ORIGINAL ARTICLE

The ergonomics design of Work-From-Home Facility during COVID-19 Outbreak inIndonesia and Its Implications for Musculoskeletal

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ABSTRACT

Aims: To evaluate the ergonomics design of the work-from-home facility during COVID-19 pandemic in Indonesia and its implications for musculoskeletal, work time, and stress.
Methodology: Data were collected from 50 respondents that work from home (WFH).
Meanwhile, google form was adopted as the instrument for data collection and both descriptive and path analyses were employed.
Results: The results showed that 72% of workers have a fairly good ergonomic work facility design, however, only 28% have a low musculoskeletal disorder (MSDS) that led to a decrease in workers' stress level,nevertheless, 33 minutes is required to deal with their pain.
Conclusion: Furthermore, the 3D path analysis showed that higher ergonomic and lower MSDS scores reduce the rest time during working hours. However, both ergonomics and MSDS have no effect on human stress.
Keywords: Ergonomic, Musculoskeletal, Working Time, Stress, Work From Home

INTRODUCTION

The COVID-19 pandemic is sweeping almost the entire country and the official website for handling the disease by the Indonesian government (www.covid-19.go.id), reported thatinfected patientsare spread across all provinces with a total number of 143,043 on August 19, 2020. The first COVID-19 patients in Indonesia were found on March 2, 2020, and due to the increase in numbers, the government and several companies implemented work from home (WFH) during the pandemic[1]. The implementation of WFH is expected to disrupt and reduce the chain of the spread of the COVID-19 disease.

Furthermore, there are several challenges associated with WFH, which include the work environment at home.In its implementation, a comfortable working environment is needed to enable workers to perform their duties optimally even from home. Mean while, the fundamental dissimilarity between the work environment at home and the office is the difference in working facilities. Also, the heterogeneous population of WFH workers spread to various regions, causing differences in the ergonomic level of the design of desks and chairs.

Ergonomic factors have a major impact on work comfort, especially in the design and facilities used by workers[2]. Meanwhile, anthropometric measurements are used as a basis for reviewing the ergonomic level of work tables and chairs[3]. The design of desks and chairs at home needs to meet anthropometric standards to avoid complaints of musculoskeletal disorders (MSDS). MSDS are functional disorders of ligaments, muscles, nerves, joints, tendons, and the spine[4], which usually occurs on the neck, shoulders, back, and legs.One of the major factors causing the occurrence of musculoskeletal disorders during WFH is the design of working tables and chairs at home.

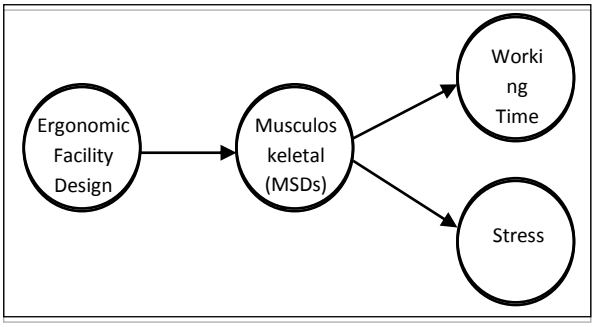
Workers who experience MSDS need longer rest periods to deal with pain before they resume activities, which will affect their working hours[5]. The rest time for each worker varies widely, someonly need a small rest period while others need a long break. The use of rest periods when experiencing MSDS will reduce normal working hours to less than 8 hours daily. Also, workers have the potential to experience physical, mental, and emotional stress due to the disease[6]. Therefore, further investigations are required regarding the complaints of musculoskeletal disorders (MSDS) in terms of ergonomic aspects of the design of desks & chairs during WFH and also on COVID-19 and its impact on working hours and stress levels.

