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Identifying Risk Factors in An Office Work Environment Using the Rapid Office Strain Assessment: A Case Study

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Abstract: The amount of computer work has dramatically increased in the past twenty years. This increasing trend has not come without a cost to the wellbeing of workers. Repetitive motion of the fingers, hands and wrists, sustained awkward postures of the wrist and forearm, and contact pressures in the wrist have been proposed as possible mechanisms of injury related to the use of the keyboard and mouse. Several tools have been proposed to identify the risk factors associated with this condition, e.g., the rapid upper limb assessment (RULA), the office ergonomic assessment tool (OEA), the Quick Exposure Checklist, and the Assessment of Repetitive Tasks. However, neither of these tools feature risk factors that are specific to office work. This study then employs the Rapid Office Strain Assessment (ROSA) that can quickly quantify risks associated with each component of a typical office workstation. ROSA is proven to be an effective and reliable tool for identifying computer use risk factors related to discomfort. A case study was conducted in a strategic planning and business development division of PT XYZ by applying ROSA to identify the associated risk factors. The result shows that 72% of the eleven workers acting as respondents have risky work posture. Several recommendations are also provided to reduce the potential risk factors in an office work environment.

Keywords: case study; office ergonomics; rapid office strain assessment; risk assessment.

Introduction

It cannot be denied that computer use is increasing nowadays (Gajšek et al., 2022). This technology makes a huge contribution to carrying out administrative tasks in the office. However, it should be noted that computer usage habits have great potential to change the way workers work and as well as the habits of the workers.

Workers are important assets for a company. Much of company's productivity depends on how workers do their works. However, companies often pay a little attention to the needs and interests of the workers, especially office workers. Office workers indeed have less potential for work hazards than workers who are directly in the production floor. But that does not mean it is without occupational hazards. If this is not given special attention, it can become an occupational risk factor. Work risk factors can occur due to high office working hours with monotonous posture, inappropriate work load or demands, unsafe body posture, repetitive activities, and office equipment that is not ergonomic. Work processes that are not supported by ergonomic work methods and facilities can cause workers to feel uncomfortable and experience musculoskeletal complaints or Musculoskeletal Disorders (MSDs) (Aprico et al., 2019).

MSDs are recognized as a damage that affects the musculoskeletal system of the human body, especially at bones, spinal discs, tendons, joints, ligaments, cartilage, nerves, and blood vessels (Korhan et al., 2019). During certain work activities, the human body can experience injury due to repetitive movements, forces and vibrations. Previously, there have been many studies looking at the relationship between workers and computers and musculoskeletal problems (Aytutuldu et al., 2020; Borhany et al., 2018). In fact, awkward

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posture when working with a computer has a real effect on many parts of the body such as tendons, bones, muscles and nerve tissue (Borhany et al., 2018). In his research, Robertson et al. (2013) shows that there is an increase in the number of workers with computers who suffer from MSDs problems, such as carpar tunnel syndrome, low-back pain and even neck pain.

Identifying things related to risk factors, especially parts that can be modified for the better, is the first and crucial thing in the prevention stage. In the risk control hierarchy, there are six levels to handle potential job risks. At the first level, what can be done is eliminating the source of risk as a better solution because no exposure can occur (CDC, 2023). Of course, in this case, the potential for MSDs to occur is greatly influenced by poor working posture. In eliminating work postures, it is necessary to analyze work postures first, to find out whether the postures used are risky or not. Several tools have been proposed to identify the risk factors associated with this condition, e.g., the rapid upper limb assessment (RULA), the office ergonomic assessment tool (OEA), the Quick Exposure Checklist, and the Assessment of Repetitive Tasks. However, none of these tools feature risk factors that are specific to office work. This study then employs the Rapid Office Strain Assessment (ROSA) that can quickly quantify the risks associated with each component of a typical office workstation. By using ROSA, an analysis of workers' body posture is carried out at each work station and designs proposals for improving work methods or work stations to minimize the risk of MSDs to workers while working.

