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IDENTIFICATION OF ERGONOMIC RISK FACTORS FOR WORK-RELATED MUSCULOSKELETAL DISORDERS (WMSDS) AMONG COMPUTER OPERATOR OFFICERS IN FACULTY OF MEDICINE UDAYANA UNIVERSITY

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Abstract: **Work-Related Musculoskeletal Disorders (WMSDs) complaints are one of the problems that often occur to workers that disrupt worker's productivity. There are few factors that caused WMSD, it can either occur because of work environment factors or factors from the workers themselves. The purpose of this study is to determine the ergonomic risk factors that cause WMSD on computer operator employees at the Faculty of Medicine, Udayana University.**

This research was conducted in the Faculty of Medicine Udayana University from May to November 2019. The research method was a descriptive study with a cross-sectional approach. The population in this study were 230 people, with a total sample of 115 people. This research uses REBA (Rapid Entire Body Assessment) and the Nordic Musculoskeletal Questionnaire. The results of the study indicate that there is a risk factor affects the occurrence of WMSD on computer operator employees, which is by awkward postures, duration, frequency and the existence of repetition at work, psychosocial stress and external or physical loads. From the results of the study, more employees experienced pain in the neck and lower back.

Keywords: **WMSD, ergonomic risk factors, computer operator officer, low back pain, neck pain.**

I. INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) has always been one of the major problems among workers in industrial countries. WMSDs can cause high costs to employers because of absenteeism from work, lost productivity, increased health care, disability, and worker's compensation costs. WMSDs are the reason for nearly 70 million physician office visits in the United States alone annually [1]. WMSDs do not constitute a disease that can be constricted, but it is a process that grows over time.

Ergonomics is the study of the interaction between humans and other elements in a system, as well as the professions that practice theories, principles, data and methods in designing to optimize the system to suit the needs, weaknesses and skills of humans. Jobs that have ergonomic hazard are activities and work conditions such as repetitive movements, working in awkward positions and postures, lifting something heavy or in an awkward position, using energy to do a job that affects the musculoskeletal system, exposure to vibration when doing work and extreme temperatures.

Office work due to computer use is now a job with a high prevalence of WMSDs. Most office workers now routinely use a computer and its accessories as a part of their equipment in the workplace and this equipment creates many ergonomic risk factors. WMSDs are always related to various kind of injuries. Back injuries (e.g. lower back pain, disc degeneration and herniation) have the highest percentage (about 60%). Next place is the injuries on the upper extremities and neck (e.g. pain syndromes at the shoulders, arms, neck, "tennis elbow", tendinitis and carpal tunnel syndrome) [2].

The aim of this research is to study what are the ergonomic risk factors that have effects towards the computer operator office workers in Faculty of Medicine Udayana University and what are the WMSDs among the computer operator officers.

II. METHODOLOGY

The type of research that been used in this study is descriptive research with a cross-sectional study design. This study was conducted at the Faculty of Medicine Udayana University from May until November 2019. The sample size was calculated based on Lincoln with a confident interval of 95% and the population proportion of 18%; the minimum size sample would be 115 workers. All participants gave written informed consent and data from the questionnaires were kept confidential. Data was collected by using Nordic Body Map questionnaire and REBA worksheet. Videos and photos of the workplace and the workers have been taken to document the awkward postures using MB ruler application. Data that have been gathered from the questionnaires have been taken and processed with Statistical Package for the Social Sciences (SPSS). The data have been analysed descriptively and presented in tables accordingly, either individually or according to age and gender. Correlations data were analysed by the chi-square test.

III. RESULTS

The final data set for analysis consisting of 115 samples consisting officers from various departments in the Faculty of Medicine in Udayana University.

1. Characteristics of respondents

The descriptive analysis in Table 1 showed that 61.7% female and 38.3% male participated in the study as subjects (n= 115). The age frequency distribution for ≥ 35 years old is 69 respondents (60.0%) and for < 35 years old is 46 respondents (40.0%). In this study population, the respondents work in a single-shift duty of 8 hours/day for 5 days a week. All respondents work in the same station as there is no job rotation.

Table 1: Descriptive characteristics of respondents

Characteristics	Frequency (N)	Percentage (%)
Gender		
Male	44	38.3
Female	71	61.7
Age		
≥ 35 years old	69	60.0
< 35 years old	46	40.0

2. Work Related Musculoskeletal Disorders (WMSDs)

Table 2 results showed the frequency of pain for various location of musculoskeletal pain based on the Nordic Body Map questionnaires that have been filled up by the respondents. Most of the respondents (82.5%) reported symptoms at least in one part of their bodies. Among all the symptoms, lower neck pain was the highest with 66 workers (57.4%), followed by upper neck pain with 64 workers (55.7%), waist with 62 workers (53.9%) and back pain with 55 workers (47.8%), where right foot (21.7%) and left foot (20.0%) was the least reported pain. Most of the respondents who reported pain in the lower and upper neck area are from female officers while most reported pain in the waist and back pain area are from male officers which can be seen in Table 3. The female workers have the most WMSDs complaints compared to male in the neck area which were 41 workers (57.7%) for lower neck and for upper neck, where for male 25 workers (56.8%) in the lower neck, 23 workers (52.3%) in the upper neck. Male has more WMSDs complaints in the waist and back pain area. 30 workers (68.2%) in waist and 26 workers (59.1%) in back pain. There is a strong correlation ($P<0.05$) between waist and back pain for computer officers. In term of age, most of the workers with WMSDs symptoms are coming from

the age below 35 years old. Most of the workers who have MSDs are in the category of < 35 years old with 65.2% for lower neck and 60.9% for the upper neck and 50.0% for back pain. Table 4 shows that the P-value is < 0.05 for each complaint.

