A Preliminary Study of Noise Effect on Pulse Rate, Blood Pressure and EEG Signal

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***Abstract*- This paper presents the effect of noise to pulse rate, blood pressure and Encephalography (EEG) signal. The investigation aims to find the correlation between noise exposures to pulse rate (PR), blood pressure (BP) and EEG signal. A total of 20 subjects (all male) with age range of 20-22 years old and no past medical history were studied. Subjects were exposed to noise at 90 dB for ten minutes. Noise at 90dB was generated by using INTERM M500 Power Amplifier (INTERM M500, Cunnings, UK). Pulse rate, blood pressure and EEG signal were recorded before and after noise exposure. UT 4000A Patient Monitor (UT 400A; Progetti, Italy) was used to record pulse rate and blood pressure during the experiment. EEG signals were captured by using PowerLab 4/25T Data Acquisition Systems (ML865; ADInstruments, Canada). This system is capable to classify the EEG signal into Alpha (8-12 Hz) and Beta (13-30 Hz). Statistical analysis was conducted by using SPSS Version 16 (SPSS Inc; Chicago, USA) to find the correlation between noise to pulse rate, blood pressure and Power Spectral Density (PSD) value for Alpha and Beta waves. The result shows that pulse rate and blood pressure increase after noise exposure. Besides that, the finding showed that there are significant positive difference ($p<0.05$) between the mean value of alpha's and beta's PSD before and after noise exposure.**

I. INTRODUCTION

Noise is a form of sound, which commonly referred to as unwanted sound or noise pollution. There are many form of noise in our routine surrounding such as traffic, machinery, industries and even electronics. The advancement of technology has lead to human to these kinds of pollutions, whether they realize it or not. In order to get what they have today, human have sacrificed the serenity offered by Mother Nature. That is the price human need to pay for what they have today anyway. However, without realized, excessive level of noise also lead to the potential health effects.

Noise activates the pituitaryadrenal-cortical axis and the sympathetic-adrenal-medullary axis. Changes in stress hormones including epinephrine, norepinephrine and cortisol are frequently found in acute and chronic noise experiments. The catecholamines and steroid hormones affect the organism's metabolism. Cardiovascular disorders are especially in focus for epidemiological studies on adverse noise effects. However, not all biologically notifiable effects are of clinical relevance. The relative importance and significance of health outcomes to be assessed in epidemiological noise studies follow a hierarchical order, i.e. changes in physiological stress indicators, increase in biological risk factors, increases of the prevalence or incidence of diseases, premature death [1].

Noise exposure is one of the major occupational hazards in many places and has a several health effects, including hearing loss and physiological effects such as sleep disturbances, annoyance and mental stress. One of the common factors which cause mental illness or depression is long term of stress [2].

In Malaysia, the problem of mental illness is growing at alarming rate . As a result there is much loss of work time and increasing medical expenses with huge financial losses for individuals as well as for goverments and companies. Malaysia Ministry of Health reported that one tenth Malaysian are facing mental illness and about 450 million peoples in the world sufferring this problems. In 2005, there were 2,508 mental illness cases with 1,151 new cases. The number of patients are expected to be increased from year to year [3].

Recently, researchers were hotly debated about the effect of noise to human in term of physiological and emotional. However, most of these studies have been carried out in developed countries [4-7]. To date, no known literature describes the effect of noise in Asian population including Malaysia. Hence, this paper will be the first attempt to describe the effect of noise to brain signal for Malaysian, hence, which may also be useful as a guideline for the general Asian populations.

Human are also exposed to excessive level of noise in community places such as concerts, dance club, discotheque and etc. Without realize, people that often visit such places actually adapt to the environments. It is like noise pollution does not going to bother them anyway. These kinds of places are fun, and there are people who visit them to reduce their stress. But, does that scientifically work? Or did they have already experience the noise hearing impairment?

Whatever the reason is, human cannot escape the noise pollution in this advanced age. Noise pollutions are everywhere especially in metropolitan. But, the advance of technology can also guide us to a way to monitor the noise effects and prevent them from happening. It is the matter of scientific research and invention.

II. SUBJECTS AND METHODS

A. Subjects

A total of 20 students from University Malaysia Perlis with no past medical history were recruited and studied. Subjects were on-randomly volunteers. All of them are male and age in range 20-22 years old with same educational level background.

