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by Renny Septiari

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Renny Septiari
Mechanical Engineering Department, Faculty of Engineering,
Brawijaya University, Malang, Indonesia
Industrial Engineering, National Institute of Technology (ITN) Malang, Indonesia

Pratikto, Purnomo B. Santoso and Ishardhita P. Tama
Mechanical Engineering Department, Faculty of Engineering,
Brawijaya University, Malang, Indonesia

ABSTRACT

Working in prolonged sitting position may cause discomfort and health problem because the body will remain statically in the position while doing activities which are repeated and monotonous such as packaging in the process of drinking glass packaging where each operator is assigned to sit while finishing their task for almost 7 hours every day. In order to minimize discomfort and health problem, sitting and standing treatment while working is suggested. The result is, hopefully, the improvement of operator's performance to finish the tasks. Operator's improvement can be indicated by fatigue level, production output and heartbeat level. The aims of measuring performance are to know whether the position change treatment influences level of fatigue, production output, and heartbeat. Linearity test indicates that there are linear and significant relationship between the influence of sitting and standing position towards fatigue, production output, and heartbeat because the level of significance is less than 5% ($p<0.05$). Significance value of fatigue level is 0.001, production output is 0.004, and heartbeat is 0.000. Correlation test shows that there is simultaneous correlation between the tested three factors caused by position change treatment. The result shows that the value between fatigue level and production output is 0.557, fatigue level and heartbeat is 0.502, and production output and heartbeat is 0.411.

Keywords: position change, fatigue, production output, heartbeat.
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1. INTRODUCTION

Prolonged sitting while working may cause some health problems [1,2,3]. The prolonged positioning may cause obesity, diabetes, cancer and even death in some cases [4,5]. The problem is not on how long we work in prolonged position but it is more on the accumulation of how many times we work in prolonged position. Sitting in a long duration of time relates with the absence of body metabolism compared to if a person change the position [6].. Prolonged behavior is a special target to intervene health. However, there is a dilemma in finding the best way to do tasks [7]. An adult spends less than 8 – 9 hours per day to do job in prolonged position and sometimes they even spend more [8,9]. Besides that, sitting in a long time while working may result in discomfort [10,11,12] while most of the employees do it [13,14] where they spend more than 8 hours a day to work [15].

Actually, workplace is a strategic place to minimize sitting and plan time to rest appropriately to improve health [16,17,18]. Finding the most comfortable sitting position while working is an attempt to minimize discomfort [19,20]. It can be achieved in many different ways starting from basic intervention such as adjusting the position or even changing sitting to standing and using more time to rest [11]. [21] states that changing the paradigm of sitting and standing at work is very suggested for the employees and should be applied soon.

From the previous explanation, it can be concluded that prolonged position while working mostly causes discomfort such as early fatigue and boredom to workers. Therefore, this study intends to suggest position change for packaging operators. They are suggested to alternate prolonged sitting to sitting and standing while doing their tasks. The treatment is hoped to minimize their discomfort and boredom felt while working.

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2. METHOD

2.1. Participants

The participants involved in this study were some beverage packaging operators in an industry or drinking Glass Company located in Central Java. In a production process line, there were 4 operators who worked in the packaging process. At present, the company runs two lines of the drinking glass packaging process. There were 8 operators who were involved as participants. They were all males with age variating between 20 to 30 years, working period of 1-3 years in the packaging process, and were in healthy condition (not suffer from any disease).

The operators involved in the study worked for 8 hours a day for packaging process minus 1 hour for break which was done in shift in order to keep the packaging kept running.

2.2. Equipment used

There were some equipments used to collect data in this study. They were both subjective such as questionnaire to measure fatigue level and objective such as stop watch and finger *pulse oxymeter*. Questionnaire to measure the level of fatigue (KAUPK2) was used to test the fatigue level felt by each operator during the packaging process. Fatigue level data was taken before and after the operators were treated. This was done to compare their level of work fatigue. Stopwatch was used to measure the speed level of each operator to finish a task. Thus, the time speed and the average time of each operator to package one box could be seen before and after the treatment. *Finger pulse oxymeter* was used to measure the heartbeat level of the operators. It aimed to know whether there was change before and after they were given the treatment.

