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Analysis Of Ergonomic Lecturer Work Chair Design With Anthropometric Method

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Abstract: Ergonomic lecturer chairs following the dimensions of the lecturer's body need to be designed so that lecturers can be healthy and comfortable in carrying out the duties of education, research, and community service. Body dimensions that can be used to design lecturer chairs are upright sitting height (TDT), front hand reach (JTD), shoulder width (LB), and hand length (PT). The research was conducted to analyze lecturer complaints during work and design ergonomic work chairs. The method used in this study is the anthropometric method. The results showed that the most complaints on the neck, shoulders, legs (calves), and ankles were 15.58% respectively followed by knees 11, 69%, and thighs 7.79%. From the measurement of the body, dimensions obtained μ TDT 84 cm, α 3,117; μ JDT 69.5 cm, α 4.89; μ LB 42.75 cm, α 2.915 and μ PT 40.86 cm, α 4.357 with normally distributed data. 5th percentile TDT 80 cm, 50th TDT 84 cm, 95th TDT 90.65 cm. 5th percentile JTD 63.15 cm, le-50 JTD 72 cm, 95th KTD 77.85 cm. 5th percentile LB 38.9 cm, 50th LB 43.5 cm and 95th LB 47 cm. 5th percentile PT 34.9 cm, 50th PT 43 cm and 95th PT 16.55 cm. The conclusion of designing ergonomic lecturer chairs is following the percentile value obtained using body dimensions.

Keywords: Designing, Work chair, Lecturer, Ergonomics, Anthropometry.

INTRODUCTION

Lecturers carry out the duties of the tridarma, namely education, research, and community service. Lecturers often have to sit for hours to prepare for the lecture process both in making textbooks, making publication articles, making community service reports, preparing materials to fill out various counseling and various scientific activities as a resource person or participant in seminars, conferences, workshops, workshops, and various other scientific activities. For this, lecturers need to have a comfortable and ergonomic workspace, desk, and chair.

Less ergonomic work conditions will cause more lecturer fatigue, which is caused by uncomfortable body parts. Therefore, the existing working system needs to be improved. The work system will be improved by rearranging equipment and changing the layout of the

facilities used. Data is also collected to help create more ergonomic designs. The data collected included questionnaires for complaints from lecturers.

Research that has been done on the dosage packing fabric, it turns out that there are complaints of pain in the waist and arms reaching 12.4%. After analysis and observation, the study recommended repairing some equipment such as work chairs and jigs. The existing equipment is not good enough to be used and has the potential to cause workers to get sick. The survey results also showed that there was a decrease in performance in the arms, waist, calves, hands, and shoulders.

Every semester lecturers must fill in SISTER BKD to report their performance. Therefore, lecturers are required not only to teach but also to make publication articles that take hours sitting on chairs. Higher education leaders must issue innovative ideas to increase the optimal use of available resources so that the level of lecturer products is as maximum as possible, both in terms of quantity and quality. By considering these conditions, it is necessary to design a working system following ergonomic principles, namely a working system that increases work comfort and productivity. The research was conducted to determine the extent of lecturer complaints against work chair facilities so far and make ergonomic lecturer chair designs using anthropometric methods so that lecturers will be more comfortable and healthy at work.

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LITERATURE REVIEW

Ergonomics is an application of science that pays attention to human characteristics that need to be considered in the design and arrangement of something used so that between humans and the objects used there is a more comfortable and effective interaction (Sander and Cormick, 1987 in Torik et.al, 2009). The use of ergonomics is to (1) Improve work performance (increase work speed, accuracy, and work safety and reduce excessive work energy and reduce fatigue), (2) Reduce wasted time and minimize equipment damage caused by "human error", (3) Improve human comfort at work. Anthropometry is a study related to measuring the dimensions of the human body, which can be widely used as a consideration for designing products or workplaces that involve humans. Human body dimensions consist of upright sitting height (TDT), front-hand reach (JTD), shoulder width (LB), and Hand Length (PT).

Symptoms of work fatigue are a feeling of fatigue, decreased alertness, slow and weak perception in addition to a decrease in physical and mental work. Fatigue is classified into 2 types, namely muscle fatigue and general fatigue. Muscle fatigue is a tremor in the muscles (feeling of pain in the muscles). While general fatigue is usually characterized by the reduced willingness to work caused by monotony, intensity, length of physical labor, environmental conditions, mental causes, health status, and nutritional state (Grandjean, 1993).

