THE CORRELATION BETWEEN PHYSICAL WORK ENVIRONMENT AND FATIGUE LEVEL ON THE PACKAGING PRODUCTIVITY OF THE REPETITIVE TASK IN SITTING POSITION

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Abstract The packaging is one of the industrial tasks in beverage an industry which is repetitive and monotonous with the same position throughout the day. In order to complete the packaging process, the workers do the tasks in sitting position during one work shift. Sitting position at work is commonly applied in both service and manufacturing industry. This position is mostly applied because it is considered to make a worker feel comfortable in finishing the task. Being supported by a comfortable physical work environment, a worker may sit in long hours during the workday. The aim of the study was to determine the level of productivity of the task done in the prolonged sitting position and affected by the work environment and level of fatigue. With software of SPSS 22 using analysis double correlation test, it was obtained that the value of Sig. F Change 0.027. The software analysis showed that the physical work environment and fatigue influenced packaging productivity significantly. R (the value of Pearson Correlation) obtained was 0.742 which means that there is a strong correlation between free variable (X) and bound variable (Y). R (the value of Pearson Correlation) obtained was 0.742 which means that there is strong correlation between free variable (X) and bound variable (Y).

Keywords: fatigue, physical work environment, productivity, repetition, sitting position.

1. Introduction
Fatigue is a problem that must get attention. All types of work both formal and informal create work fatigue. Fatigue will reduce performance and increase work errors. Declining performance means the decline in work productivity. If the level of productivity of a workforce is disrupted due to physical and psychological fatigue, the result will be felt by the company in the form of a decrease in company productivity [1]. According to the International Labor Organization (ILO), every year as many as two million workers die from workplace accidents caused by fatigue. In the study explained from 58,115 samples, 18,828 of them (32.8%) experienced fatigue. Whereas if workers experience work accidents caused by fatigue factors, it will have a direct impact on the level of work productivity. So human factors are very influential on the level of work productivity, such as sleep problems, biological needs, and also work fatigue, even stated that the decline in labor productivity in the field is largely due to work fatigue [2].

Productivity is influenced by three factors, namely workload, work capacity, and additional burden due to the work environment. The workload is usually associated with physical, mental and social burdens that affect the workforce. While work capacity is related to the ability to complete work at a certain time. And the additional burden due to the work environment includes physical, chemical, and factors in the workforce itself which includes biological, physiological and psychological.
factors [3]. In addition, labor productivity is also influenced by several factors. One of them is the fatigue factor because of the non-ergonomic conditions of the facilities, infrastructure and work environment which are the dominant factors for the decrease of low labor productivity in the workforce [4].

The physical work environment is everything that exists around the workers and that can affect him in carrying out the tasks that are charged. Like noise from production machines, lighting and so on. The physical work environment has a major influence on the smooth operation of the organization so that it will affect the productivity of the organization in general. Quality does not only cover products and services, but also includes processes, environment, and people. So a company must provide a quality environment so that its employees are comfortable so that it will increase work productivity [5]. Physical work environment is a work environment consisting of equipment, office machines that are used and office space that affects the physical environment of the office and physical work conditions in conditions where work must be done [6].

Prolonged sitting at work is mostly applied by many companies of both manufacturing and service industries. The workers are expected to complete their tasks effectively because sitting position is considered as a comfortable position and will minimize tiredness. It does not need any energy as much as a standing position. It is because the hands can be more free to move and supported by chairs during working. Moreover, the tasks which are done monotonously and repeatedly does not need much movement. Therefore, sitting is thought to be appropriate. This is can be found in cup drink packaging process where tasks mostly need simple movement. In this job, the workers fold the cardboard boxes, put the cup drinks into the boxes and arrange them to make sure that the cups fit orderly in the boxes [7]. Sitting position at work can make the body feel comfortable during the completion of the tasks which therefore may have satisfactory result. However, sitting too long while working may cause problems for the body. They can be muscle stiffness, balance problem, and monitors problem. Sitting too long may also cause health problems such as obese, hypertension, type 2 diabetic, cardiovascular disease and the increase of mortality because it is a prolonged static posture [8, 9, 10]. This is because the body will adapt to every activity which is usually done. By sitting along the day, the body will adapt to the habit rather than to other activities which need more movements. The effect is that the body may lose balance, strength and may result in bad walking posture. Sitting for 8 to 10 hours triggers the risk of neck and nape pain, hemorrhoids and back pain because the body muscles become stiff because of prolonged sitting. Sitting with stiff or straight posture needs more muscles or back nerve activity compared to sitting with leaning forward posture [11].

