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ANALYSIS OF ERGONOMIC FACTORS ON BARBERS RELATED TO THE USE OF BARBERSHOP CHAIRS IN TANJUNGPINANG CITY

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ABSTRACT
Working in standing positions for a long period of time causes muscle tension and Musculoskeletal Disorders (MSDs) complaints. It is often experienced by barbers, where work interactions between work facilities and users must ideally consider work ergonomics, such as work posture, body dimensions, and work tools. This study aimed to analyze ergonomic factors on the use of barbershop chairs for barbers in Tanjungpinang City, Riau Islands Province. This research was a descriptive analytic study, with a cross sectional study approach through observations, questionnaires, interviews, and measurements in the field. The samples of this study amounted to 50 chairs and 50 barbers. The results revealed that there was no relationship between work posture and the use of chair (p-value = 0.173-1.000). In addition, there was no relationship between the dimensions of the barbers' body and the use of chair (p-value = 0.098-1.000). However, there was a relationship between the dimensions of chair and the use of chair, for the type of chairs and conformity (p-value = 0.048), backrest length and MSDs (p-value = 0.004), seat height and convenience (p-value = 0.049), footrest length and MSDs (p-value = 0.017), and footrests width and MSDs (p-value = 0.010); There was a relationship between covariate variable (hours of work) and the use of chair (MSDs) (p-value = 0.004). Hours of work had an important role in MSDs complaints, so the barbers should be able to do muscle stretching activities to avoid static work postures and to re-design the chair design to be more ergonomic.

Keywords: Occupational Health and Safety, Ergonomic, Barbershop Chair, Barber

BACKGROUND
In the current era of globalization, one of crucial factors to consider is Occupational Safety and Health (OSH), as a prerequisite set out in the World Trade Organization (WTO) and General Agreement on Tariffs on Trade (GATT) in the economic relations and trades among countries (Trish Kelly, 2013). One of SDGs goals is a healthy and prosperous life, which by 2030 is targeted to reduce one third of premature deaths caused by non-communicable diseases, through prevention and treatment (Fadhlurrohman, Mochammad Purnomo, Eko, and Malawani Ajree, 2020), so that the implementation of OSH is one way of efforts to create a workplace that is safe, healthy, and free from environmental pollution and occupational diseases.

Formal sectors are much better than the informal sectors. The informal sectors have the potential to be prone to occupational accidents and diseases (Chamnong and Sasithorn, 2021). One of the most informal sectors is barbershop, such as in

Tanjungpinang City for example, as the capital of Riau Islands Province with a population of 233,367 in 2021, where the total workforce is around 93.69% employment and the remaining is 6.31% unemployment; around 78.42% is in the service sector, where one of which is a barbershop (BPS, 2022). Based on data from the barbershops' community in Tanjungpinang City, there are ± 1000 barbers with the dominance of work activities having a high intensity of standing position and various other work posture problems, so that it can cause work-related diseases, such as muscle complaints, aches, tingling, and other work-related disease complaints.

The American Pediatric Association (APA) reports the largest musculoskeletal complaints that occur in industrial workers in America are discomfort and pain in the legs by 83% due to standing too long, including cashier workers, shopkeepers, security guards, barbers, and other occupations that are more likely to do long-standing activities (Coenen, 2017). Ergonomics at work for barbers has been known to have quite high problems, especially with regard to discomfort at work, such as the anthropometric condition of the customer's chair design adjusted to the work posture of the barber and other factors such as workstations and work productivity (Sadeghi, et al, 2018). One of the factors that affect ergonomics activities at the work environment is equipments or tools. Working in the barbershop, the barber chair is one of the important facilities in operational activities (Khandan., et al, 2017). Barber chairs are used by customers to sit or lie down when getting their hair cut. Barber chairs that do not match the dimensions of the barber's body size when working will result in complaints of the barber's skeletal muscles and cause ergonomic problems while working (Aweto HA, Tella BA, Johnson OY, 2015). Therefore, considering the potential and number of informal barbershop sectors in Tanjungpinang City and MSDs complaints experienced by barbers, this study is needed to analyze work posture and the factors associated with MSDs complaints on barbers.

