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Risk Analysis of Musculoskeletal Disorders (MSDs) Among Computer User Workers in Makassar

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Abstract

There is interaction between humans and machines, namely interaction between office employees and the use of computers that function as a medium to support work activities every day. Workers who apply non-ergonomic work postures have about 12 times greater chances of experiencing Musculoskeletal Disorders (MSDs). MSDs complaints that attack the skeletal muscles as a trigger factor for reduced productivity, loss of working hours, high maintenance and material costs, to low quality of work and even early retirement. MSDs complaints are generally characterized by pain that usually occurs with a continuous frequency. This study aims to analyze the risk factors for the incidence of Musculoskeletal Disorders (MSDs) complaints in computer user workers, especially in individual factors and work posture. This study used a cross-sectional study approach, with a total sampling technique of 72 computer user workers at in Makassar. Nordic Body Map questionnaire was used to determine MSDs complaints and Rapid Office Strain Assessment for work posture assessment. Age (p = 0.003), gender (p = 0.006), work period (p = 0.008), exercise habits (p = 0.005) and work posture (p = 0.000) are associated with MSDs complaints, BMI (p = 0.873) is not associated with MSDs which was previously a bivariate result using the chi-square test then a binary logistic regression test was performed with the results of work posture having an Exp(B)/OR = 8.673. It is concluded that work posture is the most influential factor. The company can form a health promotion unit to educate about ergonomics and have a sound reminder system that aims to invite workers to do workplace stretching exercises.

Keywords: *Musculoskeletal Disorders (MSDs), Work Posture, Computer User Workers.*

INTRODUCTION

Workers who use computers about 85% use them every day with a relatively high level of use to complete work. Computer users but do not pay attention to ergonomics lead to risks that will attack workers, one of which is MSDs. There is interaction between humans and machines, namely the interaction between office employees and the use of computers that function as a medium to support daily work activities. Employees who work in front of a computer can generally

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reduce a person's physical activity [1]. When carrying out work, workers certainly expect the results to be maximized by using maximum energy to complete their tasks. Work posture as an internal factor with a considerable role related to ergonomics to be able to consider the relationship between humans, work tools and the environment [2].

Study by the National Institute of Occupational Safety and Health (NIOSH) on 2011, in Malaysia found 70.6% of employees using computers 61.4% complained of low back, neck and shoulder pain. Surveys in the European region, especially in the United Kingdom, there are as many as 6.9 million people losing their jobs due to MSDs with complaints as many as 19% of workers experiencing MSDs in the lower limbs, 41% in the upper limbs including the neck and 40% in the back. The incidence of MSDs is experienced by male workers, namely 1,520 cases per 100,000 workers, while for women there are 1,450 cases per 100,000 workers. The age range that dominates the incident is age over 35 years, which is around 5,060 cases per 100,000 workers [3].

Applying unergonomic postures while working for a long duration will cause problems in the muscular and skeletal systems that affect human health. The mismatch between humans and the workstation used at work disrupts activities and work [4]. The frequency of using computers that are not ergonomic when working will trigger health problems [2]. Workers who apply non-ergonomic work postures have about 12 times greater chances of experiencing MSDs than workers with ergonomic work postures [6].

The existence of complaints of Musculoskeletal Disorders (MSDs) as a disorder that can be felt by anyone who attacks the skeletal muscles with mild to severe complaints. Muscles will get static loads in a frequency that is often enough with a long enough time so that it can make damage to the muscle area, nerves, tendons, joints, cartilages and also intervetebrate discs. The complaints that usually arise such as feeling fatigue, aches, and also pain that attacks the neck, back, waist, shoulders, wrists, and will also cause tingling in the leg area. These complaints will arise due to the lack of understanding of the right posture and what should be applied during activities and work, so that when workers do not realize when doing activities or working they will apply more postures that are classified as risky [7].

MSDs as a trigger factor for reduced productivity, loss of working hours, high maintenance and material costs, to low work quality [8] and even early retirement [9]. Musculoskeletal pain experienced by a person can cause permanent disability if it cannot be treated [10]. Musculoskeletal Disorders (MSDs) are generally characterized by pain that usually occurs with a continuous frequency, resulting in decreased mobility, to reduce a person's dexterity and ability to work, as well as pain that arises during activities. These events occur especially in the structure of muscles and skeletal bones which is a fairly common form of pain found [11].

