# The Influence Of Driving Duration And Driving Shift On The Level of Fatigue And Stress On Bus Drivers P.O Taruna Jaya Of Sumbawa-Taliwang

**Nurul Hudaningsih*, Iksan Adiasa, Muhamad Iqbal Syauqi**
Research Group of Ergonomics, Work System Engineering and HSE
Industrial Engineering Department, Faculty of System Engineering
Sumbawa University of Technology
Sumbawa, Nusa Tenggara Barat, Indonesia
nurul.hudaningsih@uts.ac.id*, iksan.adiasa@uts.ac.id, iqbal1408@gmail.com

**Sopyan Ali Rohman**
Mechanical Engineering Department, Faculty of System Engineering
Sumbawa University of Technology
Sumbawa, Nusa Tenggara Barat, Indonesia
sopyan.ali.rohman@uts.ac.id

## Abstract

The bus is a transportation that can carry many passengers. Fatigue and stress can affect the driver's attitude and increase the risk of accidents. This research aims to analyze the effect of work duration and work shifts on fatigue and stress on the Taruna Jaya bus driver on the Sumbawa-Taliwang route. The sample used in this study was limited to one driver because the survey was conducted during the COVID-19 pandemic when only a few buses were operating. Fatigue was measured using a Visual Analogue Scale questionnaire and a Body Battery using Garmin Vivosmart 4. Stress was measured using a Simple Mental Health Scale questionnaire and a Stress Level using Garmin Vivosmart 4. The tests were conducted using Mann-Whitney U-test, Wilcoxon Test, and Correlation Test. The Mann-Whitney U-Test was conducted to determine whether there was an effect of shift on driver fatigue and stress based on whether there was a difference in the average results of driver fatigue and stress between the morning shift and the afternoon shift. The Wilcoxon Signed Rank Test was conducted to determine whether driving duration affects driver fatigue and stress based on whether there is a difference in the average results of driver fatigue and stress between before and after driving. The results showed that the duration of driving and shifts affected driver fatigue and did not affect the driver's stress. In addition, there was no relationship between fatigue and stress in the driver.

## Keywords
Driver Fatigue, Driver Stress, Driving Shift, Driving Duration, Sumbawa Bus

## 1. Introduction
Transportation in Indonesia has a vital role in national development as a supporter and a stimulus for economic growth and other development sectors. Of the various types of public transportation available, the bus is a mode of public transportation with a significant increase in the number of vehicles (Irawan et al., 2020). People prefer buses and minibusses because they provide an alternative to different directions, have affordable ticket prices compared to other types of public transportation and other means of land transportation and can carry large numbers of passengers (Watson et al., 2008). One of the main problems with using land transportation is the occurrence of accidents. According to 2017 Indonesian Police data published by the Indonesian Ministry of Communication and Information, an average of 3 Indonesians die every hour due to road accidents (Satria et al., 2020). The causes of these accidents are human factors at 61%, infrastructure and environmental factors at 30% and factors at 9%.

The cause of drivers experiencing decreased ability and concentration is fatigue (Zuraida et al., 2018). Symptoms of fatigue on the physical aspect include headaches, the body feeling stiff, feels pain in the back, difficulty breathing on the way, feeling excessive thirst, shaking hands and feet on the way, drowsiness, difficulty standing on the way, feeling like lying down (Mayer et al., 2012). Apart from fatigue, stress can also harm drivers. This is because a stressed driver can lead to a dispositional tendency to drive negatively. Stress can lead to a lack of concentration, an increase in accidents and aggressive behavior (DeVries et al., 2003). Fatigue and stress factors are the drivers related to work shifts and duration (Useche et al., 2017). This is evidenced in research conducted by Philip and Akerstedt (2006) that work shifts can affect fatigue in workers and can be fatal, causing work accidents. According to Meijman and Mulder (2013), work duration exceeding one's ability can decrease work efficiency and effectiveness. Therefore, it is essential to pay attention to bus drivers' physical and mental health for the safety of bus passengers. Because the human factor, in this case, the driver, is the most significant factor that causes traffic accidents.