B. Methods

The methods for this study consist of two parts. The first part involved the collection of data for 20 males. For each subject, two different readings have been taken which are the heart rate and blood pressure. The data is recorded during pre and post exposure to noise. So, for each and every subject, four different readings were recorded namely pulse rate, blood pressure for pre and post noise exposure. The second part involved the collection of brain signal from the same subjects and EEG signal were recorded for before and after exposure to noise as well.

First Part

For measuring the pulse rate and blood pressure, UT 4000A Patient Monitor is used. When the subject arrived to the lab, he will be asked to take a rest for about 10 minutes in order to ensure they are in resting condition. Then, blood pressure and pulse rate of the subject is taken. Subsequently, the subject is exposed to fixed noise level (90 dB) for 10 minutes. Noise is generated by using INTERM M500 Power Amplifier and noise level is measured by using SOLO Sound Level Meter. Immediately after that, the pulse rate and blood pressure of the subject is taken again. The same procedure is repeated for each and every subject to ensure the consistency of the date obtained. All the data obtained from the experiment is analyzed by using the SPSS Version 16. The result is presented and interpreted in simple error bar graph.

Second Part

For recording and acquiring EEG signals, ML865 PowerLab 4/25T Data Acquisition System is used. When the subject arrived to the lab, he will be asked to get a rest for 10 minutes before EEG electrodes are set up. This is to ensure that the subject in resting condition.

The montage used is the standard montage of 10-20 system and the technique of placing the electrodes is bipolar technique. Bipolar technique refers to the technique of measuring the impedance between two active electrodes. In this study only the frontal part of the brain has been focused as it is most associated to the sense of thinking. After that, subject was exposed to noise at 90 dB for 10 minutes.

Noise was generated using INTERM M500 Power Amplifier and a sound generator while noise level was measured using SOLO Sound Level Meter. Immediately, the EEG signals were recorded after noise has been exposed to subject. Before placing the electrode, the gel is spread onto the scalp in order to reduce the impedance exists in the scalp surface. Figure 2 shows the flow for steps taken in getting PSD.

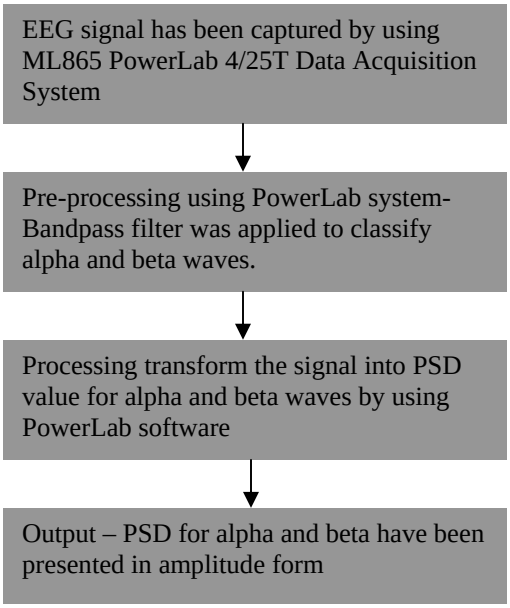

Fig. 2. The flow chart shows the steps taken in processing brain signal

A nonparametric Wilcoxon test was conducted using SPSS version 13 for Window XP. The test was used to analyze whether the mean value of the Alpha's wave power spectral density and beta's wave power spectral density measured differ significantly pre and post exposure to noise.

III. RESULTS AND DISCUSSION

A. Effect of Noise to Pulse Rate and Blood Pressure

Based on the Figure 3 and Figure 4, there are slightly significant different between both parameters, noise - pulse rate and noise – blood pressure. Figure 3 shows the effect of noise to pulse rate in error bar graph. For Figure 3 and Figure 4, 1 and 2 indicate pre-exposure and post-exposure, respectively. From Figure 3, there is slight different between pre and post exposure for the pulse rate in which the mean pulse rate is increased about 11.8%. Figure 4 shows a significant increase in the blood pressure which is about 1.3%. From this result, it can be seen clearly that noise may increase pulse rate and blood pressure. Exposure to noise in long period will cause higher pulse rate and blood pressure even in quiet condition [10].

