ergonomic risks, assessing their level, and providing guidelines for the development and implementation of effective controls in accordance with Minister of Manpower Regulation No. 5/2018 (Badan Standarisasi Nasional (BSN), n.d.-a).

This study aimed to identify the risk of ergonomic hazards to the upper body in the work environment of PT. X. The company is engaged in the crumb rubber management industry with Indonesian Rubber Standard quality (SIR 10 and SIR 20), and has a production capacity of 25,000 tons/year. Common work activities performed manually by workers include lifting, rolling, drying, cutting, and wrapping processed crumb rubber that can weigh up to 35 kg. This work, if done repetitively every day with the same work posture, has the potential to cause occupational skeletal muscle disorders (GOTRAK) such as pain in the back, hands, waist, shoulders, knees and feet. Therefore, an evaluation of the work is needed to reduce the level of risk of GOTRAK that may arise.

RESEARCH METHODS

This study is a quantitative research approach. The subjects studied were 57 workers involved in the wet production and dry production processes in one of the manufacturing plants. Primary data collection was conducted to obtain information on the potential ergonomic hazards faced by production workers who perform manual work without paying attention to ergonomic principles, as well as to identify the factors that cause these complaints. Data was collected from 57 workers who were divided into several rotational shifts with 3 cycles every day, starting at 08.00 WIB - 10.00 WIB, 11.00 WIB - 14.00 WIB, and 14.00 WIB - 16.00 WIB, with a total working hours of 8 hours per day.

FINDINGS AND DUSCUSSION

A survey of 57 workers on GOTRAK revealed that 26 workers were involved in wet production and 31 workers were involved in dry production.

Tabel 1. Frequency Distribution of Respondent Characteristics

Characteristics	Wet Production		Dry Production	
	f	%	f	%

Gender				
Female	0	0	0	0
Male	26	100	31	100
Age				
<30	6	23	7	23
≥30	20	77	24	77
Dominant Hand				
Right	24	92	30	97
Left	2	8	1	3
Lenght Of Work				
< 3 month	0	0	0	0
3-12 month	3	12	1	3
1-5 month	5	19	9	29
5-10 month	11	42	15	48
>10 month	7	27	6	19
Mental Fatigue				
Never	16	62	19	61
Smotimes	7	27	8	26
Often	2	8	3	10
Always	1	4	1	3
Physicial Fatigue				
Never	2	8	0	0
Smotimes	5	19	3	10
Often	15	58	21	68
Always	4	15	7	23
Complaints Of Occupational Pain Or Illness				
Yes	24	92	31	100
No	2	8	0	0
Previous Injury				
Yes	4	15	5	16
No	22	85	26	84

Table 1 presents the results of job descriptions and the use of the dominant hand in performing work, along with the percentage of workers experiencing mental fatigue, physical fatigue, and pain or discomfort. Table 2 explains that the dominant hand use is the right hand in performing work activities, with the percentage of wet production workers reaching 92% and dry production workers reaching 97%. Job descriptions for production workers are outlined in table 2, where more than 5 years is the length of employment for most workers, with a percentage of 42% for wet production workers and 48% for dry production workers. Mental fatigue was sometimes felt by 27% of wet production workers and 26% of dry production workers. Physical fatigue was frequently experienced by wet and dry production workers, at 58% and 68% respectively. Wet production workers who experienced pain or discomfort accounted for 92%, while dry production workers accounted for 100%. A total of 15% of wet production workers have experienced injuries, while 16% of dry production workers have.