In this study, researchers took the Sumbawa-Taliwang bus driver as the object of research. The researcher considers that on the route from Sumbawa to Taliwang, many livestock animals, such as cows and goats, are allowed to roam by their owners and wild animals, such as monkeys and dogs, are on the side of the road. This is also added to the terrain of the road, which is located on the north coast route, consisting of many bends and ravines, so the driver must remain in optimal driving conditions for the safety of passengers. Based on this, the driver's condition in driving the bus is influenced by fatigue and stress. Meanwhile, fatigue and stress experienced by drivers can be caused by work shifts and the duration of a driver's work. Therefore, the author will conduct a study to determine the effect of work duration and work shifts on changes in the level of fatigue and stress of Bus Drivers; where this research was conducted using the Field Research method or through direct observation of the object of observation in the field. With this research, it is expected to find out the optimal number of work durations, and work shifts for Bus Drivers in driving their vehicles and the level of traffic accidents caused by human factors can be reduced.

### 1.1 Objectives

This study aimed to determine the effect of work duration and work shifts on the fatigue of P.O Taruna Jaya bus drivers majoring in Sumbawa - Taliwang, to determine the effect of work duration and work shifts on the stress of P.O Taruna Jaya bus drivers majoring in Sumbawa - Taliwang and to determine the relationship between the level of fatigue and stress on the bus driver P.O Taruna Jaya heading Sumbawa – Taliwang.

## 2. Literature Review

Fatigue is a condition experienced by a person after carrying out their activities. In work, mental and physical fatigue reduces a person's ability to perform work safely and effectively. This can occur due to prolonged mental or physical activity, lack of sleep, or disturbance of the internal body clock. Fatigue can be caused by factors that may be work-related, non-work related or a combination of the two and can build up over time (Dawson and Fletcher, 2001). Fatigue can also be interpreted as an unpleasant feeling that affects a decrease in movement power and ultimately affects the decrease in achievements achieved by individuals who experience fatigue and is also an expression that is not comfortable in general, a feeling of restlessness and achievement that drains all interests and power (Smith et al., 2007). The most significant fatigue effect experienced by drivers in a study by the Center for Accident Research & Road Safety is the increased risk of collisions caused by tired drivers, which can cause victims to be injured or die (Zhang et al., 2016). Apart from that, the other effects are:

1. Performance in driving will decrease.
2. Lack of attention or concentration while driving.
3. Slow reaction to danger or some situations.
4. Time to make decisions will slow down.
5. Poor performance and ability to carry out a task.
6. High probability of falling asleep.

According to Chauhan et al. (2019), stress is a condition of tension that affects one's emotions, thought processes and conditions. Excessive stress can threaten a person's ability to deal with the environment. Stress is based on the assumption that what is meant by symptoms and signs of psychological behavior is the result of a lack of compatibility between people (in terms of their personality, talents and abilities) and their environment, which causes their inability to deal with various demands on themselves. Effectively. According to Pool (2000), factors that cause work stress, between high work tension, environmental conditions, and individual factors. According to Chung et al. (2019), road conditions are proven to influence driver stress levels.

## 3. Methods

The method used in this research is a field study by observing, interviewing, taking notes, or asking questions, where this field study is carried out in a natural situation but preceded by some intervention (interference) on the part of the researcher. This intervention is intended so that the phenomenon desired by the researcher can be immediately seen and observed. The researcher made observations by wearing the Garmin Vivosmart 4 device and interviewed the driver using a questionnaire that had been made. Thus there is a kind of control or control over the situation in the field. This research consists of independent variables and dependent variables. The independent variables in this study were the amount of sleep, sleep quality, time awake, duration of driving, and shifts. In contrast, the dependent variable in this study is the level of driver fatigue and stress.

The subject in this study was the Taruna Jaya bus driver for the Sumbawa-Taliwang route. The number of participants studied was only one person, considering the number of buses operating during the COVID-19 pandemic was only one of three buses that generally operate due to several factors. Causing other buses not to operate as they should, such as the number of passengers being deserted and the transportation of goods being almost non-existent. As for the number of samples taken, the researcher first determines the value of effect size d. Then calculate the Spooled value (combined standard deviation) with the following calculations Maxwell et al. (2017): The determination of effect size d by the researchers took the basis of research conducted by Adiasa (2019) using a preliminary experiment with test values of 28.4%, 33.2% and 34.7% with a considerable size value of f = 0.5.