METHOD

This research is a type of quantitative research that uses observational analytic methods with a cross-sectional study approach. The cross-sectional approach is a study conducted by making an observation and also measuring variables at that time and at a certain time only. Using Nordic Body Map to determine MSDs complaints and Rapid Office Strain Assessment to measure work posture. Using the total sampling method with 72 respondents. Bivariate analysis was conducted in order to identify the relationship between the independent variable and the dependent variable, namely testing the hypothesis using the Chi Square test and then presented in the form of data interpretation, frequency distribution tables and cross tabulation. Using multivariate analysis in order to determine the variable that has the greatest influence using binary logistic regression.

RESULTS AND DISCUSSION

Table 1. Computer User Workers Demographic

Variable	n	%
Age		
Old (> 35 Years)	41	56,9
Young (< 35 Years)	31	43,1
Gender		
Female	40	55,6
Male	32	44,4
Work Period		
Old (> 5 Years)	42	58,3
New (< 5 Years)	30	41,7
Body Mass Index (BMI)		
Not Normal	32	44,4
Normal	40	55,6
Exercise Habit		
Less (<3x/Week)	47	65,3
Enough (>3x/Week)	25	34,7
Work Posture		
High Risk	52	72,2
Low Risk	20	27,8

Source: Primary Data, 2023

Based on table 1, it is known that respondents in the study based on age consisted of 41 people (56.9%) > 35 years. According to the gender of the respondents consisted of 40 people (55.6%) female. Based on the working period, 42 people (58.3%) were old workers. Based on body mass index, 40 people (55.6%) had normal BMI. Based on exercise habits, 47 people (65.3%) do not exercise regularly. Based on work posture consisted of 52 people (72.2%) high risk.

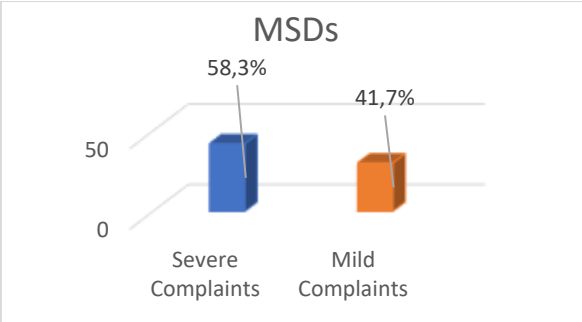

Figure 1. Distribution of MSDs Complaints in Computer User Workers

Source: Primary Data, 2023

Based on chart 1, there are 42 (58,3%) respondents who experience severe MSDs complaints and 30 (41,7%) people with mild MSDs on computer user workers.

Table 2 Relationship Between Independent Variables and Musculoskeletal Disorders (MSDs)

Variables	*Musculoskeletal Disorders*				Total		P Value
	There is		There is No				
	n	%	n	%	n	%	
Age							
Old (>35 years)	30	73,2	11	26,8	41	100	0,003
Young (<35 years)	12	38,7	19	61,3	31	100	
Gender							
Female	29	72,5	11	27,5	40	100	0,006
Male	13	40,6	19	59,4	32	100	
Work Period							
Old (> 5 years)	30	71,4	12	28,6	42	100	0,008
New (< 5 years)	12	40,0	18	60,0	30	100	
Body Mass Index (BMI)							
Not Normal	19	59,4	13	40,6	32	100	0,873
Normal	23	57,5	17	42,5	40	100	
Exercise Habits							
Less	33	70,2	14	29,8	47	100	0,005
Enough	9	36,0	16	64,0	25	100	
Work Posture							
High Risk	38	73,1	14	26,9	52	100	0,000
Low Risk	4	20,0	16	80,0	20	100	
Total	**42**	**58,3**	**30**	**41,7**	**72**	**100**	

Source: Primary Data, 2023

Table 2 shows that age (p = 0.003), gender (p = 0.006), work period (p = 0.008), exercise habits (p = 0.005) and work posture (p = 0.000) are independent variables that have a relationship with Musculoskeletal Disorders (MSDs) complaints because they have a p value < 0.05.

Multivariate Analysis

Table 3 Multivariate Analysis of Variables Affecting MSDs

Variables	Exp(B)/OR	95% CI	P Value
Age	1,083	0,987-1,194	0,112
Gender	0,780	0,219-2,772	0,702
Work Period	7,543	1,507-2,772	0,014

Exercise Habits	2,924	0,836-10,222	0,093
Working Posture	8,673	2,072-36,313	0,003

Source: Primary Data,2023

Table 3 shows the results of multivariate analysis in this study. The p value on the five independent variables that have a p value < 0.05 was found to be two variables, namely work period p = 0.014 with an Exp(B) value of 7.543 and work posture p=0.003 with an Exp(B) value of 8.673. From these two variables, it can be concluded that the work posture variable is the most influential factor on MSDs complaints in computer user workers.