Product design must be able to accommodate the largest population that will use the designed product. At least 90%-95% of the population in the user group should be able to use it and be approached with a normal distribution.

METHOD

This study was quantitative observational. The research was conducted at the Faculty of Engineering, University of Muhammadiyah Cirebon, involving 10 lecturers who are active every day in the lecturer room. This study used observation methods and was analyzed statistically descriptively. Primary data collection is carried out by observation, interviews, and measurement of respondents that have been determined. Interviews were conducted to find out subjective complaints about the use of means of work.

Anthropometric data is used to determine the exact shape, size, and dimensions, relating to the equipment designed and the humans who will operate/use the equipment. The

application of anthropometric data will be used if there are mean (mean) and SD (Standard Deviation) values of a normal distribution. In addition, percentile will be used, which is a value that expresses a certain percentage of a group of people whose dimensions are equal to or lower than that value. To further explain the anthropometric data that will be used in this design can be seen in Figure 1.

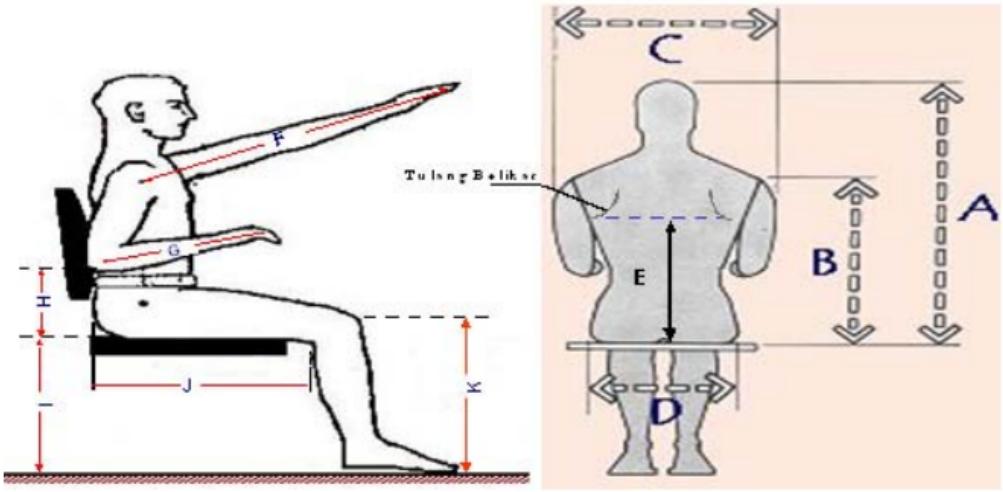

Figure 1. Anthropometric data of sitting position used

Information:
A Straight Sitting Height (TDT),
C Shoulder Width (LB),
F Front Hand Reach (JTD),
G Hand Length (PT).

The data analysis stage is carried out After rigid data collection, data uniformity tests are carried out, and data adequacy tests are carried out. Nurmianto (2004) suggests that "the application of anthropometric data will be possible if there are mean (mean) and SD (standard deviation) values available from a normal distribution". The data analysis stage is carried out After rigid data collection, data uniformity tests, data adequacy tests, and percentile calculations are carried out.

In addition, a 95% confidence level with k = 3 is also determined which shows the amount of measurement confidence in the accuracy of anthropometric data, meaning that the average measurement data is allowed to deviate by 5% from the actual average data adequacy test formula.

RESULTS AND DISCUSSION

Lecturer Complaints

Current technological advances make space for movement increasingly limited. Many people work only in front of a computer and spend hours sitting. Coupled with the time to go to the office which is also spent sitting in private vehicles and public transportation. Likewise, lecturers who sit too much. Likewise, lecturers who sit too much. The dominant lecturer complaints were on the neck, shoulders, and legs (calves) at 15.58%, then ankles at 12.98%, and knees at 11.68%. The waist and are no complaints. The habit of sitting too long can also cause neck pain. This is because sitting for a long time, especially in an uncomfortable position, can make the neck bone tense. In addition, sitting for too long can add pressure on the spine and discs that make up the spine which can cause neck pain. Sitting too long will affect the back and hip muscles, causing these muscles to become sore and

painful. In addition, improper sitting posture can press on the discs in the spine which causes persistent pain for a long time (chronic).