$$S_{pooled} = \frac{\text{Std.Deviation}}{f} \tag{1}$$

Then it is necessary to find the standard deviation as follows:

$$\text{Std. Deviation} = \sqrt{\frac{(34{,}7\%-33{,}2\%)^2+(33{,}2\%-33{,}2\%)^2+(33{,}2\%-28{,}4\%)^2}{3}}$$

Std. Deviation = 0,02888

$$\text{Spooled} = \frac{\text{Std.Deviation}}{f} \tag{2}$$

Then it is necessary to find the spooled as follows:

$$\text{Spooled} = \frac{0{,}0288}{f}$$

Spooled = 0,0576

Furthermore, the number of samples can be determined by looking at Table d Cohen (1998) with = 0.1, where this study uses a power value of 0.9. Based on the interpolation between the power value = 0.9, the value of d = 1.00, N (number of samples) = 18 and the value of d = 1.20, N = 13. Resulting in the value of N = 15.3 or equal to 16. Then the number of samples needed is 16 observations. This research was conducted at Sumer Payung Terminal and Taliwang Terminal. At 09.00 WITA, the bus driver came to the Terminal; then, at 09.40 WITA, the bus driver took the bus from the parking lot to the departure point to pick up passengers. After the passengers have boarded the bus, they are rechecked so that no goods or passengers are left behind; then, at 10.20 WITA, the driver starts leaving from Sumer Payung Terminal. At 11.00 WITA, the bus stops at Rhee to rest for about 5-10 minutes. After that, the bus left again and arrived at the Terminal at around 13.30 WITA. After that, the driver rested at Taliwang Terminal for approximately 1 hour while waiting for passengers. Then at 14.20 WITA, the bus departs again and stops at Alas Terminal at around 15.50 WITA. The driver stops at Alas Terminal to rest and wait for passengers from Alas to Sumbawa. At 16.00 WITA, the bus departs again and arrives at the destination (Sumer Payung Terminal) around 17.20.

The measuring instrument used on the Visual Analogue Scale (VAS) measures subjective fatigue. The shape of the VAS scale consists of a line 10 cm long, without markings on each centimeter, where both ends of the line are not fatigued, and the other end is exhausted. The Body Battery for objective fatigue measurement. Meanwhile, to measure stress subjectively using a simple mental health scale questionnaire and objective stress measurement using stress levels by Garmin. The data obtained will be tested using SPSS using the normality test to find out the distribution pattern of the data, with the result that the data is not normally distributed. Then the Mann-Whitney U-test was conducted to determine whether shifts affect fatigue and stress, while to determine the duration of fatigue and stress, the Wilcoxon Signed Rank Test was used. After that, a correlation test was conducted to determine the relationship between variables.

## 4. Results and Discussion

### 4.1 Driver Sumbawa-Taliwang Bus

In this study, the Taruna Jaya bus driver for Sumbawa-Taliwang was one person assisted by a kernet every trip. The driver arrives at Sumer Payung Terminal at 9.00 WITA every day. After arriving at the Terminal, the driver prepares the bus and checks its condition of the bus. Next, at 9.40 WITA, the driver brought the bus to the front of the terminal manager post to pick up passengers and consignments. In addition, the driver also receives calls from customers to pick up goods during the trip and requests to increase passengers.

For the morning shift, the bus leaves at 10.20 WITA and arrives at Taliwang Terminal at around 13.00 WITA. During the morning shift trip, the bus stopped for a short break in Rhee Village and followed the passenger inspection by the COVID-19 Task Force of the West Sumbawa Regency Government at the Seteluk Task Force Command Post. Meanwhile, in the afternoon shift, the bus departs at 14.30 WITA and arrives at Sumer Payung Terminal at 17.15 WITA. During the day shift, buses stop at agents near the Terminal to register passengers and goods. Then in West Alas, the bus stopped to take part in an examination by the Sumbawa Regency Government COVID-19 Task Force. Then the bus stops at Alas Terminal for about 10 minutes and leaves at 16.00 WITA to Sumer Payung Terminal.

While working, the driver has other jobs besides driving the bus and receiving calls from shippers and passengers who want to be picked up in the middle of the trip. In addition, the driver called the recipient of the shipment deposited on the bus. A Kernet assists the driver in transporting and delivering consignments and assisting passengers in lifting luggage.