Relationship between Age and Musculoskeletal Disorders

Age is the time of a person's life starting from the time he is born in the world until the time of his birthday. A person's maximum muscle strength occurs at the age of 20-29 years. When the age has been at the age of 60 years, then in general human muscle strength will experience a decrease of up to 20% which occurs due to non-ergonomic work attitudes that lead to the occurrence of MSDs. The most common complaint is back pain felt when aged 20-40 years, it is thought to occur due to degeneration factors and perceived static loads [12].

Age has a significant relationship to MSDs complaints in this study because the majority of respondents in this study were over 35 years old which is included in the old category. As a person ages, health complaints will increase. The existence of a significant relationship between age and MSDs variables in this study is also due to the fact that the old category is easy to experience MSDs complaints because it has physical strength that begins to weaken in carrying out work.

Old age has a direct influence on low back pain because muscle strength will decrease with age [13]. Age under 35 years is an age category that is not at risk for degradation of muscle strength, while those over 35 years old are included in the group at risk of degradation of muscle decline [14]. As a person ages, MSDs complaints will also increase. Muscle complaints that usually occur when over 35 years of age will continue to increase based on a person's age. This age can be the most important cause of muscle complaints, because the age that increases every year will make muscle capacity decrease [15].

The older a person is, the higher the chance of getting MSDs [16] in the process, a number of tissues and the size of muscle fibers will gradually decrease which can lead to a slow loss of muscle mass and muscle strength [17]. The older the age, the degenerative process will occur, namely the regeneration of tissue into scar tissue, tissue damage, and a decrease in fluid in the body which results in reduced stability in bones and muscles [18].

Relationship between Gender and Musculoskeletal Disorders

Gender is a concept that can be used to explain the differences between women and men. This difference can refer to the concept of psychological, emotional elements, as social characteristics where the relationship between women and men is constructed so that it differs

between time and place, while according to gender is a difference in behavior possessed by women and men [19].

There is a significant relationship between the variables of gender and MSDs in this study because the respondents in this study were dominated by workers who were female rather than male. Female respondents were found to experience more MSDs with severe complaints compared to respondents with male gender. Respondents with female gender are also dominated by workers who are > 35 years old so they are more at risk of experiencing MSDs complaints.

This can be attributed to the theory that states that in certain situations women's productivity levels are often found to be higher than men, for example in jobs that require patience and accuracy because women are usually more patient and thorough [20]. From this statement, it can be concluded that female workers who are meticulous in carrying out their work do not pay too much attention to work postures so that they are prone to MSDs complaints. Female workers have a higher level of accuracy when compared to male workers because male workers are found to rely more on energy when working compared to women so that this can affect employee performance [21]. Women are also more susceptible to MSDs because there are differences in biological factors, especially regarding hormones and different pain sensitivity [22]. Women will be more dominant in experiencing weakness in the muscles and bones because they experience the menstrual cycle, pregnancy where the period will make the density in the bones become reduced due to a decrease in the amount of minerals such as calcium in the bones and the menopause process causes a lack of estrogen hormone which has an impact on decreasing bone density and causes acceleration of bone strength levels in women so that it will exacerbate MSDs disorders because estrogen has an important role in maintaining health [23].

Men and women have different bone structures. Men have larger and wider bones, while women are smaller and lighter. It was also found that muscle mass and upper body strength are greater in men while women have a greater percentage of body fat and a wider pelvis that affects spinal alignment so that there are differences in MSDs complaints based on gender [24].

Relationship between Work Period and Musculoskeletal Disorders

The working period is the length of working time calculated from the first time you enter work, a factor that is closely related to the length of time a person has worked in a company. Determination of this time can be interpreted as a work measurement technique in order to record time and work comparisons of certain work elements carried out in certain situations as well as to be able to analyze this information so that the time needed to carry out the work is found at a certain level of achievement. With time, it will form a person's work experience, so the working period is the time that a person has lived while being a laborer in a company [25].

In line with existing theory, that the work period variable has a relationship with MSDs complaints in workers. The working period is an independent variable which is a factor that has a contribution as a factor that greatly influences the occurrence of MSDs complaints. The discovery of a significant relationship between working period and MSDs complaints is due to respondents in this study being dominated by workers who have worked > 5 years.

