Statistical Analysis of Electromagnetic Radiation for Stroke Patients and Non-Stroke Participants

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***Abstract*—This paper calculates the statistical analysis of electromagnetic radiation (EMR) for the stroke patients and non-stroke participants. The EMR is collected from 199 subjects undergoing post-stroke treatment and 100 non-stroke participants at 17 points around their body, namely left side, right side and chakra points. The body frequency (in MHz) is captured using frequency detector by taking the reading of the frequency 5 times at each point at the same location; hence, the average value is calculated. Data analyses were evaluated using exploratory and descriptive statistics. In conclusion, the statistical results presented in this study indicate that the data have certain pattern and behaviour. By observing the Kolmogorov-Smirnov's p-values, skewness and kurtosis, it shows that all variables were well-modelled by a normal distribution. Using Welch ANOVA, the finding shows that there are significant differences between the stroke and non-stroke in relation to frequency reading at most of the measurement points as their p-values were < 0.05.**

***Index Terms*—Electromagnetic Radiation (EMR); Stroke; Chakra; Frequency detector.**

I. INTRODUCTION

Nowadays, the interest in scientific investigations of the electromagnetic radiation (EMR) on human body condition has increased tremendously. Researchers have started to characterize physiological aspect of human being using EMR. Hence, the purpose of this research which has been approved by UiTM ethic committee is to calculate the statistical analysis of the EMR for the stroke patients and non-stroke participants. As known, stroke has become one of the major diseases in Malaysia, therefore this research is believe to be very significant to lay the foundation in the early detection of the disease. As reported by National Stroke Association of Malaysia (NASAM), stroke is the third largest cause of death in Malaysia. It was also reported that in Malaysia, as many as six people suffer a stroke every hour, and every year, an estimated 40,000 people in Malaysia suffer from stroke [1, 2].

There are a lot of techniques to diagnose stroke such as blood pressure measurement, blood test (to check the sugar level, clotting or cholesterol level), chest X-ray brain scan and few more. However, this research proposed to evaluate the differences of EMR between stroke patients and non-stroke participants using frequency detector. 199 subjects undergoing post-stroke treatment at NASAM and 100 volunteered non-stroke participants (staff of Universiti Teknologi MARA, Shah Alam) with compatible age range with stroke patients involved in this research. The body frequency in hertz is measured at 23 points around the human body namely left side, right side and chakra points. Figure 1 shows the 16 points around the human body (denotes as L1-L8 for left side and R1-R8 for right side) and 7 chakra points (denotes as CA-CG) that being measured in this research to get the EMR of the sample.

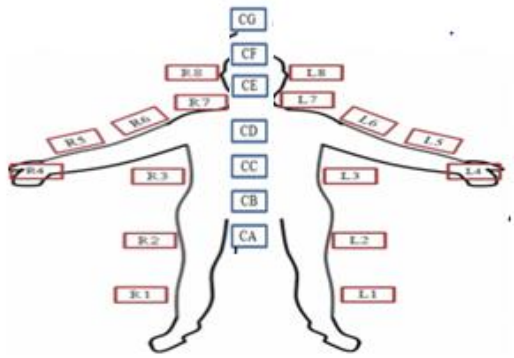

Figure 1: Points of measurements: left side, right side and chakra points

A. The Human EMR

A unique vibration of Electromagnetic Radiation (EMR) has been found to radiate into the space surround the human body which is produce due to electrical system in their body [3, 4]. It operates in the nervous system which in charge for sensing stimuli and transmits signals to and from different parts of the body. These EMR surrounds the human in an oval shape, discharges signals externally of the physical body in the distance 2-3 feet, and also discharges above the head and below the feet into the ground [5]. When the radiation field is dynamic, difference in field intensity happens as waves radiating outwards from the source body; however, if the radiation field is static, no wave is transmitted. The EMR is also represents a specific characteristic of the human which vary equivalent with the physical condition of the body [6]. The psychological and emotional actions are sent throughout the body as electrical impulses radiating electromagnetic field (EM) fields outside the body, which are the characteristic of the mental activity. Theoretically, the human radiation wave existence has been concluded to be EM field generated by the biological system of body itself [7-10]. In reality, there are two main concern of EMR in human body which is health region (outer body) and chakra region (center body). A chakra can be described as energy center in human being which acted as the focal points to receive, absorb and transmit the energy in human body. It signifies a point of intersection concerning mind and body, associated to psychological and physiological state of a body [5, 11]. There are 7 chakra points in human body, namely, base chakra, sacral chakra, solar plexus chakra, heart chakra, throat chakra, forehead chakra and crown chakra [5, 12]. All points have specific roles that are usually related with their position in the body.

