

CHAPTER 3

METHODOLOGY

In this chapter, researcher describes research object, data type, collecting data method, research flow diagram and statistical data processing method.

3.1 Research Subject

The respondents of the research sample takes 6 males and 6 females (Renshaw et al., 2010) age 3-4 years old which each of them will involve both machine conditions. The participant should in health with no activity before to avoid early fatigue and free from any medications or lifestyle treatments that will influence blood pressure and muscle (Kaur et al., 2015).

3.2 Research Object

The object research of this research is the muscle activity interaction of the Semimembranosus muscle with the motorcycle seat surface during on-machine and off machine condition. On-machine seat condition transfers vibration and transmits whole body vibration (Halim, et al., 2012). The data in this research is primer which is provided from the experiment. The data included in this research are EMG signals of Semimembranosus muscle during on-machine and off machine condition.

3.3 Collecting Data Method

The experiment is conducted in each respondents' home in the morning when the respondents are not in fatigue condition (Hines, 2004). Collecting data method involved

steps of the experiment to get quantitative data of the respondents to be processed to data analysis as referenced.

3.3.1 Apparatus

In this study, the equipment needed is motorcycle with $0,06 \text{ m/s}^2$ vibration as the main tools of the case study as shown in figure 3.1. The motorcycle has vibration as $0,06 \text{ m/s}^2$. Then, Electromyography (Lab Quest 2: Vernier Tech & Soft, Texas, USA) is a main tool for identifying the object's muscle fatigue. The attachment of the electrode needs alcohol for cleaning the attachment area, later, the electrode gel is spread on the muscle. Then applying the tape to ensure that the electrode will not move. The data recorded by Labquest will directly transfer to Logger pro software to quantify electric signal into filtered EMG data. Then, the data processed then tested to Statistical Package for the Social Science (SPSS) software version 22 was used to be analyze. Later it will be run the statistical data to empirical Study. The blood pressure data also supported by using oscillometric blood pressure device to provide comparison between respondent's pre and post experiment blood pressure.



Oscillometric blood pressure



Electrocardiograph (ECG)



Electrode Pad



Electrode Gel



SPSS



Microsoft Excel

Figure 3.1 Experiment Apparatus

3.3.2 Experiment Design

Experiment involves two conditions. Both condition are when the motorcycle is in on-machine condition which leads the immediate exposure to the seat transfers vibration and transmits whole body vibration (Halim, et al., (2012)) and off-machine condition which has no vibration exposure. This experiment is performed in the outdoor as it has ground floor. The electrode is attached around Semimembranosus muscle as it is where the muscle got pressed by the force of passenger's weight. The semimembranosus muscle is shown on figure 3.2 below:



Figure 3.2 Hamstring Muscle

Source: <https://www.dovemed.com/diseases-conditions/hamstring-muscle-injuries/>

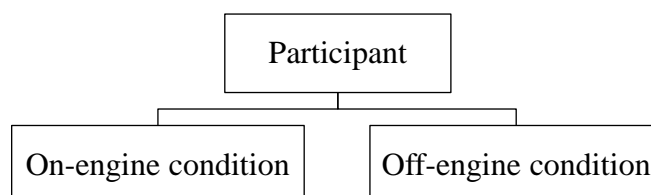


Figure 3.3 Experiment Design Diagram

Figure 3.3 shows that the experiment is within the subject. Each of respondents participated on each experiments. Before the experiment begun, the respondent should take position as they are riding motorcycle at the central part of the driver and another passenger. Then, the electromyography wire attach to the attached electrode pad to record it by using logger pro for 1 hour in off-machine condition. On the next day, they continue to the on-machine condition for 1 hour as well. Each pre and post experiment, the respondent's blood pressure will be check.

3.3.3 Task Design

The respondents are required to sit on the motorcycle for 1 hour in an off-machine-motorcycle and another 1 hour in an on-machine-motorcycle in the next day or vice versa. The respondent is expected to sit in the same position as they are in a motor riding, the EMG is begin to record the Semimembranosus muscle activity.

3.3.4 Experiment Procedure

Each of the respondents will expense more or less 1 hour on each experiment. Before starting the experiment, the following steps should be carried out:

1. Perform short interview to the respondents' parents about their motorcycle usage and health condition of the respondent.
2. Attach 3 electrode pads around Semimembranosus muscle. The electrode placement is shown on figure 3.4 below:



Figure 3.4 Electrode Placement

3. Ask respondent to sit as passenger in the central seat.
4. Measure blood pressure of respondent pre-experiment
5. Attach the Electromyography device tools
6. The electromyography starts to record during off-machine or on-machine
7. Stop the recording
8. Measure the blood pressure of respondent post-experiment
9. Release the attached electrode pad and cleanse it with alcohol
10. The respondent is required to rest and normalized his fatigue

11. The further experiment on machine condition is performed on the next day
12. The experiment is turned to the next respondents for an machine condition

The experiment has not certain rest time as the respondent can not be predicted, but each of respondents should conduct 2 experiments.