Therefore, considering the potential and many business sectors of barbershops or barbershops in Tanjungpinang City, as well as there are MSDs complaints experienced by barbers or barbers from interviews with several workers, and descriptions of procedural conditions and work environments that have ergonomic aspects. which is still not good, especially in the design of the barbershop chair, the dominance of work by workers with long standing work postures, as well as customer discomfort in using the barbershop chair provided, it is needed in conducting research to analyze ergonomic factor of the use of barber chairs on barbers in Tanjungpinang City, Riau Islands Province. This research is a continuation of previous research on work ergonomics for barbershop workers, and it is hoped that this research can provide an important role and urgency in developing information and usefulness in solving work ergonomics problems when viewed from the aspect of comfort, especially on work posture variables, anthropometric dimensions body, and the design of the barber chair for barbers, so that they can provide important input and recommendations on work activities in using a safe and ergonomic work support tool or facility, especially in the use of barber chairs for barbers and customers in the Tanjungpinang City area.

RESEARCH METHODS

This research was an analytical descriptive study, with a cross-sectional approach through questionnaires, interviews, and measurements. The independent variabels in this study were work posture and procedure, dimension of body, dimension of chair, and covariate factors (age, education, years of experience, hours of work, body mass index, smoking habit, and exercise habit). In addition, the dependent variable in this

study the use of chair (convenience, conformity, complaint, re-design). Analysis of work posture and procedure used REBA; complaint of MSDs was measured by using NBM, while dimension of body and chair used anthropometric measurement.

A total of 50 barbershops was collected in Tanjungpinang City using a simple random sampling method. There were ± 500 male barbers (57 confirmed barbershops) around Tanjungpinang City. Based on the determination of sample formulation, the number of samples measured was 50 barbershops. The minimum sample size needed was determined by the slovin formula below:

$$n = \frac{N}{(1 + Ne^2)}$$

Information:
n = Number of samples
N = Total Population
e = Error Margin (5%)

This research conducted a study of the hypothesis between the dependent and independent variables, where the hypotheses in this study were:
Ho_1 : There's no relationship between work posture and use of chair
Ha_1 : There's a relationship between work posture and use of chair
Ho_2 : There's no relationship between dimension of body and use of chair
Ha_2 : There's a relationship between dimension of body and use of chair
Ho_3 : There's no relationship between dimension of chair and use of chair
Ha_3 : There's a relationship between dimension of chair and use of chair
Ho_4: There's no relationship between covariate factors and use of chair
Ha_4 : There's a relationship between covariate factors and use of chair

Data were collected by researchers using questionnaires, interviews, measurements, and scoring. Data processing was carried out in 5 stages: cleaning, editing, coding, entry, and tabulating. Data analysis used in this study was univariate analysis and bivariate analysis. Univariate analysis was carried out on each variable to describe an overview of the studied variables and the frequency distribution. Bivariate analysis was conducted to find out the relationship between two variables. In this study, the chi square test was used; the significant test used a significant 95% confidence level. Chi Square statistical test was presented as follows:

$$X^2 = \sum \frac{(O-E)^2}{E} \qquad df = (c-1)\,(l-1)$$

Information:
X^2 = Chi Square Value
$\sum$ = Summation
O = Observed Frequency
E = Expected Frequency
df = Degree of Freedom
c = Number of Columns
l = Number of Lines

Interpretation:
1) If p-value > 0.05, then Ho is accepted and Ha is rejected, which means there is no relationship between the independent and dependent variable.

2) If p-value ≤ 0.05, then Ho is rejected and Ha is accepted which means there is a relationship between the independent and dependent variable.
3) If the chi square test conditions aren't met, then the p-value is based on the presented SPSS data, for example, if the expected value is < 5, then the Fisher's Exact Test is used.