Taifa and Desai (2017) reported that the design of work facilities reduces MSDS, therefore it has a significant effect on the occurrence of MSDS[7]. Furthermore, Houshyar's (2018), reported that a longer rest period, which affects work time, is recommended to reduce the prevalence of MSDS[5]. However, this research was conducted on workers whose work facilities were prepared by the company with due consideration of the ergonomics level. Meanwhile, thedesign of work facilities prepared by WFH workerswill beanalysed based on its impacts on MSDS, working hours, and stress. Furthermore, LP Singh, (2020) shows that by receiving MSD, the psychological situation while working from home also plays a major role in causing stress such as insomnia, family/children, anxiety during the pandemic, and decrease in work productivity during the Covid-19 outbreak[8]. This study aims to identify the design of ergonomic work facilities during WFH due to the COVID-19 pandemic in Indonesia, and its implications for musculoskeletal, work time, and stress.

METHODOLOGY

This research adopted a quantitative design and data were collected in July 2020 using google forms for WFH workers during the COVID-19 pandemic in Indonesia. Furthermore, data were collected from 50 respondents spread from Semarang, Pati, Malang, Bangka Belitung, Tarakan, and other cities in Indonesia. The respondents include workers that work from home considering all age groups, sexes, and the levels of education. The analysis of thepath of the relationship between variables is connected to the graph below.

Figure 1. The path of the relationship between variables



For the design of ergonomic work facilities, the criteria analyses include the comfort of the table and chair and the design. Data collected for the design of the table include its height as well as that of the seat and also the height of the Indonesian anthropometry elbow. The height is designed in a sitting position with the elbow at the table so that it uses the calculation of the table minus theseat level, which is then compared to the anthropometric elbow height of the Indonesian sitting position (30 cm)[9,10]. The table designs are graded on a scale of 1-5, given that the height of the table is reduced by +/- 5cm by anthropometry and is given a value of 5, etc. Similarly, the chair design is on a scale of 1-5 based on the height of the seat, which is designed with feet touching the floor (yes/no) and has a backrest up to the neck/shoulders/back/waist/has no back[10]. It is rated 5 when the user's feet rest on th efloor and the chair has a backresttothenecketc. Furthermore, the scores of the comfort of the table and chair, musculoskeletal pain, and stress were obtained from respondents on a scale of 0-100. Meanwhile, rest time is used to resolve MSDS during working hours thereby reducing the working period. When all the respondents have 8 hours of work, and they experience MSDS, then the working period reduced automatically with formula 8 being shortened.Meanwhile, the analysis of the working hours will be the same as rest time.

RESULT

The descriptive analysis of the research is presented in table 1 which shows that 70% of workers have a fairly good table design and a user comfort score, while 72% are quite comfortable with their chairs. Furthermore, 68% of workers have fairly good chair designs, and 76% are comfortable enough. In total, 72% of workers have a fairly good design of work facilities with an average score of 59.45. Furthermore, it was shown that the better the ergonomic rating of the work facility, the lower the MSDS score, rest time, and stress.

Further more, only 28% of workers had complaints of low MSDS with an average pain value of 50.44. Also, all the respondents experienced neck-ache during WFH, 70% had pains in their lower back, 40% in their shoulders, and only 16% in the legs. Furthermore, the rest time for pain relief is 33.1 minutes, which implies that the working hours is reduced to only 7.45 hours/day. In addition,68% of the respondentsengage in stretching to overcomepain while 22% lay down, other options include drinking water and getting a massage. From the table, it is shown that 74% of workers experienced low stress with an average score of 26 and most of the participants felt bored, dizzy, and anxious. The results of path analysis using SPSS software are shown in table 2:

Table 1. Results of the descriptive analysis of the questionnaire

Description	AVG Score	n	%
All participant: 50 participant			
Desk Design (Desk High vs Antropometri)	3.42		
	>= 2.5	35	70%
	< 2.5	15	30%
Chair Design (Seat High & Backrest)	2.74		
	>= 2.5	34	68%
	< 2.5	16	32%
Desk Comfortability by user	57.94		
	>= 50	36	72%
	< 50	14	28%
Chair Comfortability by user	54.5		
	>= 50	38	76%
	< 50	12	24%
All Ergonomic Facility Design	**59.45**		
	>= 50	**36**	**72%**
	< 50	14	28%
Musculoskeletal Pain	**50,44**		
	>= 50	36	72%
	< 50	**14**	**28%**
Neck		50	100%
Low Back		35	70%
Right-Left Shoulder		20	40%
Right-Left Leg		8	16%
Rest Time in minutes	**33,1**		
(Working time=8h-33,1m=7,45h)	>= 30	28	56%
	< 30	**22**	**44%**
Physical exercise		34	68%
Lie down		11	22%
Drinking-Water		2	4%
Massage		3	6%
Stress	**26**		
	>= 50	13	26%
	< 50	**37**	**74%**
Bored		21	42%
Dizziness		14	28%
Anxious		12	24%
No stress		3	6%

Table 2. Result of Path Analysis using SPSS software

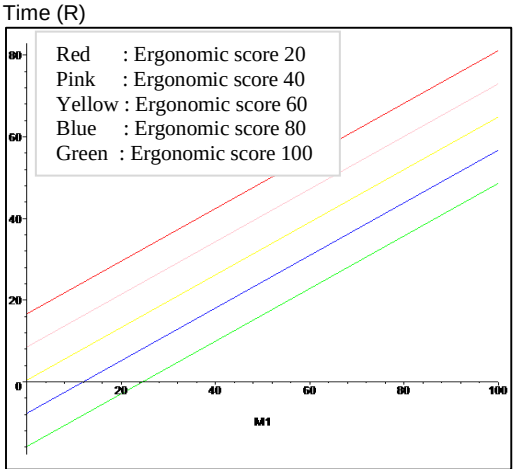
Independent	Dependent	Beta	Sig	R^2
Ergonomic	MSDS	-0.603	0.000	0.300
Ergonomic	Rest Time	-0.406	0.027	0.485
MSDS	Rest Time	0.645	0.000	
Ergonomic	Stress	-0.509	0.053	0.100
MSDS	Stress	-0.033	0.887	

The standard error of 5% is taken, such that the design of the ergonomic work facility affects the MSDS since the significance value is less than 0.05 by 30%[11]. Also, the design of the ergonomic work facility and MSDS affect the rest time by 48.5% because the sig value is less than 0.05. This is supported by the results of previous research, which shows that the design of work facilities affects MSDS[7]. However, both ergonomics and MSDS have no effect on

human stress as shown by a sig value greater than 0.05. Furthermore, it is seen from the Beta value that the direct effect of ergonomics and MSDS on rest time are -40.6% (negative effect) and 64.5%, respectively. Meanwhile, the effect of ergonomics through MSDS on rest time is -40.6% * 64.5% = -26.187% such that the total is -26.187% + -40.6% = -66.787%[12].

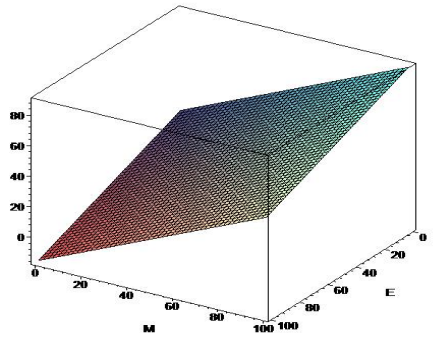
The statistical modeling of ergonomic and MSDS at rest time is R = 24.745-0.406E + 0.645M where R represents the rest time, M is MSDS and E is ergonomics. Furthermore, to better understand the effect of ergonomics and MSDS on rest time, a path analysis model is built both in 2D and 3D. The following is the 2D model of the ergonomic influence and MSDS on rest time using Maple Software.

