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Available Online through www.ijptonline.com ASSOCIATION BETWEEN S1 AND S2 WITH BLOOD PRESSURE: A DESCRIPTIVE STUDY ON HEALTHY YOUNG ADULT Noorzaid Muhamad^{*1}, Resni Mona¹, Jannathul Firdous¹, and Norazah¹

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Abstract

Heart has the essential function of pumping blood to every cell in the body which allowed the delivery of oxygen and nutrients and thus keeping us all alive. Heart sound is produced by vibration set up within the walls of the ventricles and major arteries during valve closure. This research was done to study the relationship between first and second heart sound in the four precordium areas (aortic, mitral, tricuspid and pulmonary area) and blood pressure. We performed an observational study on the relationship between first and second heart sound in four precordium areas (aortic, mitral, tricuspid and pulmonary area) and blood pressure. We performed an observational study on the relationship between first and second heart sound in four precordium areas (aortic, mitral, tricuspid and pulmonary areas) and blood pressure by comparing the duration of heart sound to systolic and diastolic value taken by using mercury sphgymomanometer. 100 healthy young adults in Universiti Kuala Lumpur Royal College of Medicine Perak (UniKL RCMP) age between 18-26 years old were chosen as the subjects for this study. The duration from first to second heart sound (*lub-dub*) was compared to systolic value while the duration from second to first heart sound (*dub-lub*) was compared to diastolic value. Non-parametric chi-square test was used to test the association between two variables.

The results confirmed that S_1 and S_2 heart sound from the four precordium areas have association with blood pressure. The duration from S1-S2 is associated with systolic phase while S2-S1 was associated with diastolic phase. Therefore, heart should be considered as one of the alternative for measuring blood pressure in cases where the usages of mercury sphygmomanometer are limited.

Keywords: Blood pressure, Diastolic values, Heart sound, Systolic value.

1. Introduction

The heart is a powerful muscular organ which acts as a pump to supply blood to all body parts. Two heart sounds resulting from cardiac contraction are normally heard through stethoscope placed on the chest wall. The first sound, a soft low-pitched *lub*, is associated with closure of the artrioventricular valves, while the second sound, a louder*dup*, is associated with closure of the pulmonary and aortic valves. The *lub* sound marks the onset of the systole while the *dup* sound marks the onset of diastole. Recent study has shown that the spectrum of S2 had a strong connection with blood pressure and has been used to estimate blood pressure from the heart sound acquired by a smartphone[1]. There is a relationship between heart sound and the acceleration and deceleration of blood flow [2], while it has been concluded that the new non-invasive method based on advanced signal processing of the second heart sound provides an accurate estimation of the pulmonary arterial pressure[3].

Blood pressure is the force created by the blood pushing against the walls of blood vessels (arteries) as it is pumped by the heart. The higher the pressure the harder the heart has to pump [4]. Numerous studies have shown that there is association between blood pressure and various diseases. Based on National Health and Morbidity Survey 2011 done by Ministry of Health Malaysia, 32.7% of population approximately 5.8 million of adults aged 18 years and above have hypertension[5].

A prospective cohort study conducted by Yale University School of Medicine on 119,963 women with high blood pressure, aged 30-55 years, who were initially free from cardiovascular disease reported 308 incident cases of coronary heart disease (66 fatal and 242 nonfatal myocardial infarctions) and 175 strokes (50 fatal and 125 nonfatal) after six years of follow up[6]. Besides, the research published in 2006 confirmed that, after adjusting all other risk factors, those pre-treated, untreated, controlled, and uncontrolled hypertensive participants had 1.74, 1.81, 2.19, and 2.77 times higher risks of developing cardiovascular disease compared with normotensive participants, respectively [7]. Thus, a reliable and accurate way of measuring blood pressure is essential as it greatly influence one's health.

