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ADJUSTABLE-ERGONOMIC CHAIR FOR GRINDING OPERATION

Comment [A1]: Artikel terlalu singkat dan sumber rujukan masih minim. Minimal artikel 4000 kata.

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ABSTRACT

Many activities are done better when people use an ergonomic chair. Although there are a lot of ergonomic chair designs, there is no specialized chair design used by an employee for grinding operation. The risk levels of the workers were evaluated using REBA. The results show that most of the grinding operations of the workers need improvement actions. Then, anthropometric measures were selected to make a chair design for the grinding operations, i.e., buttock-popliteal length (seat depth), lower leg length (popliteal height) and hip breadth, sitting. After that, existing adjustable chair designs were also considered and evaluated to get better adjustable-ergonomic chair design for the grinding operations. Finally, a chair design used for grinding operation can be gotten that is adjustable, comfortable, durable, and strong.

Keywords: Grinding Operation; REBA; Adjustable-Ergonomic Chair

Comment [A2]: Di bagian abstrak mengandung latar belakang, tujuan, kerangka teori, metode, dan hasil. Terdiri dari satu paragraf, antara 200-250 kata.

Comment [A3]: Bold, italic, minimal 5 kata. Disusun sesuai abjad.

ABSTRAK

Berbagai macam aktivitas yang dilakukan akan lebih baik ketika seseorang menggunakan kursi ergonomis. Meskipun ada banyak desain kursi ergonomis, tidak ada desain kursi khusus yang digunakan oleh karyawan untuk operasi penggerindaan. Tingkat risiko pekerja dievaluasi menggunakan REBA. Hasil dari evaluasi tersebut menunjukkan bahwa sebagian besar operasi penggerindaan perlu tindakan perbaikan. Kemudian, pengukuran antropometri dipilih untuk membuat desain kursi untuk operasi penggerindaan tersebut, yaitu, panjang buttock-popliteal (kedalaman kursi), panjang kaki bagian bawah (tinggi popliteal) dan lebar pinggul, duduk. Setelah itu, desain kursi yang dapat disesuaikan juga dipertimbangkan dan dievaluasi untuk mendapatkan desain kursi ergonomis yang lebih disesuaikan untuk operasi penggerindaan. Akhirnya, desain kursi yang digunakan untuk operasi penggerindaan dapat diperoleh yang dapat disesuaikan (*adjustable height*), nyaman, tahan lama, dan kuat.

Kata kunci: Operasi Penggilingan; REBA; Adjustable-Ergonomic Chair

Comment [A4]: Di bagian abstrak mengandung latar belakang, tujuan, kerangka teori, metode, dan hasil. Terdiri dari satu paragraf, antara 200-250 kata.

Comment [A5]: Bold, italic, minimal 5 kata. Disusun sesuai abjad.

INTRODUCTION

Many activities are done better when people use an ergonomic chair. For example, un-ergonomic designs of student furniture can lead fatigue joint and muscle pain, neck or shoulder tension, headache, neck pain, back pain, pain on legs joints, shoulder and muscles pain, and pain at elbow [1].

Although there are a lot of ergonomic chair designs, there is no specialized chair design used by an employee for grinding operation. There is a wheelchair design for helping people who cannot walk well [2], but there is no further explanation for what kind of disabilities are accommodated by it. There is also ergonomic chair design for support pedicurists and manicurists to do appropriate jobs [3], but the table attached to the chair is too big so it could make them difficult to sit on the chair.

Therefore, a chair design used for grinding operation should be designed that is adjustable, comfortable, durable, and strong.

METHOD

First, the workloads of grinding workers were assessed using Rapid Entire Body Assessment (REBA). REBA is used for assessing the risk level of grinding operation. If the risk level is high so the working postures of the employee need to be improved [3].

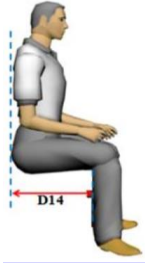
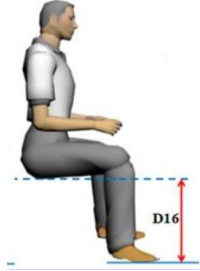
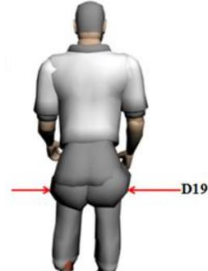
Second, body measurements that are for designing a chair were chosen. The body measurements are buttock-popliteal length (seat depth), lower leg length (popliteal height), and hip breadth (sitting) (Table 1). The body measurement data were taken from antropometriindonesia.org (the anthropometry data collection of Indonesian people). The body measurements used for designing the chair are in Table 2.

Comment [A6]: Untuk introduction terlalu singkat. Silahkan dijelaskan mengapa penelitian ini dilakukan dan beberapa penelitian yang telah dilakukan dan perbedaan dengan penelitian ini

Comment [A7]: Tidak uppercase

Table 1

Body measurement for designing a chair [1], [4]

D14: buttock-popliteal length (seat depth)	D16: lower leg length (popliteal height)	D19: hip breadth, sitting
		

Comment [A8]: Gunakan format tabel terbuka (berguna untuk semua table. Sesuaikan semua format tabel, seperti tabel 1

Table 2

The anthropometry data of the three body measurements (data filter used are all ethnic, male, 18-45 years old) [5]

Body measurement	5 th	50 th	95 th	SD
D14: buttock-popliteal length (seat depth)	30.36	40.41	50.45	6.11
D16: lower leg length (popliteal height)	38.03	43.84	49.65	3.53
D19: hip breadth, sitting	27.64	36.13	44.62	5.16

Third, industrial-adjustable chairs which are available in the marketplace are identified and compared (Figure 1-7). This step is used for getting appropriate chair design for grinding operation.