Tabel 2. Distribution of GOTRAK Complaints in the Skeletal Muscle Section of Respondents

Skeletal Muscle Parts	f	%
Neck		
Low Risk	50	87.7
Medium Risk	5	8.8
High Risk	2	3.5
Right Shoulder		
Low Risk	25	43.9
Medium Risk	17	29.8
High Risk	15	26.3
Left Shoulder		
Low Risk	38	66.7
Medium Risk	11	19.3
High Risk	8	14
Upper Back		
Low Risk	51	89.5
Medium Risk	2	3.5

High Risk	4	7
Low Back		
Low Risk	46	80.7
Medium Risk	4	7
High Risk	7	12.3

Based on the results of the study which can be seen in table 2 above, it is known that as many as 2 respondents (3.5%) experienced a high risk of GOTRAK complaints in the neck, as many as 15 respondents (26.3%) experienced a high risk of GOTRAK complaints in the right shoulder, as many as 8 respondents (14%) experienced a high risk of GOTRAK complaints in the left shoulder, as many as 4 respondents (7%) experienced a high risk of GOTRAK complaints in the upper back. A total of 7 respondents (12.3%) experienced a high risk of GOTRAK complaints in the lower back.

1. GOTRAK

Work-related skeletal muscle disorders are one of the most common types of occupational diseases, known as GOTRAK. This disease is widespread throughout the world and is a source of health problems in the work environment (Luan et al., 2018). Presidential Regulation of the Republic of Indonesia Number 7 of 2019 concerning occupational diseases (PAK) classifies GOTRAK as a type of disease related to the target organ. GOTRAK includes conditions such as radialis styloid tenosynovitis, tenosynovitis, olecranon bursitis, prepatellar bursitis, epicondylitis, meniscus lesions, carpal tunnel syndrome (CTS), and other muscle and skeletal diseases (*Peraturan Presiden Republik Indonesia Nomor 7 Tahun 2019 Tentang Penyakit Akibat Kerja*, 2019).

GOTRAK is widespread worldwide and increases workplace health problems and reduces the physiological efficiency of the human body, making it a serious public health issue. GOTRAK is not only experienced by workers who perform heavy physical labor, but is also common among workers in office environments who perform static work and repetitive motions with long duration and monotony. The high incidence of GOTRAK has an impact on occupational diseases, even becoming an epidemic that needs to be studied and resolved (Hijami & Kurniawidjaja, 2022).

Insani, Farah Dzihni, and colleagues in 2023 concluded that manual material handling is an activity that has a high risk of Musculoskeletal disorders. This is caused

by the position of the worker's body that bends forward at an angle of more than 450 when lifting the load (Dzihni Insani et al., 2023).

The results of the study at PT X showed that 32 respondents, equivalent to 56%, experienced GOTRAK complaints in the high risk category. GOTRAK complaints in all respondents were mainly felt in the upper body. This is caused by skeletal muscle complaints that arise due to the bent body position and lack of backrest when doing work, which causes pain. Complaints of skeletal muscles in the hands are caused by repetitive work. During labeling activities, rapid hand movements and lack of support lead to increased pain in the hands during and after work. Complaints of skeletal muscles in the hip are caused by prolonged and static sitting positions during work, which causes strain on the hip muscles and pain.

According to the theory introduced by the European Agency for Safety and Health at Work (2019), the adoption of a static sitting position can increase the stress on ligaments and put additional load on muscles and tendons. Such positions can increase the risk of pain and injury to soft tissues such as muscles, tendons and ligaments because under prolonged static sitting conditions, the shoulders tend to bend. The forward leaning position of the head can also cause stress on the chest muscles and weaken the upper back muscles. Musculoskeletal health effects associated with prolonged static sitting include lower back pain and shoulder and neck complaints (Safitri, 2022).

A similar theory was also presented by Wulandari, Ririn, and colleagues in 2023, which states that the acceptance of static loads by muscles for a long time can result in damage to joints, ligaments, and tendons (Wulandari, Rachmat, & Handoko, 2023).

Slouching is one of the unergonomic postures which means deviation from the neutral position. This significant deviation from the normal position will increase the workload on the muscles, leading to an increased need for power, and inefficient transfer of power from the muscles to the skeletal system. Such conditions can lead to muscular and skeletal disorders. Potential hazards are also associated with lifting activities, where even if the load is not too heavy and the lifting is not too frequent, performing such activities with improper posture can lead to muscular and skeletal disorders (Syifa Nurcholisa, 2023).