Figure 2: 2D Graph Ergonomic Effect (E) and MSDS (M) on Rest Time (R)



On the MSDS (M) e ergonomic and MSDS score is 20 anc , then the rest time is about 80 minutes. Whereas when the scores are 20 and 0, respectively, then the rest time is around 17 minutes. Similarly, on the pink graph, when the ergonomic and MSDS score is 40 and 100, respectively, then the rest time is 70 minutes, however, a score of 40 and 0, respectively result in rest time of 10 minutes. From the 2D modeling, a higher ergonomic score and the lower MSDS reduce the rest time during working hours. To better understand the ergonomic relationship, MSDS and rest time is displayed in 3D modeling using Maple software as shown in Figure2

Figure 3: 3D Graph Ergonomic Effect (E) and MSDS (M) on Rest Time (R)



Fromthe 3D graph, it is seen that an ergonomicscoreof 0 and MSDS of 100 results in resttime, which reacheditspeak. However, when the ergonomics value is 100 and MSDS is 0, then the rest period will reach its lowest point. From both the 2D and 3D models, it is seen that a higher ergonomic and lowerMSDS scoresresult in reduced rest time.

DISCUSSION

The ergonomic score is only 59.45, which implies that all workers have a good working facility design for WFH, however, the overall employees have a fairly good design. In terms of work table design, it is seen that the ergonomic value on the workbench is quite high, namely 3.45 on a scale of 5, and workers are comfortable witha score of 57.9. In view of this, it is concluded that the design of the worktable is ergonomic and quite comfortable. Similarly, the ergonomic score in the design of the work chair is 2.7 from a scale of 5, and workers are quite comfortable, with a score of 55. This also shows that the design of the work chair is quite ergonomic and comfortable. Generally, the design of the work facilities is quite good, which implies that the anthropometry of sitting elbow height is fulfilled, that is, the seat level is designed with feet touching the floor and thechairshave a backrest.

The MSDS score of 50.44, implies that among the workers experiencing moderate pain, most occurin the neck and lower back. This is in line with previous studies which stated that MSDS often occurs in the neck and lower back[13]. Furthermore, it takes workers 33.1 minutes to deal with the pain, mostly by physical exercise and by lying down. Previous studies have shown that exercise and stretching reduce MSDS complaints[14]. A stress score of only 26 means that workers experience low stress while working from home.

The design of the ergonomic work facility has an effect on MSDS, which is in line with the results of the research that chair interventionreduces musculoskeletal[15]. From anthropometric and ergonomic theory, it is also known that the design of work facilities adjusts anthropometry to reduce MSDS[16]. Furthermore, the ergonomic analysis of the design ofthe work facility is needed to reduce MSDS. Meanwhile, workers that experience MSDS will encounter difficulties in completing their tasks, therefore the results suggest that MSDS affects working time[17]. Also the time off in dealing with pain during working hours will automatically reduce working time.

The result of this study is evident in previous investigations, showing that a higher ergonomic and lower MSDS score will decrease the rest time. Furthermore, MSDS does not only affects working hoursbut also has the potential for stress. However, the design of ergonomic work facilities and MSDS has no effect on stress. This is in line with previous research, which reported that ergonomics does not affect workers' stress levels[18]..

CONCLUSION

It is concluded that WFH workers have a fairly good design of ergonomic work facility, however, the employees experience moderate MSDS complaints. In dealing with the pain, the MSDS of workers takes 33.1 minutes

duringworkinghours, which will certainly affect work productivity to be suboptimal. Conversely, workers do not experience heavy stress during WFH.

From the 3D path analysis, it is shown that a higher ergonomic and lower MSDS scores will reduce the rest time during working hours. Also, ergonomics and MSDS has no effect on stress, therefore to ensure a full working time andlow MSDS, a good work facility design is needed, which includes a seat designed such that the feet touch the floor and the chair has a backrest.

Finally, for proper identification of ergonomic factors, further research is required to analyze the ergonomic component of the body posture when working. With the addition of the identification of body posture and facility design on ergonomic factors, it is expected thatresearch on MSDS will become more extensive.

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