3.4 Data Processing Method

The initial data recorded in logger pro software is EMG raw signal which is conducted before starting the data collecting, it prepared to EMG with decay parameter template in microvolt unit. EMG with decay parameter template consists of EMG filtered, EMG Rectify and EMG with decay filter. It is used to filter the signal from noises. The data used is EMG with decay filter as it is already filtered by “highpassfilter” formula in direct calculated. Then the RMS use mRMS method to know the amplitude. The muscle contraction data is processed using inferential statistic with parametric statistical analysis using T test. The blood pressure analysis served by descriptive statistics.

3.5 Data Analysis Method

EMG signal data analysis is done using signal analysis and parametric statistical analysis. Blood pressure data is done using descriptive statistics. Signal analysis is the analysis that conducted by calculating mean root mean square (mRMS) of result after going through processing data to identify the amplitude. Besides, paired and independent T Test is performed for identifying the difference between experiment condition and respondent's gender. Descriptive statistics is carried out by using histograms to identify the difference between experiment condition and respondent's gender.

3.5.1 EMG Signal Analysis

Muscle fatigue analysis is based the amplitude value of EMG that occurred in root mean squared of EMG signal. The RMS graph that has been shown is averaged to get mRMS. Then each mRMS value is tested used T Test.

a. Paired T Test

Paired t-test is one method of hypothesis testing where the data used is not free (pairs data). The most commonly encountered features in a paired case are one individual (research object) subject to 2 different treatments. Although using the same individual, the researcher still obtained 2 kinds of sample data, in this research, the paired t test used to combined each respondents experiment between on –machine condition and off-machine condition. The data results is got from the same respondents that means the data is paired to use paired T Test. Paired T Test calculation is shown on equation below:

$$t = \frac{\text{mean} - \text{comparison value}}{\text{Standard Error}}$$

Where:

Mean value: mean difference between scores in the two conditions

Comparison value: 0, as it is expected to have no differences

Standard error: Standard error of differences

Where the hypothesis in this research is:

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$

If the significance value is > 0.05 , then H_0 is accepted and if the significance value is < 0.05 , then H_1 is rejected with H_0 is two variants of different significant population and H_1 is both are not significantly different population.

b. Independent T Test

Independent Sample T Test is used to test the significance of the average difference of the two groups. This test is also used to test the effect of independent variables on dependent variables. The independent T Test calculation formula is shown on equation below:

$$t = \frac{(M2 - M1) - \text{comparison value}}{\text{Standard Error}}$$

Where:

M2 – M1: the difference between the means of 2 groups

Comparison value: 0, as it is expected to have no differences

Standard error: Standard error of differences

Where the hypothesis in this research is:

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

If the significance value is > 0.05 , then H_0 is rejected and if the significance value is < 0.05 , then H_1 is accepted with H_0 is two variants of different significant population and H_1 is both are not significantly different population.

3.5.2 Blood Pressure Analysis

Blood pressure is analysed using descriptive statistics. The study only describes the state of the data as it is through parameters such as mean, median, mode, frequency distribution and other statistical measures. The measure of central tendency (measures of central tendency). The frequently used data centering measure is the frequency distribution. This statistical measure is suitable for nominal data and ordinal data (categorical data). While the mean value is a data centering measure suitable for continuous data. Other descriptive sizes for data centering are the median (middle value) and mode (the most commonly displayed values). The size of the frequently used data dissemination is the standard deviation. This data dissemination measure is suitable for numerical or continuous data. As for categorical data, the range value is a suitable size.