Nowadays, many safety and health authorities admit that the risk of neck and shoulders pain is not only caused by high-physical-burden tasks but also by low-energy tasks with low work variation [9]. Suma'mur [12] stated that industrial tasks are exhausting and some factors in them can be identified as the cause of the workers' complaints. As in industry of drink packaging, the tasks are mostly done in standing or sitting position which are repetitive, monotonous and boring. The effect of the boredom leads to discomfort and fatigue which decrease productivity.

Fatigue is a common condition in everyday life. The term of fatigue points to the condition of being weak or exhausted to do an activity. However, this is not the only symptom [13]. Fatigue caused by work is mostly defined as the process of the decrease of efficiency, work performance, strength, and endurance to continue working [14]. The discomfort of body position, doing high-repetition and high-energy tasks [15] are some factors that may trigger fatigue [16]. The study conducted by the Ministry of Labor in Japan on almost 12,000 industries involving 16,000 selected randomly workers found that there was almost 65% of the workers complained about physical exhaustion because of routine work, 28% of them complained about mental fatigue and 7% of them stated depression and the feeling of neglected [17]. One of the companies in Indonesia stated that the workers at production department commonly felt exhaustion with the symptoms of headache, back pain, and stiff back. Grandjean et al. [17, 11, 12, 18] concluded that fatigue shown by each person is different from one to another. However, fatigue will have effect on the body immune, weaken
the physical strength, disturb alertness, thoroughness, and health which may result in the decrease in working capacity, motivation, and work productivity.

Besides fatigue, physical work environment also influences a worker's productivity level. Physical work environment is defined as everything around the workers which may influence them in delivering the tasks. The examples are the noise from the production machine, lighting and etc. A comfortable physical work environment can make the workers feel protected which may result in the optimization of their work caused by a comfortable feeling. A worker is able to work effectively and productively if the work environment is comfortable [11]. Physical work environment can also influence an operator's productivity [19]. A physical work environment is one of the indicators which is used to measure productivity level experienced by the workers in doing their job. Each job has special characteristics and different physical work environment such as packaging process of cup drink done by the operator. The Previous Studies as follows:

1. Wahyu Ningrum Handayani, Sinta Wahyu Hati (2018). The influence of physical work environment on the work productivity of the operators at the production department of manufacturing company PT ABC Batam. The result of the study showed that there are five factors of work environment including temperature, noise, vibration, lighting and the air circulation which had influenced on the workers' productivity significantly [20].

2. Ni Kadek, I Wayan B. and I Wayan S (2014). The Influence of compensation and work environment on employees' productivity at hoster department of Usaha Dagang (local trading business) Yuri, Desa Pangkung Buluh, Melaya Sub District, Jembrana District. The study had proved that the compensation and work environment influenced the work productivity of the employees significantly and positively [21].

3. Lince Verawati (2016), The correlation between the level of subjective fatigue with the productivity of the labors at packaging department at a CV. Sumber Barokah. The result of the study showed that there was correlation between the subjective fatigue and the workers' productivity [22].

4. Misaq Arinda (2014), Relationship between Work Fatigue and Work Productivity at Batik Cap Workers in Batik Laweyan Village Surakarta. The result of the study showed that there was correlation between the work fatigue and the workers' productivity [23].