B. Stroke

Anyone can have stroke, including children, but the most common of the cases affect adults. Stroke is defined as brain injury which usually affects one side of body when the blood supply to the brain is disrupted. It happened when the blood vessel in the brain bursts or get clogged. As a result, the blood supply to the brain stops and the brain cells are deprived of oxygen and nutrients, causing that part of brain start to die. When the brain injured, it will affect the senses, speech and the understanding of language. Stroke also affects the behavior, thought and memory patterns of the victims. Stroke varies from one to another victim, subject on which part of the brain is damaged, also subject to the degree of that damage relatively minor and short-lived [13]. Ischemic stroke and hemorrhagic stroke are two types of stroke that strike human being with different causes. Ischemic stroke happened when a blood clot blocks an artery serving the brain, hence disrupting blood supply. This is due to high cholesterol or other debris in the arteries over the years. Hemorrhagic stroke attacked when a blood vessel in or around the brain bursts, causing a bleed. Untreated high blood pressure which gives a pressure on the artery walls will increase the risk of bursting and bleeding. Different factors also increase the risk of stroke; these include smoking, heavy drinking, atrial fibrillation, diabetes and many more. It is said that the risk factors is not related to age but common case happened to the people over 55 years old and the occurrence continues to rise with age [1]. Men are at a high risk of stroke than women and those with family history that have stroke increases the risk; might be due to factors such as high blood pressure and diabetes that run in the families.

II. EXPERIMENTAL

Figure 2 shows the flowchart of this research which involved four main steps. Firstly, the instrument was set and measurement procedure was outlined to validate and calibrate the frequency detector. Secondly, the frequency of EMR was collected consistently at specific points as shown in Figure 1. Next, the raw frequency data was validated to verify that the values collected were in acceptable range. Finally, the data was analyzed using exploratory and descriptive statistics. Figure 3 illustrate the process in this research.

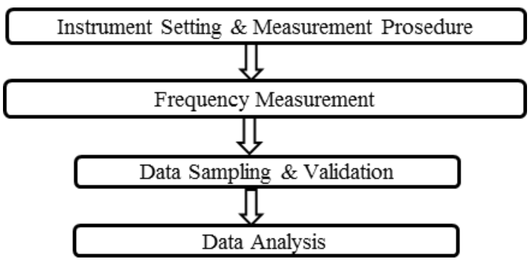

Figure 2: Flowchart of research

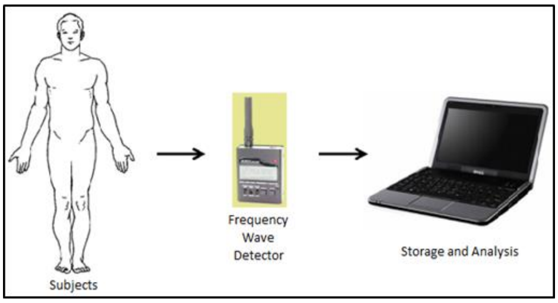

Figure 3: Data acquisition procedure [14]

A. Apparatus

The EMR of the sample is measured using body radiation wave detector, set at Mega Hertz range. This detector is a hand-held frequency meter (refer Figure 3), equipped with dipole antenna which capable of detecting broad range of electromagnetic wave of human EMR. The detector has a filter unit use to check the interference that occurred during the measurement in order to prevent display of random noise and ultra-sensitive synchronous detector that interacts with the antenna to check out the interference. It gives a true, real time reading of the frequency of EMR in natural states at the point of measurement.

B. Measurement

Before data acquisition, the experimental procedure was designed and followed closely to ensure accuracy. In accordance with the Declaration of Helsinki 1964, potential subjects were informed on the purpose of the study and the experimental procedure. In addition, the benefits of the study and matters related to confidentiality were also explained. Agreeable subjects were then required to complete the consent form before being screened for fulfillment of inclusion and exclusion criteria. EMR measurement will be conducted wirelessly using the detector while the subject is relaxed in seated or standing position at fixed position under controlled environment. During the data collection, the temperature of the room is maintained between 20^{0}C to 26^{0}C to ensure similar relaxation and also to guarantee consistency and accuracy in frequency reading. In order to collect the frequency reading correctly, the participants are advised to limit their body movement.