### 4.2 Fatigue Observation Results

The results of measuring subjective fatigue using the VAS questionnaire are shown in the graph Figure 1 below:

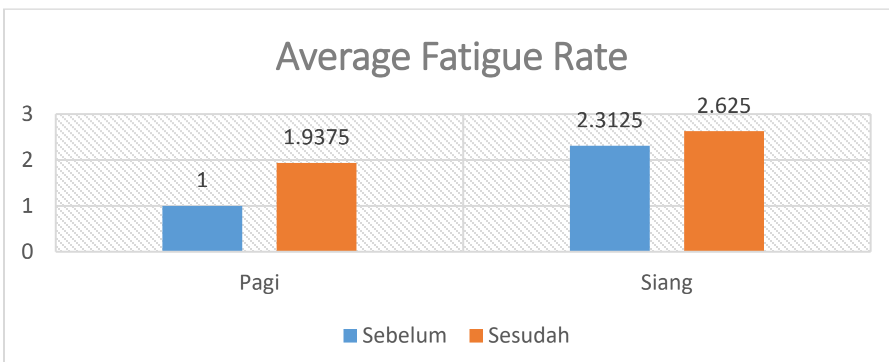


Figure 1. Graph of Average Fatigue Level

It can be seen in the graph above that based on the average value before the driver drives the bus, it is lower than after arriving at the destination, both on the morning shift and afternoon shift. In addition, the average value of the morning shift is lower than the average value of the afternoon shift.

Furthermore, the data that has been obtained is tested for normality which is shown in the Table 2 below:

Table 2. Fatigue Normality Test

| **Category** | | **Statistic** | **df** | ***Sig.*** | **Criteria** | **Ket.** |
|---|---|---|---|---|---|---|
| Fatigue score | Morning Before Driving | 0 | 16 | 0 | 0,1 | Not Normal |
| | Morning After Driving | 0,748 | 16 | 0,001 | | Not Normal |
| | Evening Before Driving | 0,591 | 16 | 0,000 | | Not Normal |
| | Evening After Driving | 0,732 | 16 | 0,000 | | Not Normal |

From the results of the normality test, it is known that the fatigue results are generally not distributed. Since the resulting data is not normally distributed, further testing will be carried out using non-parametric statistics, namely the Mann-Whitney U-Test and the Wilcoxon Signed Rank Test.

## Mann Whitney U-Test

The Mann-Whitney test was conducted to determine whether there was an effect of shift on driver fatigue based on whether there was a difference in average driver fatigue results between the morning shift and the afternoon shift. By hypothesis:

$H_0$: There is no significant difference in driver fatigue between the morning shift and shift afternoon
$H_1$: There is a significant difference in driver fatigue between the morning shift and day shift

In this test, the difference between driver fatigue on the morning shift and the afternoon shift will be compared. Before that, it is necessary to test driver fatigue results before driving on the morning and afternoon shifts. This aims to prove that the condition of the driver's fatigue before driving is the same or that there is no significant difference. In this test, the hypothesis is as follows:

$H_0$: There is no significant difference in driver fatigue before driving between the morning shift and afternoon shift
$H_1$: There is a significant difference in driver fatigue before driving between the morning shift and afternoon shift

Table 3. Mann Whitney Fatigue Test

| Category | Z | Asymp. Sig. |
|---|---|---|
| Fatigue Level Before Driving Morning - Afternoon Shift | -5,291 | 0,0000 |
| Changes in Fatigue Shift Morning - Afternoon | -2,640 | 0,0008 |

Based on the fatigue level Table 3 before driving, it is known that the z value is –5,291. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1.645 < H_0 < 1.645$, and $H_1$ is in the range of $H_1 > 1.6455$ and $H_1 <-1.645$. This shows that the calculated z value is in the $H_1$ range, so it can be concluded that there is a significant difference in the driver's fatigue level before driving between the morning and afternoon shifts.

Furthermore, on the value of changes in the level of fatigue, it is known that the z value is –2.640. Meanwhile, for changes in the level of the z table value for = 5%, the normal curve area is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1{,}645 < H_0 < 1{,}645$, and the value of $H_1$ is in the range of $H_1 > 1{,}645$ and $H_1 <-1{,}645$. This shows that the calculated z value is in the $H_1$ range, so it can be concluded that there is a difference in the level of driver fatigue between the morning and afternoon shifts.

