



THE RELATIONSHIP BETWEEN THE LEVEL OF WORK FATIGUE AND PRODUCTIVITY OF REPETITIVE WORK PERFORMED IN A STANDING POSITION

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ABSTRACT

Work performed in a standing position in a settling way generally poses a risk to health. It is characterized by more rapid exhaustion arising in a worker's physical condition that can lead to decreasing productivity. This study aims to determine the impact caused by the fatigue experienced by the operators of the beverage packaging upon the resulting output. Observations were made during the first month of the beverage packaging activities performed by the operators. Measurements were performed by questionnaire measuring devices of fatigue feeling that was given to each packaging operator after work. Meanwhile, a stop watch was used to measure the speed of a packing used, where each operator was tested on their time speed when they started packing till they finished it and ultimately produced one dos. T- test results showed that there was a relationship between the level of perceived operators' fatigue with packaging time speed.

Keywords: fatigue, packaging time, standing position.

1. INTRODUCTION

Working in a standing position is very suitable for work that often requires the up, down and lateral movement [1]. This is because the movements performed in a standing position can be more flexible so that the work can be more quickly completed. Work in a standing position as in the packaging is the one that involves physical activity that is quite tiring. In this case, the standby posture is the alert one performed by the body both physically and mentally, so that the work can be completed faster, stronger and more meticulous [2]. Basically standing is more tiring than sitting and the energy to stand expends 10-15% bigger than to have a seat [3]. Working with a prolonged standing position can cause fatigue, swelling of the lower extremities and back pain [4]. Work done by standing up can cause swelling of the feet that have an impact on feelings of discomfort and fatigue [5].

Working in a standing position for long periods of time on a regular basis can cause foot pain, leg swelling, varicose veins, general muscular fatigue, low back pain and stiffness in the neck and shoulders, as quoted by the Canadian Center for Occupational Health and Safety (2011). This results from the body affected by the setting of the working area so that it limits the body positions of workers in the move. As a result, the worker's body has little freedom to move and become stiff. The lack of flexibility of the body will cause health problems.

Sedentary behavior at work indicates the risk of diseases such as obesity, diabetes, some cancers and deaths from various cases [6], [7]. Posture discomfort, high repetition of work, and great exertions are several things that can trigger fatigue [8].

From the explanation above it can be concluded that this study aims to determine the relationship between the operators' levels of fatigue and productivity associated with a packing speed.

2. RESEARCH METHODOLOGY

The study population was packaging operators of packaged drinking in jelly beverage industry. The sample of this study was 31 people, with ages ranging from 18-46 years. The data were taken using a questionnaire measuring tool of feelings of fatigue and a stop watch to measure the time of completion speed in beverage packaging. The questionnaire was given after the operator did the job for one shift, while the time speed measurement performed on each operator as they started packaging until they finished it and produced a dos. For the time measurement in which a stop watch was used, each operator was observed up to 20x during packaging process to obtain the accurate time average.

3. RESULT AND DISCUSSIONS

3.1 Respondent category

Age variation of the operators who participated in this study ranges from 18-46 years by age groupings as follows: I. 18-23 years old, II. 24 -29 years old, III. 30-35 years old, IV. 36-41 years old, and V. 42-47 years old. The frequency of operators' age can be seen in Figure-1.

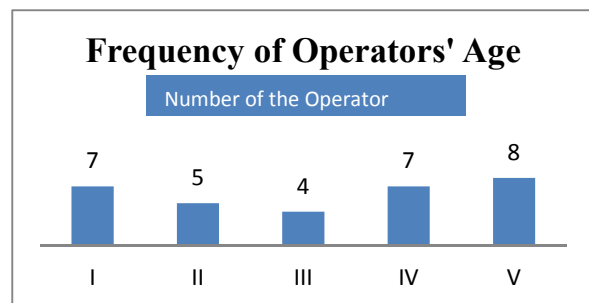


Figure-1. Frequency of operators' age.



3.2 Operators' tenure

The operators' tenure considered experienced in packaging work is over 1 year is due to the work carried out together and it happened recurring from time to time during a work shift. The frequency of operators' tenure is shown in Table-1.

Table-1. Frequency of operators' tenure.

Tenure (year)	Frequency (person)	Percentage
1 - 2	3	9,677 %
3 - 4	29	93,548 %
Total	31	100 %

3.3 Fatigue level

Based on the results of questionnaires of measuring devices upon fatigue among respondents who participated in this study, the data on the distribution level of fatigue experienced by the packaging operators is obtained as shown in Figure-2. The grouping done on the level of fatigue is the light category with a score ranging from 1 -5, the moderate with the score 6-11, and the heavy with a score of 12-17.

