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The ergonomic factor application for improvement of performance office staff

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Abstract. Comfortable workplace, healthy and safely is the goal of implementing occupational safety and health requirements. Ergonomics is one of the factors that can affect employee productivity. Achieving harmony between labor, equipment, environment, work methods and work processes is the most important application of ergonomics. The purpose of this study is to investigate the improvement of working conditions through the application of ergonomics in the workplace. Ergonomic testing is carried out using the Rapid Upper Limb Assessment (RULA) analysis method to evaluate worker posture on work machines or operating systems and to investigate reduction in upper extremities and Ergonomic Factor Policy Identification (SHORT), which is an ergonomic evaluation method that focuses on frequency, duration, weight and posture to identify ergonomic hazards faced by everyday workers using an assessment system. The results of ergonomic application analysis are on average at a low risk level. Improvements can be made to reduce the level of risk experienced by employees in accordance with ergonomic standards, including improving the design of tables and chairs, adjusting work positions, avoiding odd work positions, stretching muscles while doing work at the computer.

1. Introduction

Computer usage has increased dramatically in the last 20 years. Research shows that 56% of workers use computers while at work. Work-related musculoskeletal disorders (WRMDs) especially involving the neck area are common. Loss of productivity and lack of workers due to musculoskeletal pain complaints can be detrimental to employers. RULA is a commonly used tool for assessing the risk of posture for continuous work in a sitting position, in this way scores are calculated for each body part, among computer users RULA scores produce a pain level of 2, with 52% neck pain and lower back 52%, scores high mobility is associated with high neck pain complaints [1]. Computer users spend a lot of time sitting in static positions on computers, and many suffer from musculoskeletal problems. Office work using a computer with typing activities too long without rest can also cause pain when hands are used. This is known as carpal tunnel syndrome, other pain complaints in the fingers or wrists, the use of ergonomic computer tools and the mouse can also be used to reduce the risk of pain complaints while working with the computer.

The most common factor in computer work is typing frequency, repeated head movement from the keyboard to the monitor where more than 10 times in 1 (one) minute is included in repeated work.

Moreover, this is done over a long period of time, which can result in muscle and skeletal disorders (musculoskeletal disorders) due to static sitting postures in front of the computer. If this type of activity is carried out continuously it can lead to fatigue and injury.

Ergonomic science has been used to solve this problem to get minimum effect on this activity. Ergonomics is the study of human aspects in its work environment such as anatomy, physiology, psychology, engineering, management and design. Ergonomics requires a systematic study for people, workplaces and environments interact with the main purpose of adjusting the working environment with people. Ergonomic may affect in the workforce activity due to mismatch between workplaces (work methods, job placement, tools) and lifting of the workforce [2-4]. Potential ergonomic hazards based on Permanent Number 5 in 2018 include unsuitable work methods, work positions and posture, job design and workplace inconsistencies in employee anthropometry and lifting workloads. Complex interactions between aspects of work (work equipment, work procedures, processes or work systems and work environment with physical, and psychological/human/labor conditions) to tailor aspects of work to conditions in the field, so that they can work safely, comfortably, efficiently, and be more productive.

Office ergonomics is important to note because it is one of the potential dangers and risks that threaten employees in the office. Ergonomic hazards (biomechanical hazards) can come from work design, layout, or bad work. Ergonomic hazards are divided into three type namely work-related hazards such as consisting of duration (consist frequency, load, work order, work priority, and work posture), equipment-related hazards (consisting of dimensions, shape, design shape, and placement of facilities are used to support work) and hazards related to the environment or workplace (consisting of dimensions, areas and layout of the workplace). If the workplace, equipment, and work environment are not well planned, a variety of office effects can occur, such as eye irritation and fatigue (Astenophia) and neck muscle tension (headaches, frozen shoulders).

High frequency of using a computers that do not pay attention to the ergonomic side of the workplace results in a perceived risk to users. According to Watchman users experience excessive fatigue such as, headache, pressure, neck tension, back, arms, shoulders, muscle pain, and other parts directly related to computer work [5]. Static and continuous seating can increase the risk of pain in some parts of the body, as sitting can exert pressure and inhibit the flow of the body and thus reduce the nutrients that the joints absorb [6]. According to Watchman, complaints of high use of computers in the workplace occur due to problems with equipment or facilities, work layout, work environment conditions, or a combination of factors. Improper work layout influences may cause someone to experience poor work posture.

Office work has a very minimal variation of work movement, leading to static and prolonged work position. Working in the office includes work that requires a little muscle movement, but this type of muscle contraction can cause pain if sustained for a long time because the muscles will feel tense.