RESULTS AND DISCUSSION

The sector of barbershop service is one of the occupations that has a risk of MSDs complaints or disorders of the muscular system, where this disorder will cause a decrease in work activities that have an impact on the output of work, if not handled properly and appropriately (Mekonnen, T.H., Kekeba, G.G., Azanaw, J. et al, 2020), so a study and analysis is needed to find out determinant factors and causes of MSDs complaints in barbershop workers, especially in the Tanjungpinang area, so that they can provide input and recommendations for barbershop owners and workers in seeking promotive and preventive actions against potential risks of MSDs complaints. Here is the information data of health related to MSDs complaints in Tanjungpinang area.

Table 1 The information data of health related to MSDs complaints in Tanjungpinang

No.	Indicator	Research (2020)*	DKPPKB Tanjungpinang (2019)**	RSAL Dr. Midiyato S (2019)**	RSUD Raja Ahmad Tabib (2019)**
1	MSDs complaint	Complaints of aches, tingling, muscle/joint pain	Arthropathy cases	Cases of *low back pain*	Cases of *low back pain*
2	Total	117 respondents	976 patients	1842 patients	176 patients
3	Description	Indication of MSDs	The top 10 patients visiting public health centre in Tanjungpinang City	The first biggest disease of hospitalized patients	The third largest disease inpatient morbidity

NOTE: *Yusuf (2020) **BPS of Tanjungpinang (2020)

Univariate analysis on barbershop workers included the frequency distribution of individual characteristics, work posture and procedure, worker's body dimensions on barbershop chairs, and use of barber chairs (convenience, conformity, complaint, re-design). The distribution of respondents based on individual factors was divided into 7 classifications, namely age, education, years of service, hours of work, body mass index, smoking habits, and exercise habits. Table 2 below described that the dominance of barbershop workers was ≥ 35 years old (52%), educated (90%), with a working period of ≤ 2 years (90%), daily working hours > 8 hours (64%), with the highest BMI index in overweight (44%), smoking habits (78%), and exercise habits (74%).

Table 2 The frequency distribution of individual factors

No.	Variable	n	%

1	**Age**		
	a) < 35 yo	24	48
	b) ≥ 35 yo	36	52
	Total	**50**	**100**
2	**Education**		
	a. Less educated (≤ 9 years)	5	10
	b. Educated (> 9 years)	45	90
	Total	**50**	**100**
	Years of Experience		
3	a. ≤ 3 years	45	90
	b. > 3 years	5	10
	Total	**50**	**100**
4	**Hours of Work**		
	c. ≤ 8 hrs	18	36
	d. > 8 hrs	32	64
	Total	**50**	**100**
5	**Body Mass Index**		
	a. Underweight, < 18,5	9	18
	b. Normal, 18,5 – 24,9	19	38
	c. Obesity, ≥ 25	22	44
	Total	**50**	**100**
6	**Smoking Habit**		
	a. Non-smoker	11	22
	b. Smoker	39	78
	Total	**50**	**100**
7	**Exercise Habit**		
	a. Non-Exerciser	13	26
	b. Exerciser	37	74
	Total	**117**	**100**

Work posture in this study was the attitude or posture of barbers when interacting with work facilities, where in this case was how the work postures of barbers were adjusted to the use of barbershop chairs for customers. The following Table 3 described that the work postures of barbers were mostly at-risk status (94%). In addition, the way of working (procedure) was determined based on the intensity of body posture at work, which in this study was the way barbers working in their interactions with the use of chairs, with the intensity of work being dominated by standing work attitudes on all barbers (100%).

Table 3 The frequency distribution of work and body posture

No	Variable	n	%
1	**Work Posture**	3	
	a. Non-Risky	4	6
	b. Risky	7	94
	Total	5	100
		0	

2			
	Procedure (Body Posture)	5	
	a. Standing posture	0	100
	b. Stooped posture	0	0
	Total	5	100
		0	

The variable of body dimension in this study was adjusted to the use of barber chairs. In the dimensions of the worker's body, there were 8 anthropometric body parts measured according to the use of the barbershop chair, with the dominant category according to the height, weight, leg length, arm length, neck length, shoulder width, elbow length, and leg length. Table 4 below described the frequency distribution of body's dimension on barbers. All barber body dimensions were appropriate, with the results of anthropometric calculations for each body part measured, namely height of full body (52%), weight (58%), foot length (72%), arm length (88%), neck length (64%), shoulder width (82%), elbow length (82%), and limb/leg length (80%).