Table 1. Results of Observations with Lecturer Complaint Checklist

No	Body Part	None	Tingling	Soreness	Pain
1	Neck	-	2	2	2
2	Shoulder	-	2	2	2
3	Arm	-	-	2	-
4	Back	-	-	2	-
5	Waist	-	-	-	-
6	Buttocks	-	-	2	-
7	Elbow	-	-	-	-
8	Hand	-	-	2	-
9	Thigh	-	-	-	2
10	Knee	-	-	3	1
11	Legs (calves)	-	-	3	2
12	Ankle	-	-	2	2

Sitting for too long means it can put excess pressure on the spine, back muscles, and neck. Using ergonomic chairs can help maintain a comfortable posture. However, you should still not sit too long, considering the many other risks that can arise. Legs and buttocks that are rarely moved due to sitting too long can cause muscle atrophy so that these muscles become weak. If your muscles are weak, you're more at risk of injury.

Table 2. Percentage of Lecturer Complaints

No	Body Part	No	Tingling	Soreness	Pain	Total	Percentage (%)
1	Neck	-	2	4	6	12	15,58
2	Shoulder	-	2	4	6	12	15,58
3	Arm	-	-	4	-	4	5,19
4	Back	-	-	4	-	4	5,19
5	Waist	-	-	-	-	-	0
6	Buttocks	-	-	4	-	4	5,19
7	Elbow	-	-	-	-	-	0
8	Hand	-	-	4	-	4	5,19
9	Thigh	-	-	-	6	6	7,79
10	Knee	-	-	6	3	9	11,68
11	Legs (calves)	-	-	6	6	12	15,58
12	Ankle	-	-	4	6	10	12,98
	TOTAL	-	-	-	-	77	100

Information:

Score: No complaints 0, Tingling sensation 1, soreness 2, pain 3

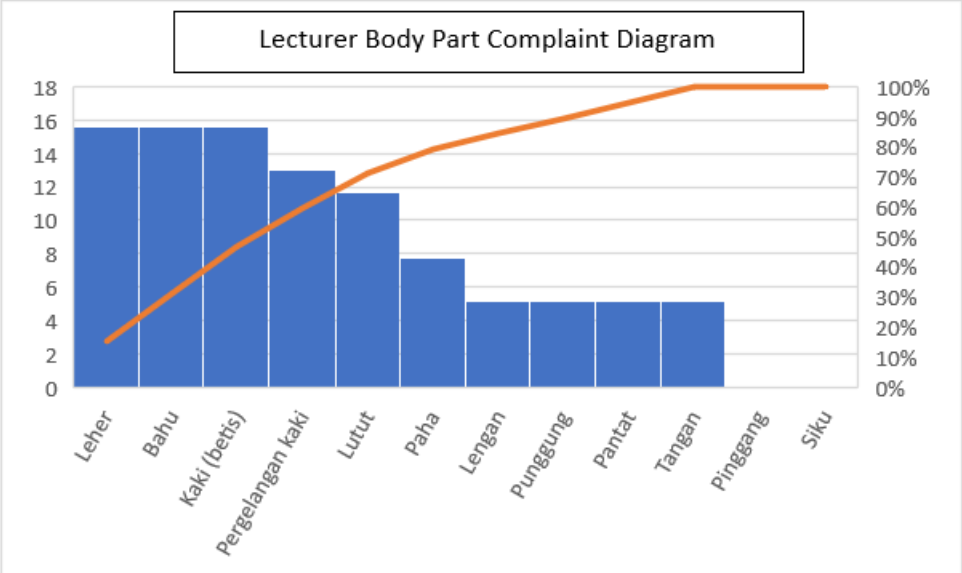

Figure 2. Body Part Complaint Lecturer

Work System Design

A system is a collection of elements that interact to achieve a certain goal (Jogianto, 2005). While work is an activity to do something, the work system is a series of work procedures and work procedures that then form a certain pattern to do a job. The success of the work system can be seen from its high efficiency and productivity (Sutalaksana, 1979). A system will occur in an environment and changes arising from this environment will affect the system and the elements of the system. The system was divided into sub-systems and so on. In this case, the relationship with human activities as a system will also be divided into job operations (sub-system), job position (job sub-system), duties (components), tasks (units), sub-tasks (parts), and task elements (behavioral elements).

Concerning the human-machine system, three kinds of relationships are known, namely: manual man-machine system, semi-automatic machine system, and automatic man-machine system. The design of the work system depends on the intended productivity. Design with a sociotechnical system approach, suitable for increasing the productivity of MSMEs bamboo fan craftsman groups (Puryani, et al., 2018).