2.3. Procedure

The procedure of the study is as follow. First, the operators were given some adequate information about the goal and the purpose of the study. Later, they were assigned to try to package in standing position which had not been done before. When they had to change the position, they could do it quickly without disturbing the packaging process. Then, each operator was given questionnaire to know whether they were tired before packaging process. Then, their heartbeat and oxygen content were measured to ensure that they were healthy before working.

After all the preliminary data were taken, all operators could start working at the set lines. Collecting preliminary data was done when the operator packaged in sitting position. Data collection in sitting position and its change was done for 3 days for each position changing.

2.4. Data collection

The data of operators' speed level to finish the tasks was taken using stop watch during the working hours with the change or position model at the time. After finishing the tasks, each operator was given questionnaire to measure their fatigue level to know whether their fatigue increased after they have packaged to measure their heartbeat variation after changing the position.

The same procedure was conducted in taking data for standing position and the other position change as modeled before. Each of the position change was applied for 3 days by each operator. The total days spent for this study was 15 week days from 5 models of test were tried in the beverage packaging process (table 1).

2.5. Design of the Study

This study used Cross Sectional approach because the cause and effect variables of the object of the study were collected in the same time and conducted in the same situation.

This study was done for some days to get adequate and accurate data to be calculated to determine operators' work burden level in some working positions while packaging. Preliminary data was collected during packaging in sitting position where the 8 operators had worked. From each position changing, data were collected. The data of operators' heartbeat was noted to measure their work burden level before and after the treatment. The operators' fatigue level was measured using the questionnaire asking about on which body part they feel tired before and after the packaging. The data of operators speed level to finish the tasks were taken using stop watch. Each operator was hoped to work based on their ability and habit to ensure their comfort which may affect their maximum output. Operators' position while packaging can be seen in Figure 1 and figure 2.

Figure 1 Sitting Position

Figure 2 Standing Position

Table 1 The Schedule of Study Implementation of Research on Work Positioning Application

Position	days														
Working	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sitting															
Standing															
Sitting- Standing alternately 0.5 hour															
Sitting- Standing alternately 1 hour															
Sitting-standing alternately 2 hour															

3. DATA COLLECTION

3.1. Data of fatigue level

Fatigue is a body protection mechanism to avoid further damage and let the body recovers after resting. Fatigue usually shows different condition of each person. It indicates the lost of efficiency and decrease work capacity and human's body immune.

There are two kinds of fatigue from working. They are muscle fatigue and general fatigue. Muscle fatigue in human is a kind of tremor or the feeling of pain on muscle, while general fatigue is indicated by deficiency of intention to work which is caused by monotonous physical activity, intensity, environment condition, mental and physiological condition, health status, and nutrition**.** The effects accumulate in human body and may cause fatigue and make somebody stops working and doing activities. Fatigue can be cured by resting and refreshing the body. If somebody forces himself working when he/she is fatigued, he may get worse and his/her productivity decreases. Fatigue is similar to hunger and thirst. They function as a mechanism to support human's life.

In this study, fatigue level was measured by using questionnaire of work fatigue measurement (*Kuesioner Alat Ukur Perasaan Kelelahan Kerja (KAUPK2*)) which would be given to each packaging operator. The test on fatigue level used likert scale with assumption as follows:

1 = never 3 = frequent

2 = Sometimes 4 = always

The result is the chosen answers of each operator which were mostly chosen from 17 questions given. Numbers on Table 2 is a average presentation of complaint felt by the operators which is >50%.

3.2. Production Output

A Production result is an output which was produced from an operator during packaging. The result of this production was calculated accumulatively. It was the total amount of output produced by an operator during working.