## Wilcoxon Signed Rank Test

The Wilcoxon Signed Rank Test was conducted to determine whether driving duration affects driver fatigue based on whether there was a difference in average driver fatigue results between before and after driving. By hypothesis:

H0: There is no difference in the results of driver fatigue between before and after driving

H1: There is a significant difference between before and after driving

The results of this test are shown in the following Table 4.

Table 4. Wilcoxon Signed Rank Test

| **Category** | **Z** | **Asymp. Sig.** |
|---|---|---|
| Fatigue Before Driving with After Driving Overall | -3,601 | 0,0000 |
| Fatigue Before Driving with After Driving In The Morning Shift | -3,419 | 0,001 |
| Fatigue Before Driving with After Driving In The Morning Shift | -1,518 | 0,129 |

Based on the Table 4 above, it is known that the z-value comparison of fatigue before and after driving as a whole is -3.601. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1.645 < H_0 < 1.645$, and $H_1$ is in the range of $H_1 > 1.6455$ and $H_1 <-1.645$. This shows that the calculated z value is in the $H_1$ range, so it can be concluded that the length of driving influences the level of driver fatigue.

Then the fatigue value before and after driving on the morning shift has a z-value of -3.419 and a z-value of -1.518 in the comparison before and after driving on the afternoon shift. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1.645 < H_0 < 1.645$, and $H_1$ is in the range of $H_1 > 1.6455$ and $H_1 <-1.645$. This shows that the calculated z value is in the $H_1$ range, so it can be concluded that the length of driving influences the level of driver fatigue on the morning shift and does not significantly affect the afternoon shift.

### 4.3 Stress Results

The results of measuring subjective stress using a questionnaire are shown in the graph Figure 2 below:

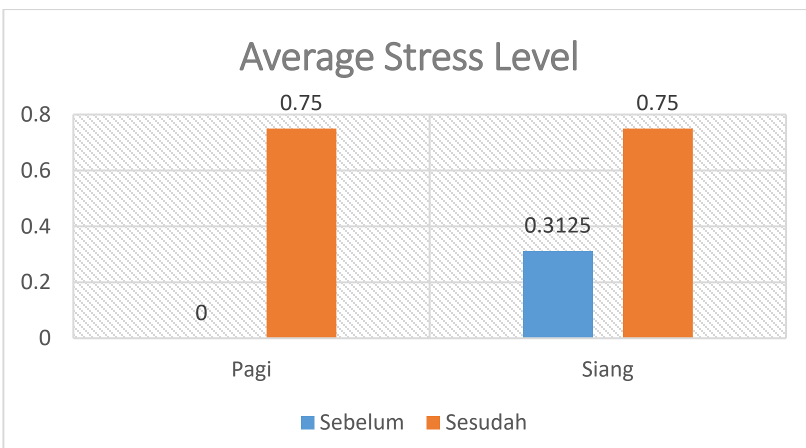


Figure 2. Graph of Average Stress Level

It can be seen in the table above that the average value before the driver drives the bus is lower than the average value after arriving at the destination, both on the morning shift and afternoon shift. In addition, the average value of the morning shift is lower than the average value of the afternoon shift. Furthermore, the data that has been obtained is tested for normality which is shown in the Table 5 below:

Table 5. Fatigue Normality Test

| Category | | Statistik | df | *Sig.* | Criteria | Ket. |
|---|---|---|---|---|---|---|
| Stress Value | Morning Before Drive | 0 | 16 | 0 | 0,1 | Not Normal |
| | Morning After Drive | 0,778 | 16 | 0,001 | | Not Normal |
| | Evening Before Drive | 0,496 | 16 | 0,000 | | Not Normal |
| | Evening After Drive | 0,642 | 16 | 0,000 | | Not Normal |

From the normality test results, it is known that the stress data results are not normally distributed. Since the resulting data is not normally distributed, further testing will be carried out using non-parametric statistics, namely the Mann-Whitney U-Test and the Wilcoxon Signed Rank Test.