2. Body Posture

Work posture refers to the body position taken by a worker while performing their duties, which is often related to the design and work equipment used. Each individual worker has a different working posture, which can lead to decreased concentration and potentially reduce their performance (Larasati, Handoko, & Nadia Rachmat, 2022). Furthermore, potential hazards that can arise in workers include neck bending, which is caused by the tendency for the head to lean and look up or down for long periods of time during the work process. This can cause stiffness and pain in the neck and potentially lead to skeletal muscle disorders (Mindhayani, 2021).

a) Transpertation Of Blanket To Milling Machine

One of the potential risks faced by workers in the dry production department is when transporting blankets to the milling machine. In the picture, workers can be seen taking a posture with arms bent more than 20º, arms above the abdomen, wrists bent forward, body bent more than 45º, ankles bent upward, pushing heavy loads, and doing manual lifting with a weight of less than 7 kg.

b) Drying Work

Having a potential ergonomic hazard has a score value of 7 (score ≥7), so based on SNI 9011: 2021, the potential ergonomic hazard is categorized as dangerous.3 This is because the neck bends >20º forward, arms and elbows that are not supported in a high position, the body bends forward to form an angle of 20º-45º, and the activity of pushing heavy loads.

c) The Job Of Removing The Cake From The Trolley

Having a potential ergonomic hazard has a score value of 10 (score ≥7), so that based on SNI 9011: 2021, the potential ergonomic hazard is categorized as dangerous.3 This is due to the position of the neck bending >20º forward, rapid rotation of the forearm, wrist bending forward the body bends forward to form an angle of >45º, manual lifting activities carried out more than 15 times per shift.

Posture refers to the relative position of body parts while working, which is determined by factors such as body size, work area design, task requirements, and the size of equipment or other objects used. Posture and movement play an important role in the field of ergonomics. Unnatural postures are one of the main causes of skeletal muscle disorders. Work with unergonomic postures and designs can result in excessive use of

force as well as incorrect postures such as twisting the body, bending the body, and performing the same movements repeatedly (Anthony, 2020). Other factors that have a major impact on the risk of MSDs are excessive workload, non-ergonomic body position, and high frequency of exposure to heavy loads, which are the main causes of MSDs (Kusmawan, 2021).

Static postures can increase the load on muscles and tendons, which in turn can cause fatigue or muscle fatigue. Workers who often sit on small stools, especially field workers, are prone to Musculoskeletal Disorders (MSDs), especially in the lower back. Ergonomic risk assessments also show that jobs such as analysts and field workers fall into the high-risk category. Meanwhile, the ergonomic risk level for administrative staff falls into the category that requires further attention. Sitting positions for less than 4 hours a day, with the body bent forward between an angle of 20° to 45°, without adequate back support, and tilting the neck forward at an angle of more than 20°, increase the risk of MSDs. Sitting positions for 3-6 hours also play a role in increasing the risk of MSDs (Kusumawardhani, Djamalus, & Lestari, 2023).

CONCLUSION AND RECOMMENDATION

A total of 32 respondents, equivalent to 56% of the total, faced a high risk of GOTRAK complaints. The most vulnerable body parts were the right shoulder (26.3%), left shoulder (14%) and lower back (12.3%). The high potential risk of GOTRAK complaints is concentrated on the right shoulder and left shoulder. Evaluation and measurement of ergonomic hazards in dry production, work such as blanket transportation, grinding, and cake dispensing from the trolley. In some situations, these conditions are considered hazardous, and require further action to improve working conditions and worker well-being.

To address and prevent GOTRAK complaints in workers, companies can implement the following measures: provide material handling aids that are appropriate to their tasks, especially for manual handling jobs that require great effort; provide instructions before work, including stretching exercises and knowledge of the risks of unnatural postures to reduce the likelihood of unergonomic postures while working; encourage workers to take advantage of breaks by performing muscle relaxation movements for 5-10 minutes to improve blood circulation; educate workers about the

importance of a healthy lifestyle, including quitting smoking, exercising diligently, and eating nutritious foods to increase endurance while working.

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