Table 4 The frequency distribution of body's dimension of barbers

No.	Variable	Barbers	
		n	**%**
1	**Height of Full Body**		
	a) Appropriate	26	52
	b) Inappropriate	24	48
	Total	**50**	**100**
2	**Weight**		
	a) Appropriate	29	58
	b) In Appropriate	21	42
	Total	**50**	**100**
3	**Foot Length**		
	a) Appropriate	36	72
	b) Inappropriate	14	28
	Total	**50**	**100**
4	**Arm Length**		
	a) Appropriate	44	88
	b) Inappropriate	6	12
	Total	**50**	**100**
5	**Neck Length**		
	a) Appropriate	34	64
	b) Inappropriate	16	32
	Total	**50**	**100**
6	**Shoulder Width**		
	a) Appropriate	41	82
	b) Inappropriate	9	18
	Total	**50**	**100**

7	**Elbow Length**		
	a) Appropriate	41	82
	b) Inappropriate	9	18
	Total	**117**	**100**
8	**Limb/Leg Length**		
	a) Appropriate	40	80
	b) Inappropriate	10	20
	Total	**50**	**100**

The dimensions of the chair in this study were an important variable to determine the characteristics and actual size of the chair, so that it could be an important input in the re-design of a more ergonomic chair. The dimensions of the barber chair included the frequency distribution of the type of chair, the length of use of the chair, and the dimensions of the chair size. Most of the barbershop chairs used in barbershops were complete (86%) and used for > 3 years (68%), for the dimensions of the chair size, where some were in accordance with the measured parts, but there were parts that need improvement such as headrests, backs, seats, armrests, and footrests (Table 5).

Table 5 The frequency distribution of chair's dimension

No.	Variable	Chair	
		n	%
1	**Type of Chair**		
	a) Complete	43	86
	b) Incomplete	7	14
	Total	**50**	**100**
2	**Length of Chair's Use**		
	a) ≤ 3 yr	16	32
	b) > 3 yr	34	68
	Total	**50**	**100**
3	**Height of Chair**		
	a) Appropriate	37	74
	b) Inappropriate	13	26
	Total	**50**	**100**
4	**Length of Chair**		
	a) Appropriate	30	60
	b) Inappropriate	20	40
	Total	**50**	**100**
5	**Width of Chair**		
	a) Appropriate	30	60
	b) Inappropriate	20	40
	Total	**50**	**100**
6	**Backrest Height**		
	a) Appropriate	25	50
	b) Inappropriate	25	50
	Total	**50**	**100**

7	**Backrest Length**		
	a) Appropriate	32	64
	b) Inappropriate	18	36
	Total	**50**	**100**
8	**Backrest Width**		
	a) Appropriate	28	56
	b) Inappropriate	22	44
	Total	**50**	**100**
9	**Seat Length**		
	a) Appropriate	39	78
	b) Inappropriate	11	22
	Total	**50**	**100**
10	**Seat Width**		
	a) Appropriate	35	70
	b) Inappropriate	15	30
	Total	**50**	**100**
11	**Seat Height**		
	a) Appropriate	31	62
	b) Inappropriate	19	38
	Total	**50**	**100**
12	**Footstep Length**		
	a) Appropriate	29	58
	b) Inappropriate	21	42
	Total	**50**	**100**
13	**Footstep Width**		
	a) Appropriate	35	70
	b) Inappropriate	15	30
	Total	**50**	**100**
14	**Footstep height**		
	a) Appropriate	25	50
	b) Inappropriate	25	50
	Total	**50**	**100**
15	**Length of Headrest**		
	a) Appropriate	31	62
	b) Inappropriate	19	38
	Total	**50**	**100**
16	**Width of Headrest**		
	a) Appropriate	36	72
	b) Inappropriate	14	28
	Total	**50**	**100**
17	**Height of headrest**		
	a) Appropriate	42	84
	b) Inappropriate	8	16
	Total	**50**	**100**

18	**Length of Armrest**		
	a) Appropriate	38	76
	b) Inappropriate	12	24
	Total	**50**	**100**
19	**Width of Armrest**		
	a) Appropriate	36	72
	b) Inappropriate	14	28
	Total	**50**	**100**
20	**Height of Armrest**		
	a) Appropriate	41	82
	b) Inappropriate	9	18
	Total	**50**	**100**

The distribution of the frequency of barbershop chair use was known that most barbers or customers also felt comfortable and suitable to use the chair, but customers also experienced muscle pain complaints and thought there was a need to change a new chair.