2. The Method of the Study

The research type used is quantitative research with a descriptive approach. Quantitative research methods are used to examine specific populations or samples, data collection techniques using research instruments. Data analysis is quantitative / statistical in order to test the hypothesis set.

2.1 The Location and the Time of the Study

The study was conducted at a packaged drinking water company which was located in Kudus, Central Java. The study was conducted in January 2019.

2.2 The Sample and the Population

According to Abdullah [24], a population is a group of units that are to study and analyze their characteristics and if the population is too large, the study took a random sample from the population and the result of the study will be applied to the entire population. The study population included 12 operators working on morning shifts.

2.3 Description Company AMDK Kudus

The bottled water company (AMDK) has been operating for 10 years and is growing so rapidly along with the increasing demand for their products. Their branches are established in the regions so that the distribution of demand will be evenly distributed and fulfilled as needed. The are the working hours of Kudus branch factory:

1. Shift one: 7am - 3pm (production section) and 8am – 4pm (administration section)
2. Shift two: 3pm - 11pm (production department)
3. Shift three: 11pm – 7am (production department)

The working day is valid from Monday to Saturday. This factory consists of three parts because they also produces bottled drinks and gallon drinking water besides glass drinks.
The total number of employees is 130 people by division, the administration section is 40 people including the manager/head of the factory, supervisors, foremen, and administration while the remaining 90 people are production employees. The plant has a production capacity of 5,000 dos for cup bottled water with 2 machine lines, 4,000 dos for 600 ml bottled bottled water with 2 machine lines, and 2,000 for 19-liter gallon bottled water capacity with 1 machine line.

At the production section, employees working hours are rolling once a week which is divided into three shifts (adjust). This is applied so that there will be an even distribution of conditions and work atmosphere so that each group of employees can feel the advantages and disadvantages of each work shift. Total production employees are 90 male employees every shift consists of 30 male employees, 3 foremen and 1 supervisor incharge.

2.4 The Variable of the Study

The variables of the study are physical work environment, fatigue, and productivity which were represented by observing the speed of packaging of each operator during one work shift. The source of data used was primary data with direct interviews using questionnaires and direct measurements. Secondary data was used to support the primary data.

Physical environment exposure is one of the aspects which may disturb the work atmosphere and influence the condition of each operator. A comfortable physical work environment is expected to increase the operators' performance optimally and productively without inconvenience and anxiety during their activity. The variable of physical work environment consisted of 11 questions which were classified into five groups: air-condition (X), noise (Y), vibration (Z), lighting (V) and workspace design (W). The physical environment measurement used Likert scale with the assumption: 1 = very disagree. 2 = disagree, 3 = agree, 4 = very agree.

In this study, the instrument used to measure fatigue was questionnaires. The questionnaires about the feeling of fatigue (Kuesioner Alat Ukur Kelelahan Kerja, KAUPK2) were distributed to each packaging operator. The scoring of fatigue level used Likert scale with the assumption as follows: 1 = Never; 2 = rarely; 3 = often; 4 = always

The result was the answer chosen by each operator which was mostly chosen from 17 questions. The questions were classified into 4 groups which were concentration (A), physical fatigue (B), anxiousness (C) and work motivation (D). The data analysis applied the data of complaint of the fatigue level which was often felt by the operators which was higher than 50% (> 50%).

The productivity level was measured by using a stopwatch to score the speed of packaging during one work period or one work shift of each of the 12 operators. Productivity measurement is based on the number of boxes of beverages packaged by the operator.

2.5 The Hypothesis of the Study

The hypothesis used in this study is the Associative hypothesis. The variables used in the study were the variables of physical work environment, work fatigue, and productivity. The formulation is to connect between the physical work environment fatigue to the productivity of beverage packaging.

The hypotheses used in the study were:

H0= physical work environment and level of fatigue did not correlate with productivity.

H1= physical work environment and level of fatigue correlated with productivity.