B. EEG Signal obtained after exposing to noise

Twenty male subjects with no medical history involved this study. Table 1 shows the results of PSD for alpha and beta waves before and after expose to noise. The findings showed that there are significant positive difference ($p<0.05$) between the mean value of the PSD's alpha and beta waves before

(alpha = 9.13 x 10^{-12}, beta = 4.41 x 10^{-12}) and after (alpha = 3.19 x 10^{-12}, beta = 4.99 x 10^{-12}) exposure to noise at 90 dB.

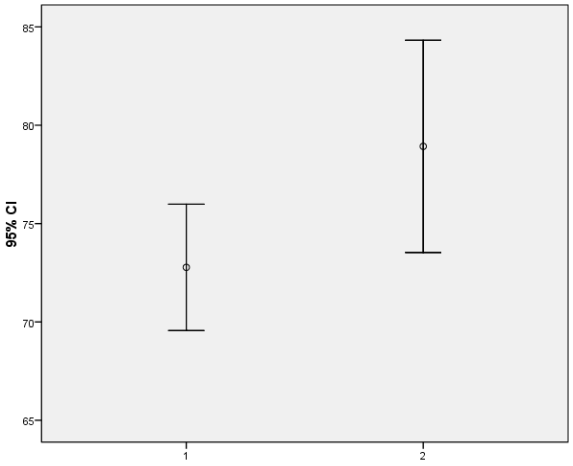

Fig. 3. The error bar graph shows the effect of noise on pulse rate.

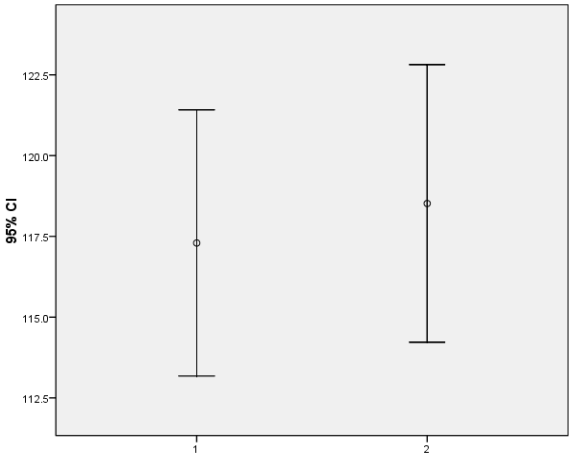

Fig. 4. The error bar graph shows the effect of noise on blood pressure (systolic).

C. EEG Signal obtained after exposing to noise

Twenty male subjects with no medical history involved this study. Table 1 shows the results of PSD for alpha and beta waves before and after expose to noise. The findings showed that there are significant positive difference ($p<0.05$) between the mean value of the PSD's alpha and beta waves before (alpha = 9.13 x 10^{-5}, beta = 4.41 x 10^{-5}) and after (alpha = 3.19 x 10^{-5}, beta = 4.99 x 10^{-5}) exposure to noise at 90 dB.

TABLE I
THE MEAN POWER SPECTRAL DENSITY ALPHA AND BETA WAVES BEFORE AND AFTER NOISE EXPOSURE FOR TWENTY MALE SUBJECTS

Power Spectral Density	Before	After	*p*-value
Alpha waves	9.13 x 10^{-12}	3.19 x 10^{-12}	0.05
Beta waves	4.41 x 10^{-12}	4.99 x 10^{-12}	0.05

The results obtained from this study support possible changes of alpha and beta waves before and after exposure to noise. Increase in alpha magnitude indicates that the subject feels more relaxed after the exposure whereby the decrease of alpha magnitude shows that the subject becomes tense or less relaxed [8]. High beta wave/low alpha wave activity has been shown in people with depression, stress, anxiety, epilepsy, and even schizophrenia [9].

IV. CONCLUSION

Exposure to noise affects subjects in various ways. In this study, pulse rate, blood pressure and EEG signals act as the biological parameter in order to measure the effect of noise. The findings indicate that pulse rate and blood pressure will increase after noise exposure. In other hand, noise may cause subject feel tense or less relaxed. The best things that can be conclude here that some of subjects said there are relaxed but EEG signals shows that they feel tense or less relax. It may shows that psychological does not affect the physiological appearance.

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