Table 2: Body region pains among participants

No	Location of Musculoskeletal Pain	Frequency of Pain			
		No Pain		Painful	
		Frequency	(%)	Frequency	(%)
1	Upper Neck	51	44.3	64	55.7
2	Lower Neck	49	42.6	66	57.0
3	Right Shoulder	66	57.4	49	42.6
4	Upper Left Arm	84	73.0	31	27.0
5	Back	60	52.2	55	47.8
6	Upper Right Arm	74	64.3	40	34.8
7	Waist	53	46.1	62	53.9
8	Hip	72	62.6	43	37.4
9	Bottom	76	66.1	39	33.9
10	Left Elbow	87	75.7	28	24.3
11	Right Elbow	82	71.3	33	28.7
12	Lower Left Arm	88	76.5	27	23.5
13	Lower Right Arm	86	74.8	29	25.2
14	Left Wrist	75	65.2	40	34.8
15	Right Wrist	80	69.6	35	30.4
16	Left Hand	83	72.2	32	27.8
17	Right Hand	81	70.4	34	29.6
18	Left Thigh	91	79.1	24	20.9
19	Right Thigh	90	78.3	25	21.7
20	Left Knee	76	66.1	39	33.9
21	Right Knee	84	73.0	31	27.0
22	Left Leg	75	65.2	40	34.8
23	Right Leg	79	68.7	36	31.3
24	Left Ankle	89	77.4	26	22.6
25	Right Ankle	85	73.9	30	26.1
26	Left Foot	92	80.0	23	20.0
27	Right Foot	90	78.3	25	21.7

Table 3: Relationship between gender and the WMSDs symptoms

Gender	WMSD symptoms							
	Lower neck		Upper neck		Waist		Back pain	
	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)
Male	25 (56.8)	19 (43.2)	23 (52.3)	21 (47.7)	30 (68.2)	14 (31.8)	26 (59.1)	18 (40.9)
Female	41 (57.7)	30 (42.3)	41 (57.7)	30 (42.3)	32 (45.1)	39 (54.9)	29 (40.8)	42 (59.2)
Odd ratio	0.987		0.821		2.696		2.167	
P value	0.973		0.611		0.013		0.047	

Table 4: Relationship between age and the WMSDs symptoms

Age (years old)	WMSDs symptoms							
	Lower neck		Upper neck		Waist		Back pain	
	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)
≥35	36 (52.2)	33 (47.8)	36 (52.2)	33 (47.8)	40 (58.0)	29 (42.0)	32 (46.4)	37 (53.6)
<35	30 (65.2)	16 (34.8)	28 (60.9)	18 (39.1)	22 (47.8)	24 (52.2)	23 (50.0)	23 (50.0)
P value	0.013		0.042		0.000		0.006	

3. Results from analysis of REBA scores

In Table 5, 20 officers are from various departments which have been chosen randomly. According to the REBA analysis, 15% of workers are working in postures which can be ignored. About 40% of workers are at low risk where a change in posture may be necessary. Medium risk postures account for 35% of workers and 10% of workers are at high risk where a change is required soon. There are no workers who are currently working in a very high risk which requires an immediate change in posture. The results of REBA indicate that a high percentage of workers are currently at low to medium risks.

Table 5: Distribution of REBA Score

REBA Score	Risk level	Action	No. of Workers	Percentage (%)
1	None	Not Necessary	3	15
2-3	Low	Maybe Necessary	8	40
4-7	Medium	Necessary	7	35
8-10	High	Necessary and soon	2	10
11-15	Very High	Investigation and action required immediately	0	0
Total: 20				

4. Ergonomic Risk Factors

There are few ergonomic risk factors that can cause WMSDs among workers in the Faculty of Medicine Udayana University. One of the ergonomic risk factors is an organisational factor. This can be observed by the highly repetitive movements, for example using a keyboard for several uninterrupted hours. Next factor is external or physical loads. A lot of work tasks require high force loads on the human body. For example, the effort with which one strikes an object like pounding the keyboard when typing. An awkward posture is another risk factor that caused WMSDs among the workers. Few workers can be seen are in a wrong sitting posture. Psychosocial factors also another factor that caused WMSDs. High workloads that lead to less rest in order to meet the job demands, which results in less time away from work for the body to recover. Stress can also worsen the symptoms.