Figure 1. The Thinking Framework
This research is observational which was conducted by observing the object of its study without giving any treatment. Based on time setting, the study was across sectional because the data variables were taken at one time. According to an analysis system, it is a descriptive study and intended as a research method that can make an objective description.

2.6. The Data Analysis

2.6.1. Validity Measurement

Validity is a degree of accuracy / appropriateness of instruments used to measure what is measured [26]. Validity is the degree that shows where a test measures what you want to measure [27]. Validity also refers to the accuracy of a test or scale in carrying out its measurement function [28].

The degree of accuracy / appropriateness of the instrument used to measure the instrument carries out its measurement function showing validity.

2.6.2. Reliability test

Reliability is interpreted as something that can be trusted (test resistance). A test is said to have high reliability if the test gives fixed results even though given at different times to the same respondent. The test results are fixed so the change is not significant, the test is said to be reliable. Therefore, reliability is often referred to as trustworthiness, reliability, constancy, consistency, stability, and so on. Reliability involves the problem of the accuracy of the measuring instrument. This accuracy is assessed by statistical analysis to determine measurement errors. Reliability is easier to understand based on aspects of stability, accuracy, and homogeneity. A reliable instrument if the instrument is trusted as a measurement of research data [29].

The basis of the decision in the Alpha Cronbach’s Reliability Test is the reliability test can be carried out jointly on all items or questions in the research questionnaire [30], as follows:
1. 1. If the Cronbach’s Alpha value > 0.60 then the questionnaire or questionnaire is declared reliable or consistent.
2. If the Cronbach's Alpha value <0.60 then the questionnaire or questionnaire is declared to be unreliable or inconsistent.

2.6.3. Normality Test

The purpose of the Normality Test is to determine whether the research sample data comes from populations that are normally distributed or not. Normality test is carried out using the Lilliefors test technique or in the SPSS program also called Kolmogorov-Smirnov. The criterion of the normality test when the data are normally distributed if the calculated L value <L table or the significance value> 0.05.

The basis for decision making can be done based on probability [31], namely:
1. If the probability is > 0.05 then the distribution of the regression model is normal.
2. If the probability is <0.05 then the distribution of the regression model is not normal.

2.6.4. Linearity test

Linearity Test to find out whether two variables have a significant linear relationship or not. A good correlation should have a linear relationship between the predictor or independent variable (X) with the criterion or dependent variable (Y). Decision making in the Linearity test there are 2, namely:
Comparing Significance Value (Sig.) With 0.05
1. If the Deviation value of Linearity Sig> 0.05, then there is a significant linear relationship between the independent variable and the dependent variable.
2. If the Deviation value of Linearity Sig. <0.05, then there is no significant linear relationship between the independent variable and the dependent variable.

Comparing F Calculate with F Table
1. If the calculated F value <F table, then there is a significant linear relationship between the independent variable and the dependent variable.
2. If the calculated F value> F table, then there is no significant linear relationship between the independent variable and the dependent variable.

2.6.5. Multiple Correlation Test

This research is to find the relationship between two independent variables, Physical Work Environment (X1) and Work Fatigue (X2) with Productivity (Y). Testing is done by using SPSS 22 software, namely Multiple Correlation Test.
Multiple Correlation Analysis functions to find the magnitude of the relationship and contribution of two independent variables (X) or more simultaneously (together) with the dependent variable (Y). The drawing decision with double correlation test is able to compare between the value of probability 0.05 with the value of probability Sig with basic of decision making as follows:

1. If the value of probability 0.05 is smaller or the same with the value of probability Sig, F change (0.05 < sig. F change), H0 is accepted and Ha is rejected. This means that there is no significant correlation between variable X with variable Y.

2. If the value of probability 0.05 is higher than the value of probability Sig, F change (0.05 > Sig. F change), H0 is rejected and Ha is accepted. This means that there is significant correlation between variable X and variable Y.