Materials and Methods

Study area

This cross-sectional analytical study was conducted in 2023. Data collection was carried out at one of the companies operating in the logistics and maritime sector in East Jakarta. The strategic planning and business development division is divided into two sub-divisions, strategic planning sub-division and business development sub-division, with one manager in each sub-division. The total sample in this study was 11 workers from the total number of 13 workers. The sample in this study was confirmed to have worked in this division for at least one year and had no history of major musculoskeletal trauma and neurological or orthopedic diseases.

Procedures

Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)

After explaining the purpose of the research to the workers and obtaining consent to be a research sample from the workers, an explanation was made of how to fill out the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). After that, workers were directed to complete the questionnaire but still with assistance from the researcher. When filling out the questionnaire, workers were asked not to be close to each other to avoid biased answers due to seeing the answers of other workers. Along with the CMDQ questionnaire, workers are also asked to complete demographic data (i.e., information about gender, and recruitment time).

CMDQ was developed by Allen Hedge in 1999 as a self-administered questionnaire. The form of illness and discomfort in 12 body parts was assessed by multiplying the three parts of this questionnaire (frequency, severity, and impact on work ability). The results of the questionnaire have been completed recapitulate. After that, weighting is carried out by multiplying the values obtained according to the categories below:

a. Frequency
   - Never = 0
   - 1-2 times/week = 1.5
   - 3-4 times/week = 3.5
   - Every day = 5
   - Several times every day = 10
b. Discomfort
   - Slightly uncomfortable = 1
   - Moderate uncomfortable = 2
   - Very uncomfortable = 3
c. Interfere
   - Not at all = 1
   - Slightly interfered = 2
   - Substantially interfered = 3

Then, a score will be obtained for each body part.

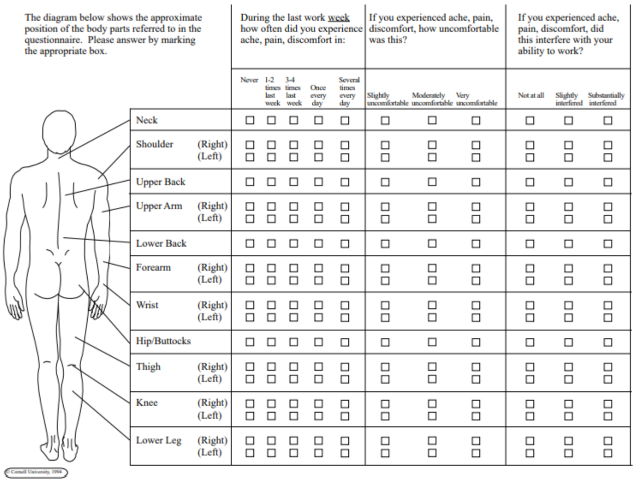

Figure 1. Cornell Musculoskeletal Discomfort Questionnaire

Rapid Office Strain Assessment (ROSA)

The rapid office strain assessment (ROSA) is carried out while the worker is working at a computer desk. The posture assessment was carried out by the researcher himself. The assessment is given based on observations of the worker's posture and the condition of the worker's environment (work desk) and then assessed using the ROSA checklist. To prevent bias during the assessment, observations are carried out in the first 4 hours of the work shift and are based on the first visit of the worker to be assessed. Apart from that, workers who are recovering from illness are also given a week's gap from the first day they return to work.

The ROSA method is based on the ISO 9241:1997 standard for evaluating ergonomic risk factors when using a computer. Evaluation with ROSA is carried out not only on working posture, but also on chairs, monitors, phones, mice and keyboards. In this method, the assessment is given in the form of a score ranging from 0 to 10. This score will then represent the level of risk from the posture carried out by the worker.