C. Configuration

The antenna of the detector is set on the 7^{th} segment length and was placed parallel to the ground on horizontal position to the human body. The frequencies are obtained remotely at a distances of 1 to 5 cm from body to antenna [16]. The reading of the frequency was collected 5 times at each point at the same location. The average value will be calculated for analysis.

D. Data Analysis

Data analysis involves three main parts which include pre-processing of raw data (refer to Table 1), exploratory statistical analysis and descriptive statistics. The fundamental descriptive analysis was performed using SPSS to determine the signal characteristic, to verify the data and to examine the outliers for further analysis. The treatment of outliers is an imperative step in the data screening method. Outliers refer to observations with a unique combination of characteristics identifiable as distinctly different from the other observations [17]. Checking for outliers is important as outliers could affect the normality of the data which could then distort the statistical results [17, 18].

The next analysis is the assessment of normality. The normality test was run, using Kolmogorov-Smirnov test, to determine whether the data set of the research variables in each context were well-modelled by the normal distribution or not. Lastly, the One-Way ANOVA test was carried out as comparative tests in this study. It produces a one-way analysis of variance for a quantitative dependent variable by a single independent variable. Therefore, the One-Way ANOVA test was run to compare the mean value of each variable between the groups of stroke (stroke and non-stroke).

Table 1
Average Raw Experimental Data

	Variable	Stroke		Non-stroke
		LH	RH	
Left Side	L1	414.45	406.50	455.60
	L2	398.54	404.67	434.76
	L6	397.25	397.93	434.65
	L7	394.58	395.55	418.15
	L8	395.96	404.63	435.20
Right Side	R1	415.14	383.50	442.68
	R2	391.60	382.66	403.11
	R6	375.91	381.93	422.20
	R7	380.37	373.90	420.65
	R8	393.29	382.93	427.29
Chakra	CB	373.06	373.79	322.08
	CC	378.16	389.58	328.35
	CD	385.95	383.16	342.13
	CE	373.24	372.63	354.64
	CF	390.94	389.53	390.90
	CG	396.86	399.90	387.09

III. Result and Discussion

In the first analysis, for the detection of outliers, besides examining histograms and box-plots, each variable was examined for the standardised (z) score. For large sample size (above 200), Absolut (z) > 4 is evidenced of an extreme observation [17]. The standardised (z) scores of all observations are summarized in Table 2. It shows that the standardised (z) scores of the observations for the variables ranged from -3.245 to 3.204, indicating that none of the variable exceeded the threshold of ±4. Thus there is no outlier among the observations.

Table 2
Assessment of Outlier Based on Standardized values

Context	Variable	Standardized value (Z-Score)	
		Lower Bound	Upper Bound
Left Side	L1	-2.478	2.823
	L2	-3.034	2.694
	L6	-2.356	2.977
	L7	-2.727	2.862
	L8	-3.245	3.204
Right Side	R1	-2.724	2.860
	R2	-2.436	2.954
	R6	-2.132	2.830
	R7	-2.406	2.693
	R8	-2.232	2.456
Chakra	CB	-2.889	2.906
	CC	-2.934	2.726
	CD	-2.725	2.847
	CE	-2.726	3.080
	CF	-3.047	2.798
	CG	-2.775	2.489

As shown in Table 3, the Kolmogorov-Smirnov p-values of all variables were lower than 0.05 which could not support the null hypothesis that the data set of variables was well-modelled by a normal distribution at the initial step. The only exception was for CB with the p-value of 0.054, above the threshold 0.05. The general rule is that the data may be assumed to be normally distributed if skew and kurtosis is within the range of -1 to +1, or -1.5 to +1.5 or even 2.0 [19]. It is also suggested using a cut-off point of less than 7 as an acceptable value for the kurtosis. The data which is skewed within the range of +2 to -2 could be considered as being normally distributed. Therefore, since the skewness of these variables were located between -2 and +2 and the kurtosis was between -7 and +7, the skewness ranged from -0.431 to 0.266 and the kurtosis ranged from -0.45 to 0.843. Therefore, it can be concluded that the data set of all variables were well-modelled by a normal distribution.