Figure 1. Industrial Height Adjustable Toledo Shop Stools [6]



Figure 2. Vintage Industrial Backless Wood and Metal [7]



Figure 3. America Alavus Industrial Height-Adjustable Swivel Barstool, Oak [8]



Figure 4. eHemco Adjustable Height Swivel Bar Stool [9]



Figure 5. Toledo Bar Stool - Vintage Industrial Bent Plywood and Metal Adjustable [10]



Figure 6. Backless Vintage Toledo Stool with Adjustable Height & Scooped Maple Seat [11]



Figure 7. Height Adjustable Swivel Industrial Conductive Chair [12]

RESULTS AND DISCUSSION

Working postures evaluation of the worker grinding workpiece shows that all of the grinding operations need corrective working postures. Especially, working posture A and B should be corrected immediately (Table 3 and 4). On working posture A, the employee does not use a chair. On the working posture B, the employee bend over himself extraordinarily. Beside of that, working posture C, D, E, F, and G also require corrective actions (Table 5-9). The worker on the working posture C has a lower risk level (medium) because he uses a small chair that makes him have a good-enough-stand-up position, so it represents that a chair can help the employee to provide better working postures.



Figure 8. Working Posture A

Table 3

The REBA scores of working postures A

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
A	Trunk	Neck	Legs	Table A	Load/Force	Score A	7	+1	8	High	Necessary soon
	3+1=4	1	1+2=3	6	0	6					
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
2-1=1	2	2+1=3	3	1	4						



Figure 9. Working posture B

Table 4

The REBA scores of working postures B

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
	Trunk	Neck	Legs	Table A	Load/Force	Score A					
B	4	2	1+1=2	6	0	6	8	1	9	High	Necessary soon
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
	3	2	2+1=3	5	1	6					



Figure 10. Working Posture C

Table 5

The REBA Scores of working postures C

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
	Trunk	Neck	Legs	Table A	Load/Force	Score A					
C	2	2	1+1=2	2	0	2	3	+1	4	Medium	Necessary
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
	2-1=1	2	2+1=3	3	1	4					



Figure 11. Working Posture D

Table 6

The REBA scores of working postures D

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
D	Trunk	Neck	Legs	Table A	Load/Force	Score A	6	+1	7	Medium	Necessary
	3+1=4	1+1=2	1	4	0	4					
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
1+1+1=3	1	2+1=3	5	1	6						



Figure 12. Working Posture E

Table 7

The REBA scores of working postures E

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
E	Trunk	Neck	Legs	Table A	Load/Force	Score A	6	+1	7	Medium	Necessary
	4	1	1+1=2	4	0	4					
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
3+1=4	1	2+1=3	5	1	6						



Figure 13. Working Posture F

Table 8.

The REBA scores of working postures F

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
	Trunk	Neck	Legs	Table A	Load/Force	Score A					
F	2+1=3	2+1=3	1	4	0	4	6	+1	7	Medium	Necessary
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
	3+1=4	1	2	5	1	6					



Figure 14. Working Posture G

Table 9

The REBA scores of working postures G

Working Posture	Group A						Score C	Activity Score	REBA Score	Risk Level	Action
G	Trunk	Neck	Legs	Table A	Load/Force	Score A	4	1	5	Medium	Necessary
	2	1	1	1	0	1					
	Group B										
	Upper Arms	Lower Arms	Wrist	Table B	Coupling	Score B					
3-1=2	2	2	6	1	7						

Similar to the students suggested to use ergonomic furniture to avoid the bad effect of poor sitting posture [1], the employee doing grinding operations ought to use an adjustable-ergonomic chair to accommodate their job. The determinant criteria for the adjustable-ergonomic chair can be seen in Table 10.

Table 10

The determinant criteria for the adjustable-ergonomic chair

Features	Anthropometric measure	Design dimension	Criteria determinant
Seat depth	buttock-popliteal length	350 mm	5 th percentile of buttock-popliteal length + 5 mm for allowance
Seat width	hip breadth, sitting	350 mm	50 th percentile of hip breadth (sitting)
Seat height	lower leg length (popliteal height)	295-400 mm	5 th -50 th percentile of lower leg length (popliteal height) to make the chair having an adjustable height. The chair has a pin used to change the chair height (Figure 15)



Figure 15. The 3D Model of the Adjustable-Ergonomic Chair



Figure 16. The Real Object of the Adjustable-Ergonomic Chair

The adjustable-ergonomic chair (Figure 15 and 16) is appropriate for grinding operation. The first reason is that the chair is adjustable to accommodate the worker doing workpiece with different size and height. The adjustable-ergonomic chair design is similar with the others chair design (Figure 1-7), but the adjustable-ergonomic chair design has lower chair height to make the employees do not bend their back when they are grinding a small-sized and low-heightened workpiece.

The second reason is that the chair is comfortable to make the employee feel enjoyable to grind workpiece in the long working hours. The chair has a soft seat made from foam that is different from the other chairs having hard seats made from wood or plastic (Figure 1-7).

The last reason is that the chair is durable and strong so the chair can be used for a long period of time. The chair made from hollow steel that makes the chair strong and light enough to be moved.

CONCLUSION

A worker doing grinding operation that has bad postures need posture evaluation and refinement. One of the ways to solve the problem is to provide an appropriate adjustable-ergonomic chair. The chair should be adjustable to accommodate the wide range of the product size, and comfortable to be used in the working hours. Beside of that, the chair should be durable and strong to sustain the weight of the employee and to be used in the long lifecycle.

The stakeholder of the enterprises using grinding operations in their production process should accommodate the employees to have an appropriate-adjustable-ergonomic chair. Therefore, their employee can work safely and do not suffer from musculoskeletal disorders.

Acknowledgments

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