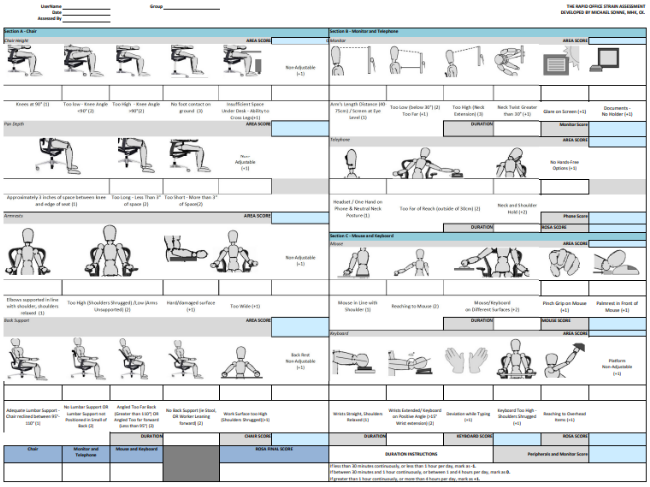

Figure 2. Rapid Office Strain Assessment Questionnaire

Postural risk levels are based on the final score classification obtained as follows (Mianehsaz et al., 2022).

- If the score is less than 3 then it is at a low risk level or does not need further treatment.
- A score of 3-5 is considered at the moderate level
- A score of 6-10 means the posture is at a high-risk level or requires treatment as soon as possible.

Data Analysis

The CMDQ and ROSA methods are used to process data. CMDQ is used as an approach to mapping MSDs complaints among workers, which parts of the body experience MSDs complaints. Next ROSA is used for calculate the dangers attached to computer use and to determine the level of change depending on the information of the employee who is feeling unsafe

Results and Discussion

Results

From the 11 workers, 45% of the sample of workers were women and 55% were men. Based on the data processing that has been carried out, the results show that the highest complaints are from SPBD Function workers is in the section neck (neck) by 26%, lower back (lower back) by 23% and upper back (upper back) by 19%.

After obtaining information about complaints about the workers' body parts, the researchers then carried out a work posture assessment using the Rapid Office Strain Assessment (ROSA) method. This aims to see whether complaints that occur in workers' body parts are related to work posture. Based on ROSA data processing, it is known that as many as eight SPBD Division workers received a ROSA assessment score > 5. Because as many as 72% of workers had a ROSA assessment score > 5, this shows that the facilities and awareness for maintaining an ergonomic work posture are still not good enough.

Tabel 1. Frequency Distribution of Employees' Responses to Musculoskeletal Status Based on Cornell Questionnaire.

Organ	Frequency					Discomfort			Interference		
	Never	1-2 times/ week	3-4 times/ week	once every day	several times every day	slightly uncomfort able	moderate uncomforta ble	very uncomfortab le	not at all	slightly interfered	substantiall y interfered
Neck	1	3	0	1	6	1	5	5	2	6	3
Shoulder											
Right	2	1	4	3	1	3	5	3	4	1	6
Left	5	1	2	3	0	5	4	2	5	1	5
Upper Back	0	3	4	2	2	2	5	4	0	7	4
Arm											
Right	4	5	2	0	0	7	3	1	5	6	0
Left	6	4	1	0	0	7	3	1	6	5	0
Lower Back	1	0	3	5	2	2	5	4	0	6	5
Forearm											
Right	7	4	0	0	0	10	1	0	8	3	0
Left	7	4	0	0	0	10	1	0	8	3	0
Wrist											
Right	4	3	3	1	0	5	6	0	8	1	2
Left	7	3	1	0	0	7	4	0	9	1	1
Hip/Buttocks	7	4	0	0	0	4	6	1	8	2	1
Thigh											
Right	10	1	0	0	0	11	0	0	10	1	0
Left	10	1	0	0	0	11	0	0	10	1	0
Knee											
Right	9	2	0	0	0	11	0	0	11	0	0
Left	9	2	0	0	0	11	0	0	11	0	0
Leg											
Right	10	1	0	0	0	11	0	0	11	0	0
Left	10	1	0	0	0	11	0	0	11	0	0

Tabel 2. MSDs Score Result from CMDQ.