Government agencies that uses computers as one of the main tools in carrying out daily office activities. In this government almost everyone has a computer on their desk, with a daily use time of 8 hours. The duration of use of a computer can cause discomfort in the eyes, back, hands and feet. The state of the art work of computer workers requires ergonomic work chairs, comfortable chairs that fit the body posture, can be rotated in the right direction, a soft foam base, high and low chair rules. Proper ergonomics can increase productivity. Long sitting position in front of computer can cause pain in back and neck. It is also found that cumulative trauma disorder (CTD) is caused by excessive pressure on the top of the computer user [7], other complaints of discomfort in the neck, right shoulder, upper limbs or upper arms, wrists or fingers [8-9]. Not aware that their work position is awkward, they do not see the connection between the lower arm and upper arm position while operating the keyboard and the appearance of pain in the shoulder joint [10].

Some researcher show that 78.6% of computer workers experience MSD complaints influenced by Body Mass Index (BMI), duration of work, perception of work pressure and body posture, equipment risk factors contributing to MSD including chair height and chairs, working hours, rest periods, work pressure factors [11].

Office ergonomics is an application of ergonomics that covers the entire work environment and tools used such as computer equipment and chairs [12]. The application of ergonomics in the office focuses more on the dangers of using computers. Office hazards are generally caused by improper work posture,

repetitive movement and long-term standing. The dangers of working in the office are also affected by the equipment used, including the mouse, keyboard, monitor, desk and computer chair. Each of these equipment has a prerequisite ergonomic condition, so that the user can use it comfortably. Using the mouse pad can reduce Dorsiflexion, the wrist belt on the mouse can provide comfort to the wrist and thus maintain a neutral hand posture [13]. Long-term use of computers can also cause eye irritation (computer vision syndrome/CVS). Works in front of computers for long periods of time, computer use without UV protection and lens use gaps make CVS worse [14]. CVS is characterized by dry and irritated eyes, eye fatigue, blurred vision, hot eyes, watery eyes, multiple eyesight, headache, sensitivity to light and changes in focus [15].

To determine and identify work postures of people using computers, a test is required, Rapid Upper Limb Assessment (RULA) and The Baseline Risk Identification of Ergonomic Factor (BRIEF). This method are used to measure risk factors for musculoskeletal disorders in the neck and upper body. The main focus of RULA assessment in detail is shoulder / upper arm, elbow / lower arm, wrist, neck and waist. RULA also considers the burdens and displacements made in its assessment. RULA also assesses whether the foot position is stable or not. RULA was developed by McAtamney and Corlett United Kingdom in 1993 [16]. The RULA Method demonstrates the effectiveness of ergonomic intervention on computer operators experiencing WRMSD complaints, Rapid Upper Limb Assessment (RULA) is a method of assessing posture, style, and movement of work activities related to use upper limbs (upper limbs) [17]. The Baseline Risk Identification of Ergonomic Factor (BRIEF) test can identify employee work postures that can be followed from the results of identifying work posture to minimize employee risk. BRIEF review is focuses on the frequency, duration, load and posture of the body to identify the ergonomic hazards faced by everyday workers using the rating system. In this study to test work position, components / office equipment, strength / pressure, repetition and office environment RULA and BRIEF are used in this research.

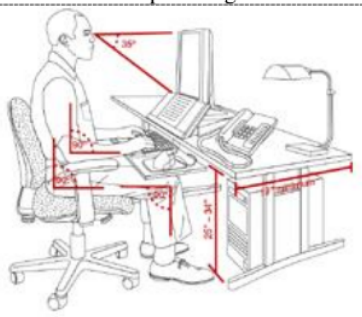
2. Method

Ergonomic method in this research using Rapid Upper Limb Assessment (RULA) and The Baseline Risk Identification of Ergonomic Factor (BRIEF) analyse to solve problem in the Office work. RULA was developed by Mc Atamney and Corlett United Kingdom in 1993 [16]. RULA calculates the ergonomic risk factors in a job where the job is to do a lot of work in a sitting or standing position without switching. The RULA method demonstrates the effectiveness of ergonomic intervention on computer operators experiencing WRMSD complaints. RULA is a method of assessing posture, style, and movement of work activities related to use upper limbs (upper limbs). This method was developed to investigate the risk of informalities experienced by an employee in carrying out work activities that employ top members. RULA calculates risk factors in the form of posture, energy / load, static work and repetition of work. The RULA method is a method of measuring upper body posture that is easy to understand and easy to implement because it has provided guidance on the evaluation procedure of each measured posture. This method also does not take a long time to evaluate. In addition, this method can also measure other ergonomic risk factors in the form of power / load, repetition and static time / work. The Baseline Risk Identification of Ergonomic Factor (BRIEF) test can identify employee work postures that can be followed from the results of identifying work posture to minimize employee risk. BRIEF Review is focuses on the frequency, duration, load and posture of the body to identify the ergonomic hazards faced by everyday workers using the rating system.