For the past century, upper arm cuff with the mercury sphygmomanometer is used to record blood pressure. However, despite their popular used in most users, these sphygmomanometers still could not be used or could not correctly assessed blood pressure in certain group or condition such as in people with no limb or in cases where their limbs were greatly severed or fractured. In addition, in those with too small limb such as in baby and those with too big limb such as

Noorzaid Muhamad et al. International Journal of Pharmacy & Technology* in obese or body-builder, their blood pressure cannot be accurately measured by using sphygmomanometer due to limited cuff size causing either over-estimation or under-estimation of reading. Other chief concern regarding the use of mercury sphygmomanometer is that it contained a toxic substance leading to maintenance and disposal problems. In addition, concern over the lack of maintenance of blood pressure measurement devices, both in the community and acute hospital settings, has been highlighted [8]. Excessive air leakage from damaged cuffs, hoses and tubing connectors may occur which reduced the accuracy of the readings.

Therefore, an alternative way of measuring blood pressure which will not discriminate people with no limbs or with different limb sizes or does not use chemicals that bring hazard to health and environment should be introduced. Therefore, this research is conducted to explore a different technique to determine blood pressure.

2. Materials and methods

2.1. Participants

An observational study was conducted among young adults in UniKL RCMP. One hundred participants from UniKL RCMPMBBS students age between 18-26 years old were recruited for this study. The population are multi-cultural races consisting of Malay, Chinese and Indian.

2.2. Sampling

100 participants of RCMP students were recruited. Sample size was calculated by assuming that 80% of sensitivity with a precision of 8%.

2.3. Heart sound

Heart sounds were recorded by using an electronic stethoscope. The stethoscope diaphragm was placed at four areas in the precordium which were aortic, pulmonary, tricuspid and mitral area. The aortic area is located at second intercostals space at right sternal border while the pulmonary area is on the left side. The tricuspid area is at fourth intercostals space on left sternal border whereas the mitral area is at fifth intercostals space on left mid-clavicular line. The first and second heart sounds were recorded and the data obtained will be transferred to computer to be analysed by the researchers.

2.4. Blood Pressure

Blood pressure was taken by using a mercury sphygmomanometer. The brachial pulse was palpated and the cuff was inflated until the pulse was impalpable. The pressure on the manometer was noted; this was the rough estimation of the

Noorzaid Muhamad et al. International Journal of Pharmacy & Technology* systolic blood pressure. The systolic and diastolic blood pressure was determined by using Korokoff sound. The first tapping sound heard when the cuff was deflated was recorded as the systolic pressure (phase 1 Korotkoff sound). The pressure when the sound completely disappeared was recorded as the diastolic pressure (phase 5 Korotkoff sound).

2.5. Study Variables

This research used two different variables which were the socio-demographic and physical findings. Socio-demographic variables included age, gender, ethnicity, lifestyles, exercise, diet and smoking; while physical finding included Body mass index (BMI), heart rate, and heart sound.

3. Results and discussion

This study was done on 100 participants consisting of 48 males and 52 females of 18 to 26 years old in age with the assumption that all of them are physically healthy. Other parameters considered in this study were body mass index (BMI), smoking status and exercise habit. All variables was statistically significant except for exercise as the p value is more than 0.05 as shown in Table 1.

Table	1: A	Association	between	blood	pressure and	heart sound.
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Variables	$P \le 0.05$	Mean
Systolic BP		114.25±9.12
Aortic systolic heart sound	0.000	0.23 ± 0.04
Pulmonary systolic heart sound	0.000	0.23±0.04
Tricuspid systolic heart sound	0.000	0.23 ± 0.04
Mitral systolic heart sound	0.000	0.22 ± 0.03
Diastolic BP		73.02 ± 7.76
Aortic diastolic heart sound	0.000	0.45 ± 0.09
Pulmonary diastolic heart sound	0.000	0.45 ± 0.10
Tricuspid diastolic heart sound	0.000	0.44 ± 0.08
Mitral diastolic heart sound	0.000	0.44 ± 0.09
Variables	$P \le 0.05$	Mean
Systolic BP		114.25±9.12
Aortic systolic heart sound	0.000	0.23 ± 0.04
Pulmonary systolic heart sound	0.000	0.23±0.04
Tricuspid systolic heart sound	0.000	0.23 ± 0.04
Mitral systolic heart sound	0.000	0.22 ± 0.03
Diastolic BP		$73.02{\pm}7.76$
Aortic diastolic heart sound	0.000	$0.45{\pm}0.09$
Pulmonary diastolic heart sound	0.000	0.45 ± 0.10
Tricuspid diastolic heart sound	0.000	0.44 ± 0.08
Mitral diastolic heart sound	0.000	0.44 ± 0.09