Body Part	Frequency	Discomfort	Interfere	Total	%
Neck	69,5	26	23	41561	26%
Shoulder R	40,5	22	24	21384	14%
Shouler L	23,5	19	22	9823	6%
Upper Back	48,5	24	26	30264	19%
Upper Arm R	14,5	16	17	3944	3%
Upper Arm L	9,5	16	16	2432	2%
Lower Back	55,5	24	27	35964	23%
Forearm R	6	12	14	1008	1%
Forearm L	6	12	14	1008	1%
Wrist R	20	17	16	5440	3%
Wrist L	8	15	14	1680	1%

Hip/Buttocks	6	19	15	1710	1%
Thigh R	1,5	11	12	198	0.13%
Thigh L	1,5	11	12	198	0.13%
Knee R	3	11	11	363	0.23%
Knee L	3	11	11	363	0.23%
Lower Leg R	1,5	11	11	181,5	0.12%
Lower Leg L	1,5	11	11	181,5	0.12%
Total				157703	100%

Tabel 3. Ergonomic Evaluation of Employees Using Rapid Office Strain Assessment Method

ROSA	Mean	STD.DEV
Chair		
Chair Height	2.27	0.4670994
Pan Depth	2.09	0.3015113
Armrest	3.00	0.7745967
Back Support	3.09	0.3015113
Monitor and Telephone		
Monitor	2.91	0.3015113
Telephone	1.00	0
Mouse and Keyboard		
Mouse	1.55	0.9341987
Keyboard	2.36	0.6741999
Total Score	6.18	0.8738629
Low Risk	0	
Moderate Risk	4	0.3636364
High Risk	7	0.6363636

Discussion

In this study, the most frequent complaints from workers were on the neck, then the lower back and upper back. This is in line with the results of several previous studies (James et al., 2018; Mianehsaz et al., 2022). There sults are acceptable because the common cause of this discomfort, especially in the neck, is the tendency of office workers using computers to perform flexion and extension movements. This result has been proven by previous research, using a smart system based on Bragg Grating Sensors (FBGs), which revealed that awkward poses (flexion/extension) in the neck are the main cause of neck pain (Presti et al., 2019). However, other previous research obtained different results, where (Riyahi et al., 2019) obtained the highest results for discomfort in the lower back, only then followed in second place, namely in the neck. Many factors can cause differences in organ research results with the highest MSDs complaints, such as working environmental conditions (differences in chair specifications, computer heights and so on), the amount of working time in one shift and even the details of each individual's tasks.

Based on the results of the MSDs complaint assessment carried out using CMDQ, it can be seen that the right side of the body has a higher level of discomfort complaints. This can be seen from the upper body, namely the shoulders, arms and wrists. However, for the lower body such as thighs, knees and legs, there was no difference in the level of discomfort complaints. Differences in discomfort due to MSDs which are more dominant on the right side can occur because there are dominant and non-dominant sides on the human body (Krzysztofik et al., 2021). Another reason why the upper right side of the body's organs can have a higher level of discomfort is due to using the mouse on the right side. This indirectly causes the right side of the worker's body to work more often.

Posture assessments carried out with ROSA show that 63.64% of the total number of workers have unergonomic postures and work environments and 36.36% of workers have a moderate risk level. The high number of workers in the moderate risk level category can occur due to several factors, starting from work equipment (i.e. chairs, monitors, mice, etc.), work habits to workers' lack of knowledge regarding ergonomic work postures (Safarian et al., 2019). Apart from this, the researcher's personal assessment can also be another differentiating factor in giving scores for posture and work equipment.