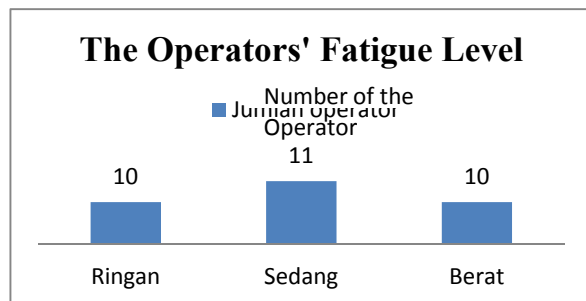


Figure-2. The operators' fatigue level.

3.4 Packaging speed time

As for the level of productivity (measured from the speed time of packaging per one dos) was obtained from the given observations. From these observations an average time speed of packaging done by the operators was obtained divided into three categories: fast, medium, and slow. These categories were tailored to the target company's output. The elaboration of the categories of packaging speed time was: fast → less than 15 seconds, medium → 16-20 seconds, slower → more than 21 seconds. The frequency of time packaging speed is shown in Figure-3.

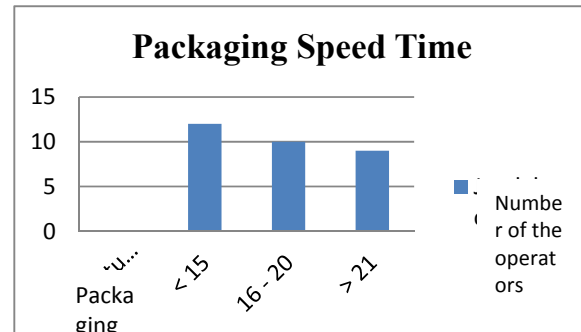


Figure-3. Packaging speed time.

The variables used in this study are variable of fatigue levels and packaging speed time in which the research hypotheses are:

- H0: fatigue level has no relationship to time of packaging speed
H1: fatigue level is associated with time of packaging speed

Based on the results of t-test, it showed that the significant is $0.002 < 0.05$, then H0 is rejected which means that there is a relationship between the fatigue level perceived by the operators and the time of packaging speed.

4. CONCLUSIONS

From the observations made during one month the data of the fatigue level perceived by the operators while in the work of packaging performed in a standing position and packaging speed time by each operator were obtained. t-test results shows that there is a relationship between the fatigue level perceived by each operator and the time of packaging speed. It can be concluded then that the higher the levels of perceived fatigue, the lower the speed of time of packaging speed produced by the operators which will ultimately have an impact on the decreasing output (productivity).

REFERENCES

- [1] Hasegawa T., Inoue K., Tsutsue O., Kumashiro M. 2001. Effects of a sit-stand schedule on a light repetitive task. *International Journal of Industrial Ergonomics* 28, 219-224.
- [2] Iftikar Z S., Ruhana A., Jann H.T. 2006. Teknik perancangan sistem kerja. ITB, Bandung.
- [3] Tarwaka. 2004. Ergonomi untuk keselamatan, kesehatan kerja, dan produktivitas. Uniba Press, Surakarta.
- [4] Chester M., Rys M., Konz S. 2002. Leg swelling, comfort and fatigue when sitting, standing, and



sit/standing. International Journal of Industrial Ergonomics 29, 289-296.

- [5] Hansen L., Jorgensen, K., Krijnen, R., Winkel J. 1996. Significance of mat and shoe softness during prolonged work in upright position: based on measurement of low back muscle EMG, foot volume changes, discomfort and ground reactions. Applied Ergonomics 29, 217-224.
- [6] Blanck H.M., McCullough M.L., Patel A.V., Gillespie, C., Calle, E.E., Cokkinades V.E. 2007. Sedentary behavior, recreational physical activity, and 7-year weight gain among postmenopausal U.S. women. Obesity. 15, 1578-1588.
- [7] Katzmarzyk P.T., Church T.S., Craig C.L., Bouchard C. 2009. Sitting time and mortality from all causes, cardiovascular disease and cancer. Med. Sci. Sports Exerc. 41, 998-1005.
- [8] Trougakos William P. 2007. The effect wrist and forearm posture on muscle fatigue during a repetitive pinching task. York University, Toronto, Ontario, Canada.