Noorzaid Muhamad et al. International Journal of Pharmacy & Technology* Data is presented as mean \pm SD with P \leq 0.05.

A study done by Addis Abba University to determine the relationship between BMI and blood pressure proved that body mass index has positive association with blood pressure [9]. Other than that, exercise habit plays an important role on maintaining blood pressure. Based on an article released by the American Heart Association, physical activity can also help in sustaining blood pressure within normal range rather than to prevent weight gain [10]. Half of the respondents were physically active and 69% have normal BMI. Most of them who were physically not active have high BMI.

The most significant finding that this study proves is the direct correlation between heart sound in the aortic, pulmonary, tricuspid and mitral areas and systolic and diastolic blood pressure. Both heart sound and blood pressure were grouped into low normal, normal and high normal. Based on non-parametric chi square test, there was a statistically significant relationship between duration S1-S2 (lub-dub) heart sounds in four areas (aortic, pulmonary, tricuspid and mitral areas) with systolic blood pressure. Likewise, the chi square test also showed statistically significant relationship between the duration of S2-S1 (dub-lub) heart sounds in four areas (aortic, pulmonary, tricuspid, mitral) with diastolic blood pressure. Heart sounds are caused by the vibration of structures in heart as the pressure increases and the valves closes. Thus, heart sounds portrayed the activity of heart during cardiac cycle, the systolic and diastolic phase which are also directly related to blood pressure. This has been proved in previous study by Bombardiniet al. (2008) [11], which utilized a force sensor to collect heart sound signals and compared the relationship between S2 and blood pressure in 146 patients. The correlation coefficients (r²) between the amplitude of S2 and systolic, diastolic, and mean blood pressure were 0.544, 0.502, and 0.567, respectively which proved a medium association between S2 and heart sound. The Framingham Heart Study showed that every component of blood pressure was associated with risk for congestive heart failure especially for pulse and systolic pressure [12]. Since heart sound and blood pressure are the basic indicators for heart condition, the understanding on association between these two variables would help in better prevention and diagnoses of in heart diseases.

There was a significant difference in blood pressure between gender. This is because male usually has bigger body size compared to female and thus the heart had to pump harder to meet the demand. Chi square test was also done to investigate the relationship between BMI, smoking and exercise with blood pressure. However for exercise, the p value is more than 0.05. This means that the relationship between exercise and blood pressure is not statistically significant.

Noorzaid Muhamad et al. International Journal of Pharmacy & Technology* The possible explanation for this might be because the participants who claimed to do exercise does not perform the exercise routinely or the exercise was not intense enough to have significant effect on heart power and blood pressure.

3.1. Limitation and Ethical Issue

Various ethical issues were considered in this research. First, the data collected from the subjects were kept anonymous and confidential to respect human dignity and privacy. Second, the letter of consent was given to each subject to let them know the aim and objectives of this research and their permission to be a volunteer in this research was acquired. Lastly, the inclusion criteria and exclusion criteria ensures a rigidly controlled study and the error variance are reduced. This study is limited by the participant body built, physical activity before taking the test, subjective interpretation of researchers on heart sound, absence of digital filter device in heart sound analysis and also small sample size.

4. Conclusion

Heart sound has potential as a reliable tool for assessing blood pressure. Thus, it should be investigated as one of the alternative for measuring blood pressure in cases where the usage of mercury sphygmomanometer are limited.

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