The BRIEF method uses three steps in its assessment, namely the assessment of ergonomic risk factors in the work environment, symptom review and medical examination results [18]. This method uses body posture charts and assessment tables to provide an assessment of the risk factors that employees will experience. The risk factors studied in this method are factors described by McPhee 'as external load factors which include amount of movement, static muscle work, strength, work posture determined by equipment and furniture, and restless work hours.

This study was carried out through ergonomic testing using the RULA and BRIEF methods, the investigation was carried out at the Office Staff with samples taken per level floor 2^{nd} to 8^{th} of Government building. The examination is carried out at the time of the official. Tests carried out with direct attention and image capture. Investigation data collection is done by filling out the RULA and

BRIEF assessment sheets. In filling out the RULA assessment sheet, he is assisted by looking at the position of the worker, the state of work ease, taking pictures with a camera and measuring the ease of work. Figure 1 show the workplace ergonomic and seating guide in the office.



Good posture

Source: : Workplace Ergonomics Reference Guide

Good posture

Source: Seating Guide, Worksafe British Columbia 2009

Figure 1. Workplace Ergonomics and seating guide [10]

3. Result and Discussions

Analysis of the results of ergonomics testing using the RULA and BRIEF methods based on the results of the analysis of the Laboratory of the Directorate of Occupational Safety and Health as shown in Fig. 2 and 3. Figure 2 show the position working place of Ministry, Secretary and Employee in 2nd Floor. In Ministry Room no recommendation for improvement BRIEF due to support at the back and shoulder/arm is well and good. No risk in of wrist disturbance so this place it's good for activity. In the administration place there was no improvement but it ensure writing activity was separate from the operation area of computer. They have BRIEF for back is not support properly, have risk disturbance wrist, neck not likely to result in stiffness in the neck muscles.

Similarly with Administration place, General Secretary have BRIEF condition not supportedproperly such as rear posture is not supported properly, as personnel must reach the computer mouse, shoulder/arm position is not appropriate to the height of the table, the reach is too far, keyboard position is uneven and far from the wrist, risk of wrist disturbance. The legs are imperfect so the leg posture is bent inward. The recommendation is the writing work is separated from the computer desk, so there is enough space and reach for the hands, provides stitches/ keyboards that allow the wrist to be in neutral position as the keyboard is at the elbow level, re-position the monitor so that the horizontal operator can see straight, directs to rest periodically by moving the wrist to reduce static posture, slowly bend / bend your neck forward, as well as bend back and forth to relieve muscle cramps, put the foot down and provides training on ergonomic hazard awareness.

For other floor such as 3-6th floor they have similar case or observation with the Administration and Secretary Room. For 3th Floor Data and Information centre the recommendation is similar with the Secretary Room provides stitches/keyboards that allow the wrist to be in neutral position as the keyboard is at the elbow level, directs to rest periodically by moving the wrist to reduce static posture, move the cabinet under the table, so that there is enough leg space, slowly bend/bend your neck forward, as well as bend back and forth to relieve muscle cramps, put the foot down, provides training on ergonomic hazard awareness. Biro KLN Room have no recommendation for improvement.

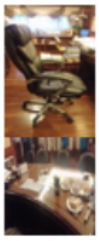
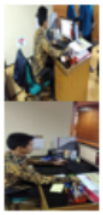
Picture	Observation Results	Risk Value Legend	Recommendations for Improvement
	2nd Floor THE MINISTRY ROOM		
	**BRIEF: 0** **The back** →Back-up posture is well supported at the back, so personnel feel comfortable when reaching for letters / books or phones at work desks. **Shoulder / arm** →Natural shoulder / arm position according to the height of the table, good reach. **Wrist** →Position of objects flat and adequate from wrist **Wrist posture for dynamic writing** → There is no risk of wrist disturbance. The foot is perfect so the posture does not bend inside. **Neck** → neck posture for the front (flexion) and the front of the spinal disc, not likely to result in stiffness in the neck muscles.		No Improvement
	2nd Floor ADMINISTRATION OF MINISTRY ROOM		
	**BRIEF: 1** **Back** → Rear posture is not supported properly, as personnel must reach the computer mouse. **Shoulder / arm** →Natural shoulder / arm position according to table height **Wrist** →Keyboard position is uneven and far from the wrist **Wrist posture to type firmly** → risk of wrist disturbance. The legs are imperfect so the leg posture is bent inward. **Neck** → neck posture for the front (flexion) and the front of the spinal disc, not likely to result in stiffness in the neck muscles.		There was no improvement, but it ensured writing activity was separate from the operating area of the computer.
	2nd Floor GENERAL SECRETARY ROOM		
	**BRIEF: 2** **Back** →Rear posture is not supported properly, as personnel must reach the computer mouse. **Shoulder / arm** → Shoulder / arm position is not appropriate to the height of the table, the reach is too far. **Wrist** →Keyboard position is uneven and far from the wrist. **Wrist posture to type firmly** → risk of wrist disturbance. The legs are imperfect so the leg posture is bent inward.		The writing work is separated from the computer desk, so there is enough space and reach for the hands. Provides stitches / keyboards that allow the wrist to be in neutral position as the keyboard is at the elbow level. Re-position the monitor so that the horizontal operator can see straight Directs to rest periodically by moving the wrist to reduce static posture. Slowly bend / bend your neck forward, as well as bend back and forth to relieve muscle cramps Put the foot down. Provides training on ergonomic hazard awareness.