Data Sufficiency Test

The data adequacy test is a useful measurement to objectively ensure that the data collected is sufficient. If it is found that the data is insufficient, it needs to be added according to the number of shortcomings. The amount of this addition can be found manually using a formula. In research, ideally, the data collected should be sufficient so that the conclusions drawn can be logically accepted. With data adequacy tests, how much is said to be "enough" can be known and adjusted to needs. Each study has its adequacy value so it cannot take a benchmark on other studies. The data adequacy test in this study was 4, while the probands were measured from 10 people. So the data has been declared sufficient.

Lecturer Anthropometry Data

Human body dimensions consist of upright sitting height (TDT), front hand reach (JTD), shoulder width (LB), and Hand Length (PT) see Table 3.

Table 3. Observations Lecturer human bidy dimensioan

NO	NAMA DOSEN	TDT (cm) A	JTD (cm) F	LB (cm) C	PT (cm) G
1	Agust Isa Martinus	89	74	44	46
2	Wahyu Triono	87	74	45	45
3	Syaiful	80	67	44	43
4	Budi	85	71	43	36
5	Agus Irfan	83	69	41	43
6	Dian Novianti	80	60	38	38
7	Iskandar	84	73	47	42
8	Dein Iftitah	84	68	40	34
9	Pahla	82	81	43	47
10	Ghojali	92	73	47	43

A percentile is a value or number that represents a position on a series or group of data. Usually, these percentiles will be created or shaped to represent the sequence in percentage form see Table 4.

Table 4. Kind of Lecturer Complaint

Percentile	Accounting	Result
5 th	X-1,645 SD	0,1
50 th	X	6,5
95 th	X+1,645 SD	15,6

Data Normality Test Results

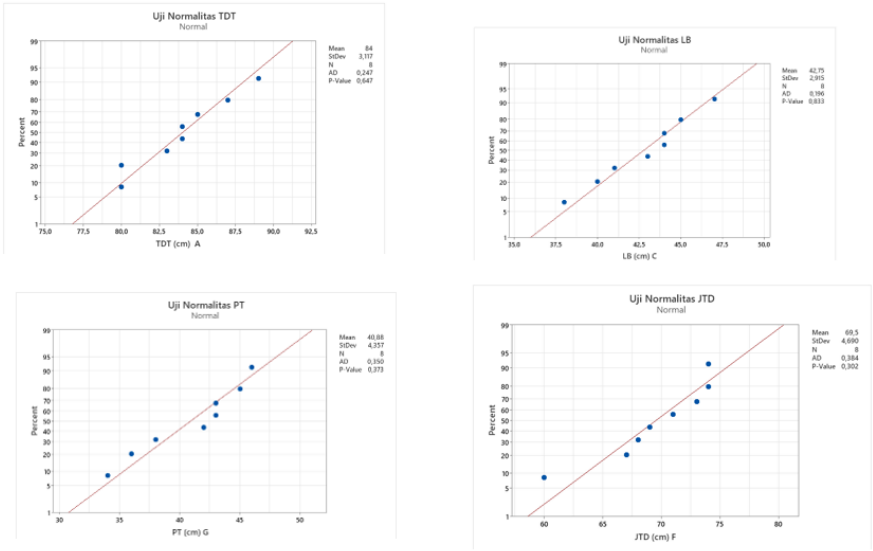

Figure 3. Body dimension data normality test graph

From the graph above, it can be seen that the data is normally distributed. The results of data analysis of standard deviation, BKA, BKB, 5th percentile, 50th percentile, and 90th percentile both on body dimensions measurement of upright sitting height, upright sitting height, measurement of front hand reach, shoulder width, and hand length can be seen in table 5. While the graph can be seen in Figure 4.