3. Result and Discussion
3.1 Validity Measurement
A statement was considered valid if the value of significance was less than 0.05 (<0.05)[25]. From 11 questions about physical work environment, 17 items of statement about fatigue and about productivity which were in the form of time measurement of packaging speed. After being field-tested, all of the questions were stated valid because the test result showed the value of significance which was less than 0.05 (<0.05).

3.2. Reliability Test
After the reliability test conducted on the variables of the study, the result was that the value of Cronbach's Alpha of all the question items of physical work environment (X1), fatigue (X2) and productivity (Y) was higher than 0.6. Thus, it was considered reliable.

Table 1 shows the Physical Environment has a Cronbach's alpha value of 0.807>0.06, indicating that all statements made are considered appropriate and can be used for research purposes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reliabilitas Coefficient</th>
<th>Cronbach’s Alpha</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Environment</td>
<td>11 question item</td>
<td>0.807</td>
<td>Reliabel</td>
</tr>
</tbody>
</table>

Table 2 shows that Fatigue has a Cronbach's alpha value of 0.829>0.06, indicating that all statements made are considered appropriate and can be used for research purposes.

Table 3 shows that Productivity has a Cronbach's alpha value of 0.892>0.06, indicating that all statements made are considered appropriate and can be used for research purposes.

3.3. Normality Test
The normality test uses the Lilliefors test technique or in the SPSS program it is also called Kolmogorov-Smirnov. The following results are obtained.

Based on Table 4, the Normality test results show that Productivity has q Sig.0,200>0.05; Physical Environment value of Sig.0,200>0.05; Fatigue Sig.0,200>0.05 so it can be concluded that the data is normality distributed because it has a Sig.value>0.05.

3.4. Linearity Test
Linearity Test aims to determine whether the two variables (X) and (Y) have a significant linear relationship or not. The Linearity Test is presented in Tables 5 and 6.

Based on the Significance value (sig): from table 5, the value of Deviation from Linearity Sig. is 0.636 greater than 0.05, it concludes a significant linear relationship between the Environment variable (X1) and the Productivity variable (Y).
Based on the Significance value (sig): table 6, the value of Deviation from Linearity Sig. is 0.298 greater than 0.05, it can be concluded that there is a significant linear relationship between the Fatigue variable (X2) and the Productivity variable (Y).

3.5. Multiple Regression Test

This study was aimed at finding the correlation between the two independent variables which were physical work environment (X1), fatigue (X2) and productivity (Y). The test was conducted using software SPSS which was double correlation test. Double correlation analysis functions to find the correlation and the contribution of two free variables (X) or more simultaneously with bound variable (Y).

Table 7. The result of double correlation test

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>Sig.F Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation physical environment, fatigue and productivity</td>
<td>0.742</td>
<td>0.27</td>
</tr>
</tbody>
</table>

From Table 7, From double correlation test, it was obtained that the value of Sig. F Change 0.027 was smaller than 0.05 (0.05 > 0.027). Thus, it can be stated that H0 was rejected and Ha was accepted. It can be concluded that physical work environment and the level of fatigue correlated with productivity. R (the value of Pearson Correlation) obtained was 0.742 which means that there is strong correlation between free variable (X) and bound variable (Y).

The results showed that the physical work environment and the level of fatigue were significantly related to the level of productivity produced by each packing operator carried out in a sitting position. This is indicated from the results of the multiple correlation test which has a value of 0.027 smaller than 0.05. Where this value means that the physical work environment and the level of fatigue are simultaneously and significantly related to productivity.

4. Conclusion

Based on the study, conclusions are drawn as follows:

1. Physical work environment and fatigue influenced the cup drink packaging operators’ productivity where the tasks were done in sitting position during one work shift.
2. The tasks of cup drink packaging were repetitive and monotonous and it did not need many movements except the usual packaging movement/tasks. It is that the company is expected to pay more attention to the work environment of employees. If the environment does not support the workers, the workers are easy to feel fatigue because of the repetitive and monotonous work.
3. The early feeling of fatigue might influence the operators’ productivity which made the result not maximum or did not reach the company’s target.

References