Table 6 The frequency distribution of barbershop chair use

No.	Variabel	Use of Chair	
		N	%
1	**Convenience**		
	a) Yes	46	92
	b) No	4	8
	Total	**50**	**100**
2	**Conformity**		
	a) Yes	44	88
	b) No	6	12
	Total	**50**	**100**
3	**Complaint of MSDs**		
	a) Yes	41	82
	b) No	9	18
	Total	**50**	**100**
4	**Re-design**		
	a) Yes	39	78
	b) No	11	22
	Total	**50**	**100**

Bivariate analysis was used to determine the relationship between work posture and the use of barber chair. In addition, bivariate analysis was also carried out on body dimension variables and covariate variables (individual characteristics). The results of the study revealed that there was no relationship between work posture and the use of barber chairs, both for comfort, suitability, health complaints, or seat replacement.

Table 7 The relationship between work posture and barbershop chair use

Variable	Convenience				Total		OR (95%)	*P* value
	Yes		No					
	n	**%**	**n**	**%**	n	%		
Work Posture								
Risky	45	95.7	2	4.3	47	100	11,250 (0.693-182.643)	0.173
Non-risky	2	66.7	1	33.3	3	100		
Total	**47**	**94**	**107**	**91.5**	**50**	**100**		
Variable	**Conformity**				**Total**		**OR (95%)**	***P* value**
	Yes		No					
	n	**%**	**n**	**%**	n	%		
Work Posture								
Risky	44	93.6	3	6.4	47	100	0.936 (0.869-1.009)	1.000
Non-Risky	3	100	0	0	3	100		
Total	**47**	**94**	**6.0**	**100**	**50**	**100**		
Variable	**Complaint of MSDs**				**Total**		**OR (95%)**	***P* value**
	Yes		No					
	n	**%**	**n**	**%**	n	%		
Work Posture								
Risky	11	23.4	36	76.6	47	100	0.611 (0.050-7.397)	1.000
Non-Risky	1	33.3	2	66.7	3	100		
Total	**12**	**24**	**38**	**76**	**50**	**100**		
Variabel	**Re-design**				**Total**		**OR (95%)**	***P* value**
	Yes		No					
	n	**%**	**n**	**%**	n	%		
Work Posture								
Risky	14	29.8	33	70.2	47	100	1.179 (0.099-14.081)	1.000
Non-risky	1	33.3	3	66.7	3	100		
Total	**15**	**70**	**38**	**76**	**50**	**100**		

Bivariate analysis was also carried out on covariate variables and barber body's dimensions on the use of barbershop chairs, where the results of the bivariate analysis can be seen in the following tables. Based on the results of statistical analysis, it was known that there was a relationship between the covariate variables (hours of work) and health complaints of using barbershop chairs. Meanwhile, for the variable dimensions of the worker's body, it was indicated that there was no relationship to the use of barber chairs. However, there was a relationship between the dimensions of the chair and the use of the barber chair, which included:

- There was a relationship between the type of chair and the conformity of the chair
- There was a relationship between the length of the backrest and MSDs complaints
- There was a relationship between foot length and MSDs complaints
- There was a relationship between foot width and MSDs complaints

Table 8 The relationship between individual factors and barbershop chair use

No.	Variable	*P* value				Conclusion
		Convenience	**Conformity**	**Complaint**	**Re-design**	
1	Education	0.276	0.276	0.582	1.000	Not Significant
2	Years of Experience	0.276	0.276	0.082	0.629	Not Significant

3	Hours of Work	0.291	1.000	**0.004**	0.754	**Significant with MSDs complaint**
4	BMI	0.279	0.279	0.332	0.162	Not Significant