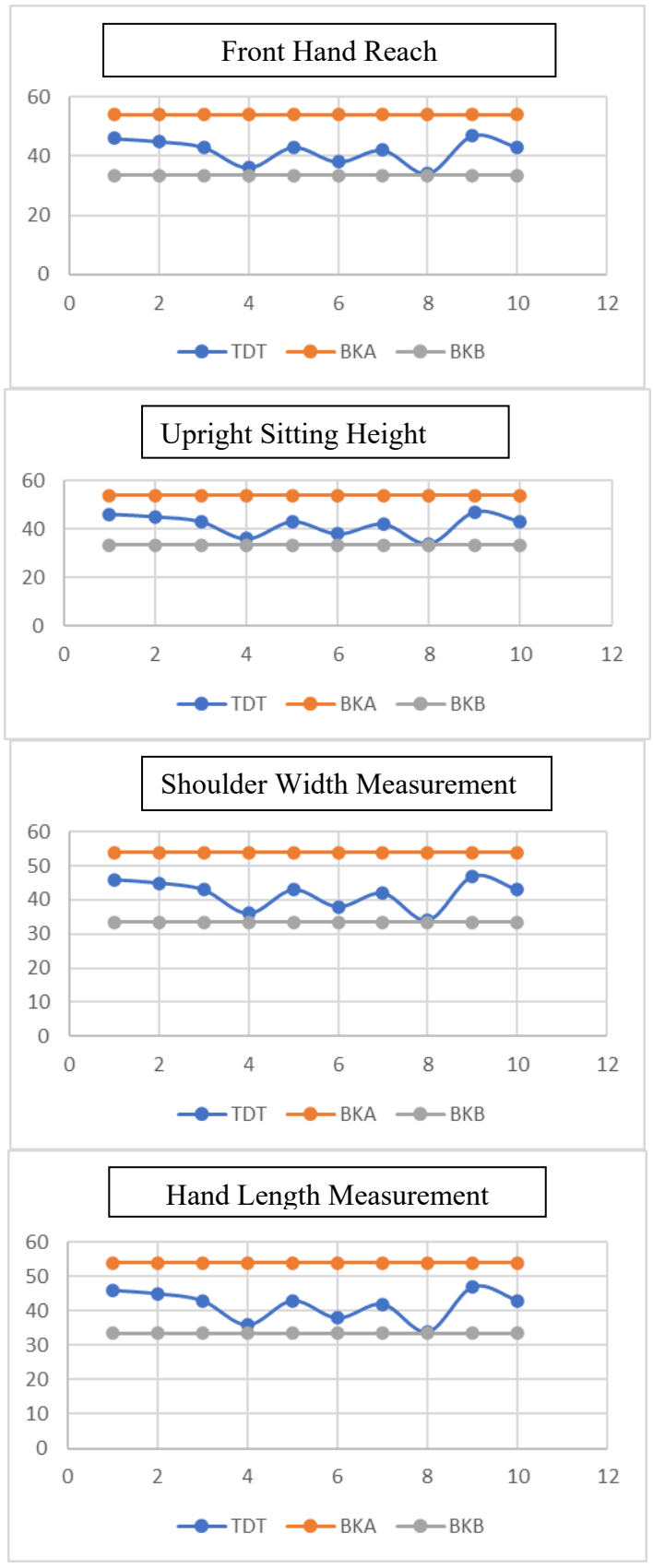

Figure 4. Lecturer Body Dimension Measurement Chart

Table 5. Analysis of anthropometric data lecturer body dimension

NO	DATA ANALYSIS	TDT (cm)	JTD (cm)	LB (cm)	PT (cm)
1	Standard deviation	3,84	5,54	2,90	4,32
2	BKA	93,351	84,17	50,495	53,931
3	BKB	77,883	61,61	35,835	33,503
4	Percentile -5	80	63,15	38,9	34,9
5	Percentile -50	84	72	43,5	43
6	Percentile - 95	90,65	77,85	47	46,55

CONCLUSION

1. Ergonomic work chairs can be designed according to percentile values obtained using body dimension measurements. Some sources of variables that will result in differences in human body dimension measurements are age, gender, ethnicity, posture, body defects, the thin thickness of clothing, and pregnancy. The design of ergonomic lecturer work chair products is following the percentile value obtained using body dimension measurements.
2. From the measurement of the body, dimensions obtained μ TDT 84 cm, α 3,117; μ JDT 69.5 cm, α 4.89; μ LB 42.75 cm, α 2.915 and μ PT 40.86 cm, α 4.357 with normally distributed data. 5th percentile TDT 80 cm, 50th TDT 84 cm, 95th TDT 90.65 cm. 5th percentile JTD 63.15 cm, le-50 JTD 72 cm, 95th KTD 77.85 cm. 5th percentile LB 38.9 cm, 50th LB 43.5 cm and 95th LB 47 cm. 5th percentile PT 34.9 cm, 50th PT 43 cm and 95th PT 16.55 cm. Conclusion of ergonomic lecturer chair design following percentile values obtained using body dimensions.

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