MSDs are chronic illnesses that take a long time to develop and manifest. The disorder cannot be felt directly, but is the result of accumulation derived from exposure that occurs continuously over a long period of time [26]. So that the longer the working time and the longer a person carries out a fairly monotonous job, the greater the risk level of a worker experiencing MSDs [27] . Complaints that occur in the musculoskeletal system in general almost do not occur directly, but will occur due to a small and growing impact or accumulation of pressure that occurs continuously with a long period of time. Whether in days, months, or years. These complaints occur based on the type of work performed by workers [28]. In general, all fields of work are included in the risk category for MSDs complaints, both static work, bending or standing, sitting positions that take too long [27]. Longer work periods can also cause accumulation of stress in the muscles and tendons resulting in decreased blood flow which causes tissue ischemia and pain complaints [29].

Relationship between Body Mass Index and Musculoskeletal Disorders

Body mass index is a fairly simple way used in order to see nutritional status, especially those related to excess or lack of weight. The formula used is body weight/height $(m)^2$ and then determined into predetermined categories, namely normal or abnormal. BMI with a normal category has a 90% effect on reducing the risk of MSDs disorders [30]. Lack or excess nutrition experienced by a person is a problem that is considered important because it will affect work productivity. Therefore, the situation must be monitored continuously in order to maintain a normal or ideal body weight. A person who has excess weight will try to support the body weight from the front by contracting the lower back muscles. If this is continuous or occurs continuously, it will create pressure, especially on the spinal cord [26].

BMI does not have a significant relationship to MSDs complaints in computer user workers on this research. The absence of a significant relationship between the IMT variable and MSDs complaints is due to the fact that most respondents have normal IMT categories rather than workers who have abnormal IMT, but it was found that workers who have normal IMT experience more MSDs complaints. Although in theory IMT is one of the factors of MSDs complaints, workers who have normal IMT still experience MSDs complaints can be caused by other factors whose role is greater so that they are still at risk for MSDs complaints.

Relationship between Exercise Habits and Musculoskeletal Disorders

Sports can be stated as a general terminology derived from all activities that are closely related to physical activity. Exercise is a structured, repetitive, and planned body movement that is carried out to maintain and improve physically so that MSDs complaints will increase if the lack of muscle flexibility due to physical activity continues to increase without being followed by sufficient body fitness [31].

Exercise habits have a significant relationship with MSDs complaints in computer user workers on this research. This can occur because most of the respondents in this study have poor exercise habits that put them at risk for MSDs complaints. In this study, those who are > 35 years old have assumed that it is difficult to do sports activities in the midst of busy office work, they also assume that their age is also included in the old category which makes a lot of decline in body function. Female workers also think that exercise activities can be replaced by household activities that are carried out every day so they think that these activities can replace exercise activities because these activities require heavy physical labor so there is no need to do regular exercise.

The habit of exercise is a positive habit for those who need a lot of energy who do not have enough time to rest. Someone who has low fitness will trigger the risk of MSDs complaints [32]. Regular exercise habits are believed to be able to improve quality of life and prevent osteoporosis or other bone diseases [33]. Workers who have less physical fitness will be at three times the risk of those who have high or good physical strength. If respondents routinely carry out sports activities every week, it will reduce the risk of MSDs complaints, because routine exercise will improve body fitness. Exercise that functions can increase temperature, increase metabolism and high oxygen levels in the body. Thus, the body's muscle strength will become stronger and there is an increase in endurance because it can make the body avoid muscle fatigue. Having the habit of regular and sufficient sports activities will make the body's abilities, especially muscle endurance, increase so that the body does not easily feel tired and has a fairly stable endurance and improve physical fitness.

Relationship between Work Posture and Musculoskeletal Disorders

Work postures are generally divided into two, namely static (stationary) and the second is dynamic (moving), where this static position is defined as a position at work where there is no transfer of position or known as isometric with little movement for the duration of work. This situation will then provide a static load on the muscles because a static load in an unnatural work posture will provide a postural load that causes pressure. With this situation, the blood flow will decrease the oxygen carrier to the muscles which makes an

imbalance of the need for oxygen supply that occurs which has an impact on muscle fatigue [34] .

Work posture has a significant relationship with MSDs complaints in computer user workers on this research. Based on the results of the identification of the causes, there are several things that make respondents do work in an unergonomic position, namely working with a sitting work position in a static state for a long time with an awkward position without stretching and there are work facilities that are not ergonomic.

Applying improper work postures by respondents due to work chair facilities that cannot be adjusted in height makes workers' backs disturbed due to a hunched position. Cohen et al (1997) argue that work postures with static positions can make muscles feel the burden and tendons will be easy to experience fatigue which triggers disorders in muscles and bones. Improper posture at work causes fatigue and discomfort at work caused by the technology used, especially monitors, mice, keyboards, desks and work chairs [35]. The work done by a person is generally monotonous which of course requires good fitness. Every time working in an awkward situation will trigger body parts to become tense so that it can cause injury, resulting in permanent disability and ergonomic risks that will arise, namely musculoskeletal disorders [35].