## Mann Whitney U-Test

The Mann-Whitney test was conducted to determine whether there was an effect of shift on driver fatigue based on whether there was a difference in the average results of driver stress between the morning and afternoon shifts. By hypothesis:

$H_0$: There is no significant difference in driver stress between the morning shift and shift afternoon
$H_1$: There is a significant difference in driver stress between the morning shift and the afternoon shift

This test will compare the difference between the driver's stress on the morning and afternoon shifts. Before that, it is necessary to test the results of the driver's stress before driving on the morning and afternoon shifts. This aims to prove that the stress condition of the driver before driving is the same or that there is no significant difference. In this test, the hypothesis is as follows:

$H_0$: There is no significant difference in driver stress before driving between the morning shift and afternoon shift
$H_1$: There is a significant difference in the stress of the driver before driving between shifts morning and afternoon shift

Table 6. Mann Whitney Stress Test

| Category | Z | Asymp. Sig. |
|---|---|---|
| Stress Before Drive in Morning – Evening *Shift* | -1,789 | 0,0074 |
| Changes Stress Drive in Morning – Evening *Shift* | -0,931 | 0,352 |

Based on the Table 6 of stress levels before driving, it is known that the z value is –1.789. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1.645 < H_0 < 1.645$, and $H_1$ is in the range of $H_1 > 1.6455$ and $H_1 <-1.645$. This shows that the calculated z value is in the $H_1$ range, so it can be concluded that there is a significant difference between the driver's stress level before driving on the morning and afternoon shifts.

Furthermore, on the value of changes in stress levels, it is known that the z value is -0.931. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So that the value of $H_0$ and the value of $H_1$ is in the range $H_1> 1.645$ and $H_1 <-1.645$. This shows that the calculated z value is in the range of $H_0$, so it can be concluded that there is no significant difference between the stress level of the driver on the morning shift and the afternoon shift.

### Wilcoxon Signed Rank Test

The Wilcoxon Signed Rank Test was conducted to determine whether driving duration affects driver stress based on whether there was a difference in average driver fatigue results between before and after driving. By hypothesis:

$H_0$: There is no difference in the results of driver stress between before and after driving
$H_1$: There is a significant difference between before and after driving

The results of this test are shown in the following table.

Table 7. Wilcoxon Signed Rank Test

| Category | Z | Asymp. Sig. |
|---|---|---|
| Stress Before Driving with After Driving Overall | -3,497 | 0,000 |
| Stress Before Driving with After Driving On Morning Shift | -2,807 | 0,005 |
| Stress Before Driving with After Driving On Morning Shift | -2,111 | 0,035 |

Based on the Table 7 above, it is known that the overall z-value of the stress ratio before driving with after driving is -3.497. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1.645 < H_0 < 1.645$, and $H_1$ is in the range of $H_1 > 1.6455$ and $H_1 <-1.645$. This shows that the calculated z value is in the $H_1$ range, so it can be concluded that there is an influence between the driving length and the driver's stress level.

Then the fatigue value before driving and after driving on the morning shift has a z-value of 2.807 and a z-value of -2.111 in the comparison before and after driving on the afternoon shift. While the value of z table for = 5%, then the area of the normal curve is 50%-5% = 45% or 0.45. In table z, the area of 0.45 has a value of 1.645. So the value of $H_0$ is in the range of $-1.645 < H_0 < 1.645$, and $H_1$ is in the range of $H_1 > 1.6455$ and $H_1 <-1.645$. This shows that the two z-count values are in the $H_1$ range, so it can be concluded that the duration of driving does not significantly affect stress in the morning and afternoon shifts.

## 4.4 Correlation Test

This study conducted a correlation test using SPSS to test the relationship between independent variables. The variables used in this correlation test are all dependent and independent.

The hypothesis on the correlation test with a probability of 0.01 is as follows:

$H_0$: There is no significant relationship between variables
$H_1$: There is a significant relationship between variables

Furthermore, the hypothesis on the correlation test with a probability of 0.05 is as follows:
$H_0$: There is no relationship between variables
$H_1$: There is a relationship between variables