Data of production result displayed in Table 2 is the total average output which was produced by each operator after working for 4 hours a day during the research based on the treatment given at the moment. The data were hoped to represent the overall performance of each operator during packaging for 3 days respectively.

3.3. Heartbeat data

The measurement of physical work burden with heartbeat is the easiest way to do and it is suitable with outdoor measurement [22]. Heartbeat correlates highly with oxygen consumption. High heartbeat rate followed by low oxygen consumption usually shows muscle tiredness especially for static tasks [23].

Work burden data which was analyzed were the heartbeat of each operator which was taken after they finished tasks based on position change applied. Work period followed time change based on the schedule/model determined which 4 hours was. Heartbeat data was taken because it was based on change happened to each operator. If an operator's work burden was high, the level of heartbeat would change rapidly.

4. RESULT AND ANALYSIS

The aim of this study is to gain information about the influence of position change towards fatigue, output capacity, heartbeat rate which are the indications of high work burden.

There were 5 models tested in this study including prolonged sitting which was usually done by the operators when working. The models were standing position without change; sitting position for 0.5 hour to standing position for 0.5 hour; sitting position for 1 hour to standing position for 1 hour, sitting position for 2 hours to standing position for 2 hours. Each position and its change were applied for 4 hours in 3 days respectively based on condition at the work place.

Table 2 Data of the result of observation

	Operator	position				
		Sitting	Standing	Sitting-standing alternately 0.5 hour	Sitting-Standing alternately 1 hour	Sitting-Standing alternately 2 hours
Data of Fatigue	1	3	2	2	1	1
	2	3	2	2	2	2
	3	3	2	2	2	1
	4	2	3	1	1	2
	5	3	2	1	2	2
	6	3	2	3	2	1
	7	2	3	2	3	2
	8	2	1	2	1	2
Output of Packaging	1	420	574	508	522	535
	2	408	454	444	454	466
	3	442	471	460	466	480
	4	444	491	488	512	514
	5	498	522	508	518	523
	6	377	412	424	438	452
	7	474	480	476	490	501
	8	444	477	484	502	516
Heartbeat	1	81	114	89	95	108
	2	87	96	90	103	105
	3	87	117	101	100	111
	4	106	103	99	103	107
	5	89	106	100	100	103
	6	114	108	99	104	111
	7	94	112	98	103	101
	8	117	118	109	111	106

(Source :analysis)

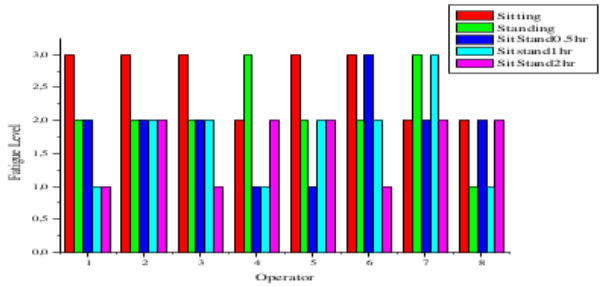

Figure 3 Fatifue Level

In figure 3, operators' fatigue level tended to be stable when they were in sitting position for 2 hours and standing for 2 hours compared to other treatments, *e.g.*, on of the tallest operator was more fatigued than the others when he was in sitting position for 0.5 hour and standing position for 0.5 hour; and sitting position for and standing position for 1 hour. Therefore, it could be concluded that the treatment had not represented the operators' condition which affected the improved performance.

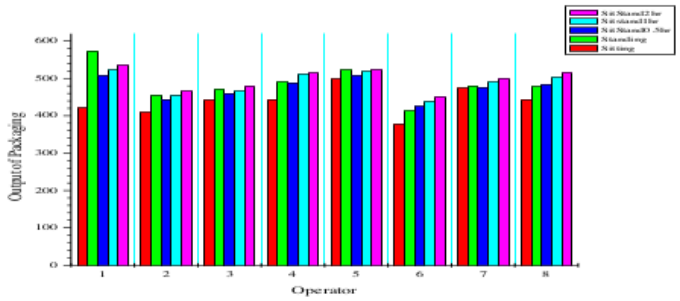

Figure 4 Packaging Output

In figure 4 packaging output, the operators' output stability appeared during the three treatments as displayed on Figure 4 compared to if there was no treatment. It can be concluded that changing work position while working gave positive effect towards the packaging operators and it is shown in the output improvement.