Figure 2. Workplace and seating for 2nd Floor in Ministry Room.

In Figure 4 the observation result of 4-6th Floor show that Binapenta Room have similarly case with the General Secretary Room and Data and Information Centre Room. For administration of Sesitjen Room there is no improvement and Binalatas Room have recommendation such as to move the archives under the table, so that there is enough leg space, put the foot down, and provides training on ergonomic hazard awareness.

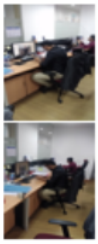
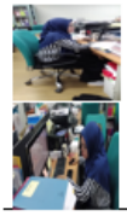
Picture	Observation Results	Risk Value Legend	Recommendations for Improvement
3rd FLOOR DATA AND INFORMATION CENTER ROOM			
	**BRIEF**: 2 **Back** → Rear posture is not supported properly, as personnel must reach the computer mouse. **Shoulder / arm** → Shoulder / arm position is not appropriate to the height of the table, the reach is too far. **Wrist** → Keyboard position is uneven and far from the wrist Wrist posture to type firmly → risk of wrist disturbance. The legs are imperfect so the leg posture is bent inward and space is limited		Provides stitches / keyboards that allow the wrist to be in neutral position as the keyboard is at the elbow level. Directs to rest periodically by moving the wrist to reduce static posture. Move the cabinet under the table, so that there is enough leg space. Slowly bend / bend your neck forward, as well as bend back and forth to relieve muscle cramps Put the foot down. Provides training on ergonomic hazard awareness.
3th FLOOR BIRO KLN ROOM			
	BRIEF: 1 **Shoulder / arm** → Shoulder / arm position is not appropriate to the height of the table, the reach is too far. **Wrist** → Keyboard position is uneven and far from the wrist Wrist posture to type firmly → risk of wrist disturbance.		There is no improvement, but keep writing activities separate from the computer operating area. By moving the archive stack, so that the writing work is done, so that there is sufficient space and reach Put the foot down.

Figure 3. Recommendation workplace and seating for 3th Floor in Information Centre and Biro KLN Room

Picture	Observation Results	Risk Value Legend	Recommendations for Improvement
4th FLOOR BINAPENTA ROOM			
	**BRIEF**: 2 **Back** → Rear posture is not supported properly, as personnel must reach the computer mouse. Shoulder / arm → Shoulder / arm position is not appropriate to the height of the table, the reach is too far. **Wrist** → Keyboard position is uneven and far from the wrist **Wrist posture to type firmly** → risk of wrist disturbance. The legs are imperfect so the leg posture is bent inward and space is limited		Provides stitches / keyboards that allow the wrist to be in neutral position as the keyboard is at the elbow level. Directs to rest periodically by moving the wrist to reduce static posture. Move the cabinet under the table, so that there is enough leg space. Slowly bend / bend your neck forward, as well as bend back and forth to relieve muscle cramps Put the foot down. Provides training on ergonomic hazard awareness.
5th FLOOR, ADMINISTRATION OF SESITJEN ROOM			
	**BRIEF**: 1 **Back** → The back posture is not well supported on the back. **Shoulder / arm** → Shoulder / arm position is not appropriate to the height of the table, the reach is too far. **Wrist** → Keyboard position is uneven and far from the wrist		No improvements, the room is ergonomic, but ensures adequate lighting for reading and writing. Provides training on ergonomic hazard awareness.
6th FLOOR, BINALATAS ROOM			
	**BRIEF**: 1 The legs are imperfect so the leg posture is bent inward and space is limited		There is an improvement, which is to move the archives under the table, so that there is enough leg space. Put the foot down. Provides training on ergonomic hazard awareness.

Figure 4. Recommendation workplace and seating for 4-5th Floor

4. Conclusions

Based on the results of the ergonomic testing using the RULA and BRIEF methods are obtained that in this office have some improvement for writing work is separated from the computer desk, moving some cabinet to have enough space and reach for the hands, adequate lighting for reading and writing, provides stitches/keyboards to be in neutral position at the elbow level, re-position the monitor into the horizontal direction to easily operate and seen, directs to rest periodically by moving the wrist to reduce static posture, slowly bend/bend your neck forward, as well as bend back and forth to relieve muscle cramps and put the foot down.

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