3.6 Research Flow Diagram

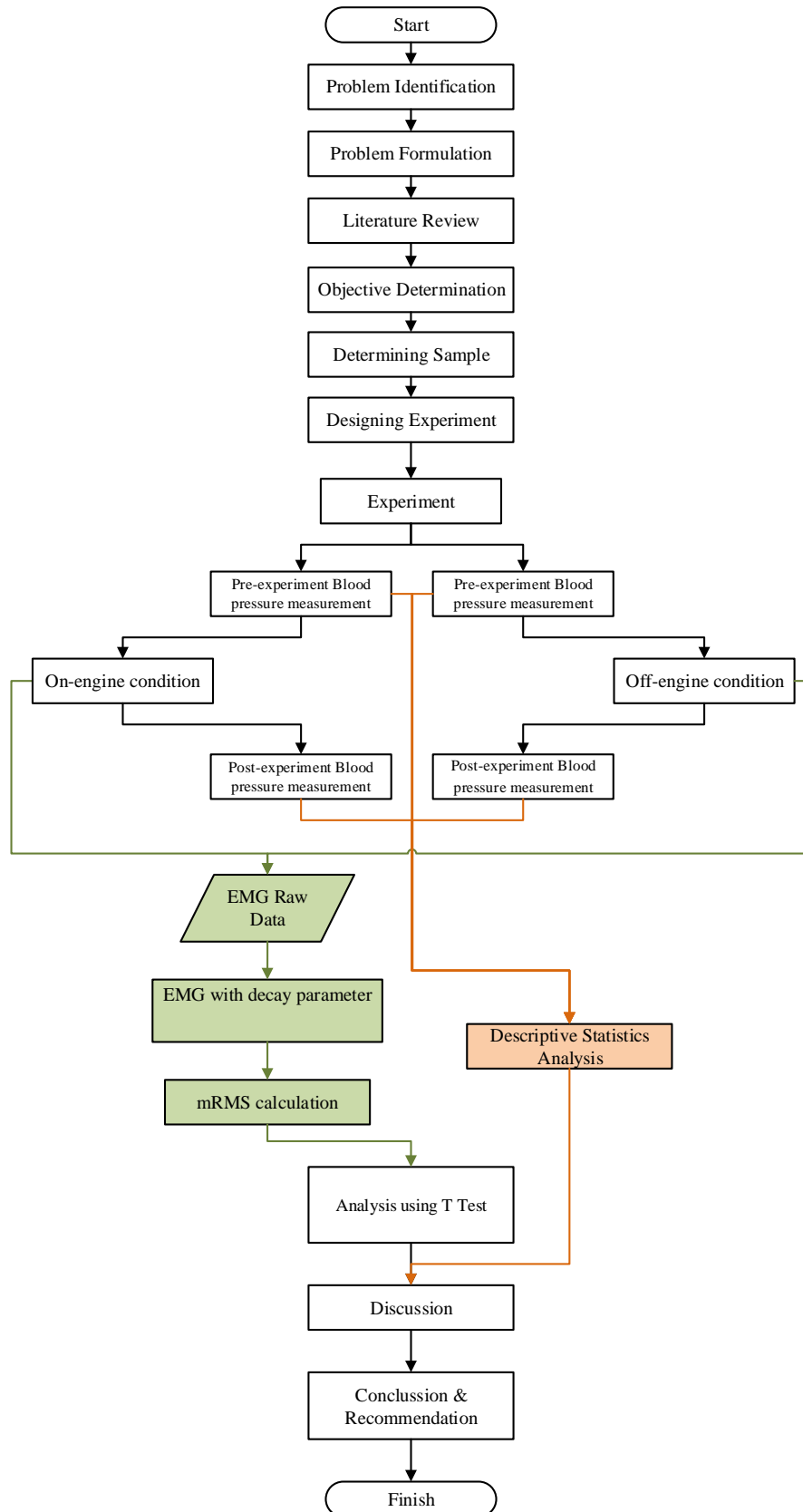


Figure 3.5 Research Flowchart Statistic

Figure 3.5 shows the flow of this research. This research is started by the problem identification. In daily activity, there are still many drivers who ride with 2 passengers and urge their children whose legs are not long enough to reach the pedal. So that, researcher do a literature study of the ongoing problem to find out the real case in the field that defines the middle-to low society who still use motorcycle for travelling around with their children. It also designated to find possible methods on problem that occurs as the children's leg cannot reach the pedal, it would like to give force to children leg to be loaded. The part directly affected is in lower extrimities of semimembranosus muscle that located in the inner thigh as a research method would likely use electromyography as the object of using Vernier and ECG / EMG sensors. Then, the objective of the research is to identify the muscle contraction on the respondent and how is blood pressure.

The experiment is carried out in two conditions, during off-machine and on-machine condition and involved 12 children as the respondents. The experiment was performed for an hour of each condition. before the experiment, respondents are required to follow some electromyograph installation steps. Then, the children are asked to sit on the motorcycle between two people as if they are going to travel. But, before positioning themselves on the motorcycle, the researcher measured their blood pressure. The measuring also conducted after the experiment.

The data recorded by Logger Pro Software through Laquest will directly show the RMS graph. Mean RMS is then calculated to determine EMG signal amplitude. The amplitude of each respondents' compared each other to know the differences between them. The test is using T test as the data is parametric and it was under 30 samples. The paired T test and independent T Test used to compare both data to compare between the condition towards each respondents, and each respondents towards each machine condition. blood pressure measurement data also served using histograms. At the end of the statistical calculation, the researcher can give the conclusion and recommendation from this study.