IV. DISCUSSION

Around 115 office workers participated and agreed to cooperate in this research. In this study, the majority of office workers was female (61.7%) and aged ≥ 35 years old (60.0%). This is comparable to study [3] where 78% of the study population were female and workers aged ≥ 35 years old (50%). The results of the study based on the Nordic Body Map questionnaire shows that most of the workers (82.5%) experienced at least one musculoskeletal pain in any part of their bodies. The symptoms that can be felt by the appearance of joint stiffness, muscle tightness, aching and tiredness on the

affected limbs. The highest WMSDs complaints are lower neck pain (57.4%), which then followed by upper neck pain (55.7%), waist (53.9%) and back pain (47.8%) were the most prevalence problem among the office workers. In another study [4], stated that around 27% of computer operator officers report backaches or discomfort. The findings of previous studies have demonstrated that musculoskeletal problems in different body regions, especially in the upper limbs, neck and low back are common among computer office workers [5]. Generally, the prevalence of MSDs has been reported to range from 40-80% among office workers [6].

The prevalence of neck pain was the highest among the computer officer with 57.4% and 55.7% for both upper and lower neck. It was substantially higher among women (57.7%) than among men (56.8%) for lower neck and (52.3%) for upper neck, which is consistent with a previous study [7]. The smaller statue and lower strength of the shoulder muscles have been suggested to partly explain the sex difference. In computer work in particular, for example, using a computer mouse. Women are working with higher relative musculoskeletal load, for instance, applying high forces and using a greater range of motion than are men. The present study revealed that < 35 years old have more neck pain occurrence than ≥ 35 years old. This finding is different from previous studies that demonstrate workers above 35 years were at greater risk of neck pain [8].

The prevalence of low back pain was the second highest among the 115 computer officers with the waist (53.9%) and back pain (47.8%). Based on gender, male (68.2% for waist and 59.1% for the back) has higher lower back pain compared to female (45.1% for the waist and 40.8% for the back). These results indicates a reverse gender pattern which generally indicate that female experience a higher prevalence. Women are known to have a higher prevalence of low back pain and to be more susceptible to environmental risk factors than men. This might be due to their physical inability, lower bone mineral density and specific anatomical structure [9].

Based on the REBA score, 10% of the worker were in high-risk level and 35% were at medium risk level. Although the risks were not high some changes can be done to reduce the prevalence of MSDs among computer operator officers. REBA is been used to analyze the working posture. In office work environments, workers start the workday with good posture, but eventually, recline or bend throughout the course of day assuming risky postures and enhancing their risks WMSDs. The officers work for 8 hours/day with more or less 1 hour to do their personal activities like going to the washroom, eating or drinking, which the average of 6 hours of an 8-hour working shift in a sitting position.

There are few ergonomic risk factors that can be seen among the officers like repetitive movements, external or physical loads, awkward postures and psychosocial factors like stress. Working in the office often means performing the same repetitive tasks and spending most of the time in awkward positions. As computer workers often engage in tasks that demand a high level of concentration, they get absorbed in their work and assume a given posture for long periods of time [10]. During the prolonged static sitting, the muscles that sustain body posture undergo a prolonged state of contraction, which can cause accumulation of waste products like lactic acid and carbon dioxide in those muscles, leading to muscle spasms and fatigue. Prolonged sitting also contributes to health problems like neck and low back pain [11].

Poor work environments increase the risk of WMSDs. For instance, the workstation keyboard and mouse are placed at different levels which cause the user to elevate/abduct their shoulders. Maintaining any position for too long can impact health, worse if maintaining a poor one. Necks and shoulders can stiffen and curve, spine lose their flexibility as they absorb pressure and pelvises rotate incorrectly. Most of the time workers spent typing, reaching for or clicking the mouse or staring at the computer. These muscles that exposed to trauma repeatedly day to day with a little rest can result in strain and microscopic tears to muscle and tendons.

When the workers repeatedly reach for the computer mouse, it can affect the muscles of the neck. Symptoms can worsen with psychological stress, awkward posture and repetitive movements with little rest. WMSDs don't exist with only one factor, it happened over a period of time with several risk factors occurring at the same time.

V. CONCLUSION

This cross-sectional study investigates the ergonomic risks factor for work-related musculoskeletal disorders (WMSDs) among computer operator officers in Faculty of Medicine Udayana University. Based on the research it can be concluded that neck and low back pain affects half of the workers thus; it should be an issue of concern. Neck pain is more prevalence among female workers and low back pain are more prevalence among male workers. This study also found that there are ergonomic risk factors like organizational factors, for example, repetitive movements, external or physical

load, awkward posture and psychosocial stress among computer operator officers in the Faculty of Medicine Udayana University. Based on the research, it is recommended that further action been taken to reduce the ergonomic risks at the office in the Faculty of Medicine Udayana University. For further research, BMI and the history of past illnesses should be assessed along. As computer interaction is an integral part of a wide range of population, it is necessary to understand the full health implications and how it may interfere with our life. Moreover, replication of this study in a large population-based sample as recommended to assess the stability of findings.

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