Table 8 correlation test using SPSS

| | | Total Time Sleep | Sleep Quality | Driving Duration | Keeping Time | Changes of Stress | Changes of Fatigue | Shift |
|---|---|---|---|---|---|---|---|---|
| Total Time Sleep | Pearson Correlation | 1 | -.065 | -.067 | -.023 | .080 | -.057 | .000 |
| | Sig. (2-tailed) | | .722 | .714 | .902 | .665 | .755 | 1.000 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Sleep Quality | Pearson Correlation | -.065 | 1 | -.095 | .004 | -.023 | .195 | .000 |
| | Sig. (2-tailed) | .722 | | .604 | .983 | .901 | .284 | 1.000 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Driving Duration | Pearson Correlation | -.067 | -.095 | 1 | .501** | .204 | -.200 | .502** |
| | Sig. (2-tailed) | .714 | .604 | | .003 | .264 | .272 | .003 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Keeping Time | Pearson Correlation | -.023 | .004 | .501** | 1 | -.208 | -.432* | .995** |
| | Sig. (2-tailed) | .902 | .983 | .003 | | .253 | .014 | .000 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Changes Stress | Pearson Correlation | .080 | -.023 | .204 | -.208 | 1 | .114 | -.199 |
| | Sig. (2-tailed) | .665 | .901 | .264 | .253 | | .533 | .275 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Changes Fatigue | Pearson Correlation | -.057 | .195 | -.200 | -.432* | .114 | 1 | -.423* |
| | Sig. (2-tailed) | .755 | .284 | .272 | .014 | .533 | | .016 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| Shift | Pearson Correlation | .000 | .000 | .502** | .995** | -.199 | -.423* | 1 |
| | Sig. (2-tailed) | 1.000 | 1.000 | .003 | .000 | .275 | .016 | |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | |

From the correlation test results, above Table 8 the variables with a significant relationship are the relationship between work duration and waking time, work duration with shifts, and awake time with shifts. In contrast, the variables that have a relationship are awake time with changes in fatigue on the questionnaire and shift with changes in fatigue on the questionnaire.

## 6. Conclusion

This study aims to determine the relationship between work duration and work shifts on changes in fatigue and stress on bus drivers majoring in Sumbawa-Taliwang. Using measuring tools in the form of Visual Analogue Scale, Simple Mental Health Scale, Garmin Body Battery by Firstbeat and Stress Level by Firstbeat. From this research, it can be concluded that the duration of driving and shifts influence changes in driver fatigue, where the level of driver fatigue after driving increases compared to before driving and the increase in fatigue in the morning shift increases more than in the afternoon shift. As for stress, it was concluded that the duration of driving and work shifts did not affect changes in driver stress, where the level of driver fatigue after driving was relatively the same as before driving, and the level of added stress in the morning shift was also relatively the same compared to the afternoon shift. There is no significant relationship between changes in stress levels and driver fatigue. Where the level of fatigue always rises both in the morning shift and afternoon shift.

## References

Adiasa, I., Model Development of Fitness for Duty in Train Driver's: Study on Operation Area I and III, Master's Thesis, Institut Teknologi Bandung. 2019.

Chauhan, R., Ali, H., and Munawar, N., A. Building performance service through transformational leadership analysis, work stress and work motivation (empirical CASE study in stationery distributor companies). Dinasti International Journal of Education Management and Social Science, 1(1), 87-107. 2019.

Chung, W. Y., Chong, T. W., and Lee, B. G., Methods to detect and reduce driver stress: a review. International journal of automotive technology, 20(5), 1051-1063. 2019.

Dawson, D., and Fletcher, A., A quantitative model of work-related fatigue: background and definition. Ergonomics, 44(2), 144-163. . 2001.

DeVries, A. C., Glasper, E. R., and Detillion, C. E., Social modulation of stress responses. Physiology & behavior, 79(3), 399-407. 2003.

Irawan, M. Z., Belgiawan, P. F., Joewono, T. B., and Simanjuntak, N. I., Do motorcycle-based ride-hailing apps threaten bus ridership? A hybrid choice modeling approach with latent variables. Public Transport, 12(1), 207-231. 2020.

Mayer, T. G., Neblett, R., Cohen, H., Howard, K. J., Choi, Y. H., Williams, M. J., ... and Gatchel, R. J., The development and psychometric validation of the central sensitization inventory. Pain Practice, 12(4), 276-285. 2012.

Maxwell, S. E., Delaney, H. D., and Kelley, K., Designing experiments and analyzing data: A model comparison perspective. Routledge. 2017.

Meijman, T. F., and Mulder, G., Psychological aspects of workload. In A handbook of work and organizational psychology (pp. 15-44). Psychology Press. 2013.

Philip, P., and Åkerstedt, T., Transport and industrial safety, how are they affected by sleepiness and sleep restriction?. Sleep medicine reviews, 10(5), 347-356. 2006.