Conditions with ergonomic risks carried out by workers certainly need special attention. In this case, there are several interventions that can be done to prevent MSDs in workers, namely facilities, work posture and work habits. Working posture can be adjusted by ensuring that the shoulders are relaxed and the arms are parallel to the floor, the height of the monitor is at eye level with a distance of 45-70 cm, the back position is relaxed with the backrest (90° angle). O-110°) and ensure your thighs are parallel to the floor (UNC, 2023). Intervention in work can be done by stretching every 45 minutes (Dwi Purwantini & Ruslani, 2021) and the 20-20-20 rule. The 20-20-20 rule contains recommendations to take a break every 20 minutes looking at a computer screen by looking at an object 20 feet away or about 6 meters for 20 seconds. This rule can reduce eye fatigue due to long-term use of computer screens (Aprico et al., 2019). This form of intervention can also be carried out by improving work facilities. In improving work facilities, many health institutions have provided recommendations regarding good work facilities (Sjarif & Ferdinand, 2022). Some recommendations for improving facilities that can be made are adjustable chairs, keyboard and mouse should be placed on the same surface and at a height slightly lower than the neutral position of the forearm, vertical use of the mouse, etc. Several recommendations for improvements that can be made include four work facilities that generally exist in the work environment of office workers.

1. Chair

Ergonomic chairs have the following adjustable features:

- Seat pan: can be adjusted in height and distance. A good chair has a distance between the edge of the seat and the knees of 3 inches or around a human wrist. Seats should have a slightly curved shape rather than a square to reduce pressure on people's legs.
- Backrest: can be adjusted in height and angle. The ideal backrest should have sufficient height to support the user's back, shoulders and neck, neither too high nor too low. The backrest angle should be adjustable between 90°–110°.
- Lumbar support: can be adjusted in height and distance. Lumbar support can support the natural curvature of the spine to reduce complaints of low back pain.
- Armrests: can be adjusted in height, width and rotating ability. Armrests should be able to allow the user to maintain a neutral body position, have an adjustable feature, and can rotate to adjust the position of the user's hands.

2. Monitor

   The top of the monitor is almost the same height as your eyes when sitting. The distance between the eyes and the monitor is around 45-70 cm. Position the monitor slightly upwards.

3. Keyboard and mouse

   The keyboard and mouse should be placed on the same surface and at a height slightly lower than the neutral position of the forearms. The majority of workers use standard type mouse. This type of mouse is easy to find and is the most commonly used, but it has the weakness of not supporting a neutral position of the hand, wrist and elbow. The recommendation for using a good mouse is to use a vertical mouse. A vertical mouse can support a neutral position of the hand, wrist and elbow and minimize contact stress. However, for users who are used to using a standard mouse, it will be a little difficult to adapt to using a vertical mouse.

4. Document holder

   Document holders are needed for workers with jobs that often use documents. The recommended document holder is an in-line document holder so that workers can carry out typing work using a computer while viewing documents with their body posture remaining in a normal position.

Conclusions

From the 11 workers studied, 45% of them were women and 55% were men. Based on the use of the CMDQ method, it was found that the highest complaints in the body parts were the neck (26.35%), lower back (22.80%), and upper back (19.19%). The results of the ROSA score show that 63.64% of workers are exposed to high risk and 36.36% to moderate risk related to unergonomic work postures and environments. Analysis of the relationship between ROSA and CMDQ shows that there is no positive relationship between the ROSA variable and the level of worker discomfort. It was found that the most common complaints from workers were on the neck, followed by the lower back and upper back. This is in line with the results of previous research. The results of the CMDQ assessment showed that the level of discomfort complaints was higher on the right side of the body, especially on the upper parts such as the shoulder, arm and wrist. The research results also show that the majority of workers (63.64%) have a posture and work environment that is not ergonomic. There was no significant relationship between posture and work station (assessed based on ROSA) and MSDs complaints from Cornell's questionnaire. The research also notes that results can be influenced by factors such as differences in work equipment specifications, work time, and individual tasks. In addition, differences in assessment methods and number of respondents can influence research results.

Conflict of Interest: The authors declare that there are no conflicts of interest concerning the publication of this article.

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