Mild complaints that are felt that do not require immediate treatment of the disorder, if left for a long enough period of time will aggravate the situation. This occurs due to the increasing workload supported by the longer duration of loading. In order to be able to adjust and organize themselves to face physical challenges at work, prevention must be carried out in order to overcome MSDs [37].

Factors Most Influential with Musculoskeletal Disorders

Four variables that previously had a significant relationship, the results were bivariate using the chi-square test, namely the variables age, gender, length of service, exercise habits and work posture, then a multivariate analysis was carried out using multiple logistic regression. After the regression was carried out, it was obtained that 2 variables had a significant value of <0.05, namely the work period and work posture variables, so it can be concluded that work posture is the most influential factor in the incidence of MSDs with an Exp(B)/OR value of 8.673, which means that work posture has an 8.673 times greater chance of having an influence on MSDs complaints. Followed by the work period variable with an Exp(b)/OR value of 7.543, which means that work experience has a 7.543 times greater chance of having an influence on MSDs complaints among computer user workers.

Working period is a factor that can influence workers to increase the risk of MSDs complaints. Based on the research results, it was found that when working > 5 years, around 71.4% of computer user workers experienced MSDs complaints. Workers who have worked for a long time means they have gained a lot of experience compared to those

with a new job period so they are used to carrying out the work they do every day. The same work is work that uses the same muscles for a long time, namely more than 2 hours per day [38]. Work of period can influence skills in carrying out a job, therefore the more skilled a person is at carrying out the job, the more efficient they will be so that the workload on the journey will be smaller. However, the longer the worker works and the older the worker, the lower their work capacity will be, resulting in a longer exposure to the duration of work carried out during work. Working period is a risk factor that is closely related to MSDs complaints, because MSDs are related to work which has a cumulative nature [39].

Adopting a body posture when working that is unnatural or ergonomic greatly contributes to the occurrence of MSDs which will cause a person to experience problems in the back, neck and shoulders [40] . Working posture is the variable that has the most influence on MSDs complaints among computer users. Based on the results of observations, researchers found that the average final ROSA score of respondents was > 5, which was included in the category requiring immediate corrective action.

Working postures that are not ergonomic will cause some parts of the body to move away from natural activities. Meanwhile, the working posture adopted by workers was found to be around 52% in an unergonomic position with the body position being bent too long for a long period of time without stretching due to still lack of knowledge regarding office ergonomics. It was found that the work facilities, especially the work chairs used, could not be adjusted in height (non-adjustable) so that some workers had to raise their arms slightly higher to be able to reach the mouse. The backrest and seat cushions on the chairs were less comfortable and it was found that there were still work chairs used that did not have armrests which caused the development of MSDs symptoms, feeling pain in more than one point on the body. Apart from that, lack of intervention or proper posture training is also an unavoidable reason.

The absence of armrests on chairs that function to support the elbows and arms is an additional factor that causes less than ideal working postures adopted by workers. In general, armrests that have been designed properly and correctly aim to reduce the burden on the muscles on the neck [41] . The use of work facilities that are not ergonomically designed and do not comply with anthropometry will have a strong influence on the worker's performance. When the height of the work desk does not match the height of the sitting elbows, it will trigger workers to make unergonomic movements of the upper arms, lower arms and wrists. This part of the body is one of the most crucial when carrying out work, especially those related to computer use [41].

Implementing poor work posture and incorrect work methods can cause permanent damage to the human body and tissue. So it is important to evaluate whether body posture is good or not because usually workers do not intentionally use bad work posture so that this

evaluation can later be used to improve work design and also the work facilities used [43]. Workers who use incorrect body posture are usually found to be forced, this occurs due to the characteristics of the task and also poor design of work facilities [44]. Work with repetitive activities can result in cumulative strain on the discs resulting in injury or pain to the spine as well as tissue trauma [45]. Workers with non-ergonomic work postures with an age at risk will also be prone to MSDs [46].

CONCLUSION

In conclusion, work posture is the most influential factor on MSDs complaints among computer user workers. Bad posture and incorrect working methods can cause permanent damage to the human body and tissues. So, it is important to evaluate whether the posture is good or not because usually workers do not intentionally use bad work postures so that the evaluation can later be used to improve job design and also the work facilities used. The company can form a health promotion unit to educate about ergonomics and have a sound reminder system that aims to invite workers to do workplace stretching exercises.

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