Pool, S. W., Organizational culture and its relationship between job tension in measuring outcomes among business executives. Journal of management development. 2000.

Satria, R., Tsoi, K. H., Castro, M., and Loo, B. P., A combined approach to address road traffic crashes beyond cities: hot zone identification and countermeasures in Indonesia. Sustainability, 12(5), 1801. 2020.

Smith, W. A., Allen, W. R., and Danley, L. L., "Assume the position... you fit the description" psychosocial experiences and racial battle fatigue among African American male college students. American Behavioral Scientist, 51(4), 551-578. 2007.

Useche, S. A., Cendales, B., and Gómez, V., Measuring fatigue and its associations with job stress, health and traffic accidents in professional drivers: the case of BRT operators. EC Neurology, 4(4), 103-118. (2017).

Watson, R. T., Boudreau, M. C., Chen, A., and Huber, M., Green IS: Building sustainable business practices. Information systems. 1-17. 2008.

Zhang, G., Yau, K. K., Zhang, X., and Li, Y., Traffic accidents involving fatigue driving and their extent of casualties. Accident Analysis & Prevention, 87, 34-42. 2016.

Zuraida, R., Iridiastadi, H., and Sutalaksana, I. Z., Indonesian Drivers' Characteristics associated with road accidents. International Journal of Technology, 8.2: 311-319. 2017.

**Acknowledgments**

I am grateful to Ms. Linda Safitri, Mr. Sukirman, Mr. H. Mochsin Hasan, and all of those I have had the pleasure to work on during this and other related projects.

## Biographies

**Nurul Hudaningsih** is a lecturer at the Industrial Engineering Department, Faculty of System Engineering, Sumbawa University of Technology, Sumbawa, Nusa Tenggara Barat. She obtained his M.T (Industrial Engineering) from Sepuluh November Institute of Technology, Indonesia, in 2015 and her S.T (Industrial Engineering), from Sepuluh November Institute of Technology, Indonesia (2012). She has been teaching at UTS, specializing in Industrial Engineering courses, for more than six years. She is a member of the Ergonomics and Work System Engineering and HSE research study and now supervising undergraduate students as part of her academic responsibilities. She is very active in journal and conference publications with 15 journals. Her H-Index currently stands at 2, and her Scopus Index stands at 1. She is a member of the Indonesian Association of Ergonomics (PEI) and part of PEI in Balinusra.

**Iksan Adiasa** is a lecturer at the Industrial Engineering Department, Faculty of System Engineering, Sumbawa University of Technology, Sumbawa, Nusa Tenggara Barat. He obtained his M.T (Management and Industrial Engineering) from Bandung Institute of Technology, Indonesia, in 2019 and his S.T (Industrial Engineering) from Sebelas Maret University, Indonesia (2017). He has been teaching at UTS, specializing in Industrial Engineering courses, for more than two years. He has been the chief of the Industrial Engineering Department since 2020 and a member of the Ergonomics and Work System Engineering and HSE research study. He is now supervising undergraduate students as part of his academic responsibilities. He is very active in journal and conference publications with 18 journals. His H-Index currently stands at 3. He is a member of the Indonesian Association of Ergonomics (PEI) and the Cooperation Agency for Higher Education in Industrial Engineering (BKSTI).

**Muhamad Iqbal Syauqi** is a fresh graduate with a bachelor's degree in Industrial Engineering 2020. He received his S.T. degree from the Industrial Engineering Department, Faculty of System Engineering, Sumbawa University of Technology. During college, he was active in the Industrial Engineering Student Association organization. He also joined the department's Ospek committee in 2017. He has joined a research group in the Ergonomics and Work System Engineering and HSE research study.

**Sopyan Ali Rohman** is a lecturer in the Mechanical Engineering Department, Faculty of System Engineering, Sumbawa University of Technology, Sumbawa, Nusa Tenggara Barat. He obtained his M.Eng (Mechanical Engineering) from Gadjah Mada University, Indonesia, in 2017 and S.T (Mechanical Engineering) from Mataram University, Indonesia (2012). He has been teaching at UTS, specializing in Mechanical Engineering courses, for four years. He has been the chief of the Mechanical Engineering Department since 2018. He is now supervising undergraduate students as part of his academic responsibilities. He is very active in journal and conference publications with 13 journals. His H-Index currently stands at 1.