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Sleep Deprevation Effect On The Driving Activity Using Sustained Attention Test

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Abstract: The rate of train accidents in Indonesia is still high, mainly caused by humans related to fatigue while on duty. One of the factors that influence the level of fatigue is the duration of the previous sleep time which causes the level of alertness at work to decrease. This study aims to determine how significantly a person alertness performance decreases due to sleep deprivation using Sustained Attention Test. The study was conducted with laboratory experiments using a train simulator involving twelve participants aged 21.2 ± 0.92 years. The independent variable is the duration of sleeping time before driving with a duration of eight hours for normal conditions and a duration of two hours for sleep deprivation. The dependent variable is the parameter on the Sustained Attention Test which is tested before and after driving using the Kruskal-Wallis test. The results showed that there was a increase in the value of the Sustained Attention Test, especially the error and miss parameters which were significant due to sleep deprivation with an average significance of p-value less than 0.05 and increasingly significant with an average of p-value less than 0.01 after driving activity. This shows that sleep deprivation greatly affects the drivers performance while on duty.

Keywords: *driving, fatigue, sleep deprivation, sustained attention test*

Introduction

The human aspect is still one of the dominant aspects causing rail transportation accidents. Various factors that cause accidents in terms of human aspects, one of the dominant ones is caused by tired and sleepy drivers. Drivers who are feel sleepy will cause a greater risk of accidents [5]. This happens when a person is sleepy, there is a decrease in motor skills. As a result, the time to respond to a stimulus is slower. In addition, when a person is tired and sleepy, the brain decreases its ability and slows down its activities.

Sleepiness is a process that is influenced by several factors such as the number of hours of sleep beforehand [8]. This is because someone who is sleep deprived will have difficulty waking up while doing activities such as driving. Lack of sleep also causes a person's accuracy level to be reduced. So it can be concluded that lack of sleep can cause a person to become tired and sleepy which causes performance at work to decrease.

The activity of driving a train is a complex task because it is associated with many cognitive functions such as continuous attention, object detection and recognition, decision making and memory [1]. This work is usually carried out in a long duration and tends to be monotonous in its journey. This can cause the driver to feel tired and sleepy while on duty. So that the problem of fatigue and sleepiness is an important thing that must be considered by rail transportation companies regarding service and safety of train service users.

The problem that will be discussed in this study is how much it affects the lack of sleep that affects the decline in cognitive abilities in the form of vigilance as a manifestation of fatigue and drowsiness. Measuring the level of fatigue and sleepiness will be measured using the Sustained Attention Test (SAT) which tests a person's alertness level [2].

Fatigue as an unpleasant symptom in which the body feels very tired and creates an overall condition that interferes with human abilities and functions in their

normal capacity [6]. Fatigue can also be interpreted as a condition where someone is reluctant to do work and a decrease in work efficiency [7]. In addition, fatigue is also a pattern that arises from a situation that results in individuals unable to carry out their activities [3]. Based on these definitions, it can be concluded that fatigue is a decrease in the physical and mental condition of humans by workload so that it can reduce human work performance. This decline in performance can have an impact on decreasing the level of productivity and the quality of the output produced.

The purpose of this study was to determine the impact of lack of sleep on fatigue levels in train driving activities. This measurement of fatigue was measured using a Sustained Attention Test with several parameters measured to participants before and after driving. With this research, it can be useful as a suggestion in measuring the level of fitness for duty of machinists before driving the train.

Method

This research aims to see a decrease in cognitive abilities in the form of vigilance due to lack of time to sleep and during driving activities. The research is conducted in the form of an experiment in the laboratory. using a train simulator involving twelve participants aged 21.2 ± 0.92 years. Participants will be asked to drive a train simulator for four hours. The measuring instrument for fatigue and sleepiness that will be used is the Sustained Attention Test. Data was collected at the beginning and end of the data collection session. The variables taken into account in this study are divided into dependent variables and independent variables with the following description. The independent variable is the duration of sleeping time before driving with a duration of 8 hours for normal conditions and a duration of 2 hours for sleep deprivation. Participants on the night before data collection were limited to a maximum of two hours of sleep. The duration of sleep is expected to significantly affect the level of fatigue and drowsiness. The dependent variable is the parameter on the Sustained Attention Test which is tested before and after driving using the Kruskal-Wallis test.

While the dependent variable consists of the level of fatigue obtained from the parameter values of the Sustained Attention Test measuring instrument. There are several parameters used in the SAT, including:

• Miss, is the percentage of the total stimulus that failed to respond.

• Error (ERR), is the percentage of the number of stimulus that failed to respond to and was late to respond, which is more than 850ms.

• Mean, is the average response time given from a set of experiments.

• Fastest 10% (10%F), average 10% fastest response time of the trial set.

• Slowest 10% (10%S), average 10% longest response time of the trial set.

The experiment was carried out for two days, with the first day of training using the Sustained Attention Test (SAT) and a train simulator to eliminate the effect of the learning curve [4]. After the SAT training, baseline data was collected. So that from this measurement, it is obtained three values for each parameter, namely the baseline value, before and after driving. This value is then tested for the significance of differences using the Kruskal-Wallis test with the results (Table 1).

Table 1. Recapitulation of p-value

Parameters	p-value		
	Baseline vs Before	Baseline vs After	Before vs After
MIS	0.045*	0.002**	0.186
ERR	0.034*	0.002**	0.174
MEAN	0.034*	0.034*	0.94
10%F	0.131	0.008**	0.545
10%S	0.023*	0.038*	0.762

The values for each parameter in the baseline, before and after measurements are shown in the following boxplot (Figure 1-5).