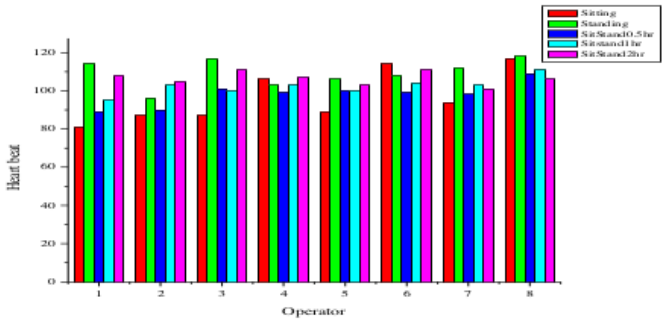

Figure 5 Heartbeat Level

In Figure 5, the average treatment change of working position has stability which is mostly similar and there is no significant increase of operators' heartbeat except on unchanged sitting position.

Linearity test was conducted to know correlation between work position change towards fatigue level, packaging output and heartbeat. In order to know correlation between factors caused by position changing, correlation test between variables would be conducted.

1. Linearity test

Linearity test is aimed at knowing whether two variables have significant linear correlation or not. This test is usually used as a requirement in correlation analysis or linear regression.Test on SPSS used *Test for Linearity* with level of significance of 0.05. The two variables were said to have linear correlation if the significance (linearity) was less than 0.05.

Table 3 Result on linearity test

Correlation between variables	Significance	Note
Position and fatigue	0.001	Linier
Position and output	0.004	Linier
Position and heartbeat	0.000	Linier

Result on Table 3 shows that three kinds of correlation between variables in structural model are linear based on their significance level which is less than 5 % ($p<0.05$) as rules determined before. Thus, assumption of linearity on the models is accomplished.

2. Correlation test between variables

Correlation test is aimed at knowing whether there is correlation between two variables or not. If there is correlation, it attempts to know where they correlate and how big they correlate. This study tried to find out the correlation between 2 variables and the effect of the position changing.

Table 4 Result of correlation test

Relationship between variables	Coefficient of correlation	Note	Sig.F Change	Note
Fatigue and Output	0.557	Give effect - medium	0.001	Significant
Fatigue and beat	0.502	Give effect - medium	0.005	Significant
Output and beat	0.411	Give effect–medium	0.033	Significant

From Table 4, it can be explained that:

- There is correlation between fatigue level and output caused by position changing with coefficient of correlation of 0.557. This shows that the influence is medium. Probability value (sig.F Change) = 0.001 < 0.05. In other words, fatigue and output correlates simultaneously and significantly because of position changing.
- There is correlation between fatigue level and beat caused by position changing with coefficient of correlation of 0.502. This indicates that the influence is medium. Probability value is (sig.F Change) = 0.005 < 0.05. It means that fatigue and beat correlate simultaneously and significantly caused by position changing.
- Correlation between output level and beat is caused by position changing which was done with coefficient of correlation of 0.411. This indicates that the influence is medium. Probability value (sig.F Change) = 0.033 < 0.05. Therefore, it can be said that output and beat correlate simultaneously and significantly because of position changing.

5. CONCLUSION

Position changing treatment applied to the operators while packaging gives positive effect. It can minimize fatigue and improve their work performance. The improvement of packing production capacity is seen from the production output amount which increases more after applying some models of work position changing.

It is hoped that work position changing can be sustainably applied in the future with models suit the working condition to make the operators comfortable in doing their tasks. In the end, it is hoped that the operators' performance and productivity may increase and they reached optimum production capacity.

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