Table 9 The relationship between body's dimension and barbershop chair use

No.	Variable	*P* value				Conclusion
		Convenience	Conformity	Complaint	Re-design	
1	Height	0.62	0.62	1.000	1.000	Not Significant
2	Weight	1.000	0.565	0.738	0.617	Not Significant
3	Foot H.	1.000	0.534	1.000	1.000	Not Significant
4	Arm H.	1.000	0.324	1.000	1.000	Not Significant
5	Neck H.	1.000	1.000	1.000	1.000	Not Significant
6	Shoulder W.	0.080	0.456	0.191	1.000	Not Significant
7	Elbow H.	0.456	0.456	1.000	1.000	Not Significant
8	Leg H.	0.098	0.098	0.225	0.462	Not Significant

Table 10 The relationship between chair's dimension and barbershop chair use

No.	Variable	*P* value				Conclusion
		Convenience	Conformity	Complaint	Re-design	
1	Type of Chair	0.37	**0.048**	1.000	0.176	**Significant with Conformity**
2	Chair H.	0.558	1.000	0.480	0.294	Not Significant
3	Chair L.	1.000	1.000	0.317	0.753	Not Significant
4	Chair W.	0.556	0.058	1.000	0.345	Not Significant
5	Backrest H.	1.000	1.000	0.321	0.537	Not Significant
6	Backrest L.	0.291	0.291	**0.004**	0.479	**Significant with MSDs complaint**
7	Backrest W.	0.576	0.576	1.000	0.576	Not Significant
8	Seat H.	0.534	0.534	1.000	0.065	Not Significant
9	Seat L.	1.000	1.000	1.000	0.502	Not Significant
10	Seat W.	**0.049**	0.549	0.171	1.000	Not Significant
11	Footstep H.	0.565	0.068	**0.017**	0.169	**Significant with MSDs complaint**
12	Footstep L.	0.543	1.000	**0.010**	1.000	**Significant with MSDs complaint**

13	Footstep W.	1.000	1.000	1.000	0.217	Not Significant
14	Headrest H.	1.000	**0.049**	0.171	0.611	Not Significant
15	Headrest L.	0.235	1.000	0.098	0.217	Not Significant
16	Headrest W.	1.000	0.414	0.082	0.683	Not Significant
17	Armrest L.	1.000	1.000	0.705	1.000	Not Significant
18	Armrest W.	0.186	0.186	0.071	0.085	Not Significant
19	Armrest H.	0.456	1.000	0.668	0.423	Not Significant

CONCLUSION AND RECOMMENDATION

The distribution of the frequency of use of barbershop chairs among workers, most of the workers felt comfortable (92%) and appropriate to use the chair (88%), but workers also experienced health complaints (82%) and requested a new chair change (78%). The distribution of the frequency of work postures in barbershop workers were mostly at-risk status (94%), with the intensity of work standing working attitude (100%). The dimensions of the worker's body were adjusted to the use of the barber chair, with the dominant categories according to body height, weight, leg length, arm length, neck length, shoulder width, elbow length, and leg length. The same applies to customers. Most of the barber chairs used in barbershops were complete (86%) and used for > 3 years (68%), for the dimensions of the chairs, some are appropriate, but there are parts that need improvement such as headrests, backs, seats, armrests and footrests. There was no relationship between work posture and the use of a chair. Meanwhile, there was no relationship between the dimensions of the worker's body and the use of the barber chair (p-value = 0.098-1,000); There was a relationship between the dimensions of the chair and the use of the chair, for the variable type of chair (p-value = 0.048), backrest length (p-value = 0.004), foot length (p-value = 0.017), and footrest width (p-value = 0.010). The owner of barbershop should pay attention to work ergonomics issues, especially related to the prevention of MSDs complaints, through efforts to create safe, ergonomic, and healthy working conditions, such as redesigning the barber chair used according to the dimensions of the worker's body. It is also necessary to carry out further similar research on a wider range of research areas and a larger population, as well as a study on the design and design of an ergonomically based barber chair.

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