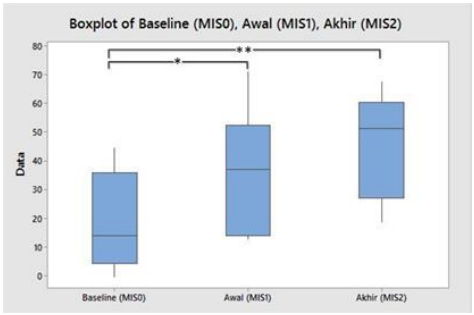

Figure 1. Result of Miss

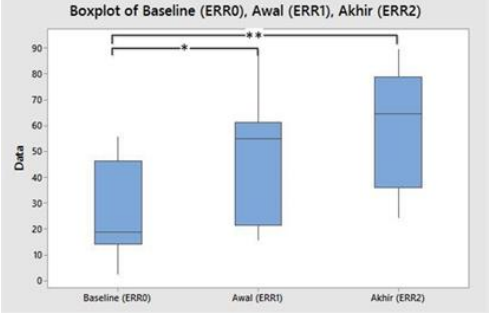

Figure 2. Result of Error

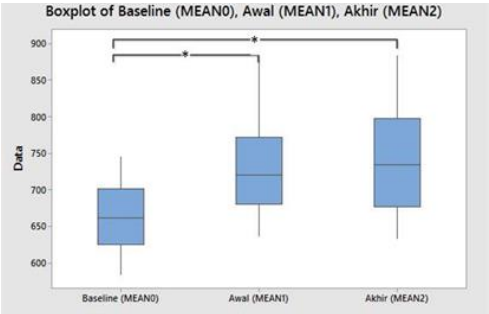

Figure 3. Result of Mean

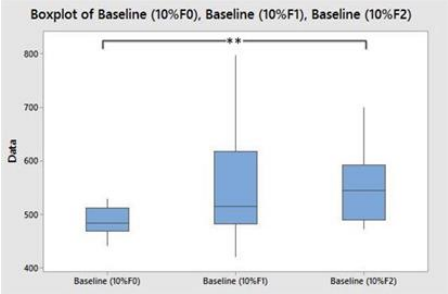

Figure 4. Result of 10% Fastest

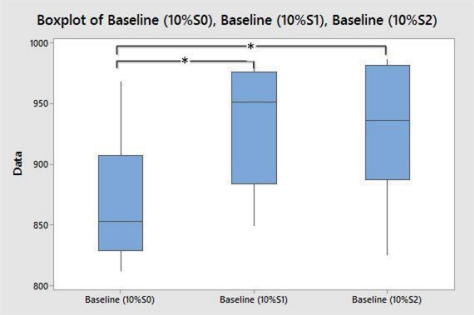

Figure 5. Result of 10% Slowest

* significant at the 0.05 level

** significant at the 0.01 level

Results And Discussion

SAT data were obtained through measurements made on participants in the conditions before the experiment, after the experiment and the day before to be used as a baseline. This test is done for 10 minutes. Participants were asked to respond to stimuli that appeared randomly during the test. The data obtained in this test is then processed to produce the parameters miss, error, mean, fastest 10% and slowest 10%. The results showed that the miss and error parameters showed the most sensitive results in detecting a decreased level of alertness.

The general percentage increase in baseline conditions before driving with a sensitive baseline was detected by miss and error parameters with a mean increase of two times. This is reinforced by the level of significance in the inference test so that this parameter can be a reference.

Between the start and the end of the experiment, the SAT did not show a very high percentage of improvement, however, it still showed signs of improvement and might be more visible if the duration of driving time was increased. Meanwhile, the subjective increase shows almost two fold differences. This indicates that the symptoms of fatigue and drowsiness felt by the participants were very high.

In general, the values for the parameters measured at different measurement times give significant results. This shows that there is an increase in the level of fatigue and drowsiness in the participants due to lack of sleep plus activity in driving a train simulator. The increase in the level of fatigue and sleepiness is strongly influenced by the number of hours of sleep previously [8]. This is also related to homeostatic factors related to the length of the period a person is awake, the amount of pressure that causes drowsiness. As a result, the need for sleep is high and it is difficult to fight drowsiness [8].

The increase in the level of fatigue and sleepiness was even more significant when compared between the baseline and the end of the experiment after the participants had finished driving the train. This is because driving a train is a complex task. This task is associated with many cognitive functions such as sustained attention, detection and recognition of objects, decision making and memory [1]. Besides that, it is usually done in a long duration and tends to be monotonous in its journey. So it can be concluded that the driving task is not recommended to be carried out in

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a state that lacks sleep because there is a decrease in performance to perform these complex tasks because it can cause a higher risk of accidents.

The implication of this research can be used to determine the level of fatigue and sleepiness in driving a train based on the parameters of the measuring instrument used. In addition, it can also be a suggestion in measuring the level of work readiness or fitness for duty of the machinist before driving the train.

Conclusions

Based on the results, it was concluded that there was a significant decrease in cognitive abilities in the form of vigilance due to increased fatigue and drowsiness due to lack of sleep. This decrease can be measured using the Sustained Attention Test, especially in the miss and error parameters which are the most sensitive to detect this change. This can be seen from the significance value and the change in the percentage value descriptively.

Conflicts of interest

There are no conflicts to declare.

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