Table 3
Assessment of Normality Test

	Variable	Kolmogorov-Smirnov[a]			Skewness	Kurtosis	Distribution
		Statistic	df	Sig.			
Left Side	L1	.071	299	.001	-0.136	0.344	Normal
	L2	.064	299	.005	-0.108	0.083	Normal
	L6	.076	299	.000	0.2	-0.073	Normal
	L7	.070	299	.001	-0.075	0.146	Normal
	L8	.079	299	.000	0.102	0.843	Normal
Right Side	R1	.073	299	.001	-0.022	-0.265	Normal
	R2	.084	299	.000	0.266	0.28	Normal
	R6	.060	299	.012	0.101	-0.424	Normal
	R7	.063	299	.006	0.214	-0.45	Normal
	R8	.063	299	.006	0.188	-0.349	Normal
Chakra	CB	.051	299	.054	-0.286	0.322	Normal
	CC	.097	299	.000	-0.431	-0.026	Normal
	CD	.101	299	.000	-0.307	-0.095	Normal
	CE	.078	299	.000	-0.039	0.205	Normal
	CF	.074	299	.000	-0.015	0.375	Normal
	CG	.097	299	.000	-0.088	0.354	Normal

The p-value lower than 0.05 demonstrates that the obtained differences in sample variances were likely to have occurred based on random sampling from a population with unequal variances. Thus, the null hypothesis of equal variances was accepted for the non-significant p-values.

A total of three contexts (Left Side, Right Side and Chakra) were considered in performing the One-Way ANOVA test which comprises all variables. The main assumption of One-Way ANOVA test is homogeneity of variances which was examined by Levene's test in this study. The population variances are considered as equal if the Levene's p-value is above the threshold 0.05. If the data fails this assumption, the Welch ANOVA test should be carried out instead of one-way ANOVA test.

As shown in **Error! Reference source not found.**, the results indicated that the equal variance assumption was not supported for the research variables as their relative Levene's p-values were all below the 0.05 and statistically significant. These results implied that the Welch ANOVA test should be conducted instead of one-way ANOVA test for the research variables.

Table 4
Assessment of Levene's Test for Testing Equality of Variance

	Variable	Levene Statistic	p-value	Equal Variance Assumed
Left Side	L1	16.271	0	No
	L2	8.501	0	No
	L6	19.896	0	No
	L7	20.618	0	No
	L8	23.418	0	No
Right Side	R1	8.312	0	No
	R2	36.192	0	No
	R6	6.193	0.002	No
	R7	10.071	0	No
	R8	18.083	0	No
Chakra	CB	28.425	0	No
	CC	20.305	0	No
	CD	34.888	0	No
	CE	43.609	0	No
	CF	58.645	0	No
	CG	53.54	0	No

Table represents the results of Welch ANOVA Tests for comparing mean value of the research variables in three contexts between stroke and non-stroke. The finding shows that there are significant differences between the various groups of stroke in relation to some variables as their p-values were below 0.05. Based on the results, the mean values of the L1, L2, L6 and L8 in the context of left side are significantly differed between stroke and non-stroke. Similarly, significant differences were found for R1, R6, R7 and R8 in the context of right side as well as CB, CC and CD in the context of chakra. Conversely, the results indicated that there is no significant difference in L7, R2, CE, CF and CG between stroke and non-stroke in relation to the other variables as their p-values were above 0.05.

Table 5
Results of Welch ANOVA Tests for Comparison between Stroke Groups

	Variable	Welch ANOVA Statistic	df	p-value	Significant Difference Occurred
Left Side	L1	8.579^{***}	188.23	0	Yes
	L2	4.497^{*}	181.29	0.012	Yes
	L6	5.265^{**}	177.69	0.006	Yes
	L7	2.486	174.43	0.086	No
	L8	6.274^{**}	183.05	0.002	Yes
Right Side	R1	12.943^{***}	185.17	0	Yes
	R2	1.522	180.48	0.221	No
	R6	9.757^{***}	188.49	0	Yes
	R7	13.656^{***}	182.98	0	Yes
	R8	10.357^{***}	183.17	0	Yes
Chakra	CB	8.736^{***}	183.14	0	Yes
	CC	12.418^{***}	183.86	0	Yes
	CD	5.970^{**}	176.98	0.003	Yes
	CE	1.082	175.33	0.341	No
	CF	0.028	178.41	0.972	No
	CG	0.343	168.95	0.71	No

df: Degree of Freedom;
*. Difference is significant at the 0.05 level (2-tailed);
**. Difference is significant at the 0.01 level (2-tailed);
***. Difference is significant at the 0.001 level (2-tailed)

IV. CONCLUSION

In conclusion, the statistical results presented in this study indicate that the data have certain pattern and behaviour. By observing the Kolmogorov-Smirnov's p-values, skewness and kurtosis, it shows that all variables were well-modelled by a normal distribution. Using Welch ANOVA, the finding shows that there are significant differences between the stroke and non-stroke in relation to frequency reading at most of the measurement points as their p-values were < 0.05.

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