Original Research Article

The Effect of the Harvard Step Test Exercise on Blood Pressure in Christian University Faculty of Medical Students Indonesia Batch 2021

Frisca Ronauli Batubara[1], Amasa Maichel Kambu[2], Randolph Serep Marantuan[3]

[1,2,3]Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia
[3]Regional General Hospital, Dr. Chasbullah Abdulmadjid, Bekasi, Indonesia

Corresponding Author: Frisca Ronauli Batubara

ABSTRACT

Introduction: Physical activity, defined as any physiological movement produced by skeletal muscles, results in increased energy expenditure and decreased resting blood pressure; this, in turn, helps prevent and treat hypertension. The Harvard Step Test, a heart test developed at Harvard, can help assess a student's labor capacity, cardiovascular health, and the correlation between fitness and blood pressure.

Methodology: This study aimed to measure changes in blood pressure in medical students in the class of 2021 at Indonesian Christian University after carrying out the Harvard Step Test. Researchers used a cross-sectional, qualitative, experimental design. The primary data for this research was collected by observing the class of 2021 students at the Faculty of Medicine, Indonesian Christian University.

Results: A bivariate analysis found an association between the Harvard Step Test and hypertension, with a p-value of 0.000 (0.05). Given the strong correlation between physical activity and hypertension, it is important to follow healthy habits such as regular exercise, reducing smoking and drinking, and eating right to keep hypertension under control.

Conclusion: Based on the description of the research results and discussion regarding the effect of the Harvard Step Test exercise on blood pressure in students at the Faculty of Medicine, Indonesian Christian University, class of 2021, according to the results of the analysis of the relationship between the Harvard Step Test variable and the variable Increase in blood pressure and pulse rate, it can be concluded that there is a relationship between the effect of the Harvard Step Test on increasing blood pressure and pulse rate.

Keywords: *Harvard Step Test, Physical Activity, Hypertension, Lifestyle.*

INTRODUCTION

According to the World Health Organization, moderate and vigorous physical exercise is recommended to improve health.[1] Being overweight, which can cause high blood pressure, is another risk factor for inactivity. However, regular exercise can help prevent hypertension and lower blood pressure in those with it [2].

This physical fitness can be obtained by doing physical activity. The American College of Sports Medicine defines physical fitness as carrying out routine activities without feeling too tired. A person with a high level of physical fitness is less likely to get sick and is more likely to achieve

personal and professional goals [3]. One way to measure physical fitness is the Harvard Step Test method, created by Brouha at the Harvard Sports Laboratory. Heart and lung function were evaluated using bench tests. Heart disease can be detected or diagnosed using the Harvard Step Test. This evaluation measures the subject's capacity to engage in sustained physical activity over time. The quicker a person's heart rate returns to normal after the test, the higher their fitness level [4]. The Harvard Step Test aims to assess work capacity, which measures a student's physical ability to perform a task, and blood pressure assessment, which measures the correlation between fitness and blood pressure [4]. The need for oxygen-rich blood increases in direct proportion to a person's physical activity. The heart will respond by pumping more blood to the body. People who exercise less have a greater resting heart rate, indicating that physical activity has a significant impact on blood pressure stability [5].

For endurance, try using a bench as a stepper. The bench press is a modification of the original Harvard Step Test. At the Harvard Sports Laboratory, Brouha developed the Harvard Step Test. Children and young adults, both men and women, are often tested using the Harvard Step Test. During World War II, the Harvard Step Test was initially used by the military to selecting recruits. The Harvard Step Test has received much attention for use in athletic selection since the advent of exercise physiology training. The American Alliance for Health, Physical Education, Recreation, and Dance (AAHPPRD) suggests the Harvard Step Test as a healthy starting activity to investigate heart health. The bench used in the original Harvard Step Test is higher than the modified version, and the time allowed for exercise in the original version is longer, from >15 minutes to 30 minutes, or until fatigue begins to feel. Timeframe changes are limited to 5 minutes. The Harvard Step Test can be adapted to each individual's needs and is easy to understand and administer [17].

The step up test is often used to determine the condition of a person's heart and lungs. Height and training frequency often determine the intensity of effort, with the total training load being proportional to the number of exercises performed throughout a training session. All step-up exercises can be performed safely in groups, and results can be measured by monitoring resting heart rate and blood pressure. There are a number of ways in which the Step Up Test can improve cardiorespiratory fitness [18]. This exercise can benefit a person's heart health, muscle strength, and overall fitness [19]. Due to individual differences, the height of the bench in this exercise varies. Maximum physical strength varies from person to person based on factors such as body size, fat percentage, muscle mass, bone density, blood volume, lung capacity, and many more [20]. Interval training is an effective training technique for increasing maximum heart rate and leg muscle endurance. By alternating between fast and moderate speeds when going up and down the bench, you can perform interval training [21]

Research Problem
Based on the description in the background above, the problem can be formulated as follows:
Is there a relationship between the Harvard Step Test and an increase in blood pressure and pulse rate in students at the Faculty of Medicine, Indonesian Christian University, class of 2021

Research Purposes
To find out whether there is a relationship between the Harvard Step Test and an increase in blood pressure and pulse rate in students at the Faculty of Medicine, Indonesian Christian University class of 2021.
General purpose
To determine the effect of the Harvard Step Test on improving physical fitness
Special purpose
1. To determine the effect of the Harvard Step Test on increasing Blood Pressure.

2. To determine the effect of the Harvard Step Test on increasing heart rate.

Benefits of research
For Educational Institutions
It is hoped that it will help educate clinicians about the importance of maintaining stable blood pressure and pulse rate with the Harvard Step Test exercise, and it is hoped that in the future, it can be implemented in health facilities.

For Society
This research helps provide information to the public so that it can be a means of education in maintaining and controlling the stability of blood pressure and pulse by practicing the Harvard Step Test.

Research Hypothesis
Ho: There is no relationship between the Harvard Step Test and an increase in blood pressure and pulse rate in students at the Faculty of Medicine, Indonesian Christian University class of 2021.

Ha: There is a relationship between the Harvard Step Test and an increase in blood pressure and pulse rate in students at the Faculty of Medicine, Indonesian Christian University class of 2021.

MATERIALS & METHODS
Research Design
The research design used in the study was observational with a cross-sectional approach.

Location and Time of Research
The location for research data collection was carried out at the Faculty of Medicine, Indonesian Christian University and the time required by researchers from submitting the proposal to the end of the thesis implementation was December 2022.

Population and sample
The research population used was students from the Faculty of Medicine, Indonesian Christian University class of 2021, totaling 138 students. There were 57 samples that met the inclusion criteria representing the 138 populations used in this study.

Research Criteria
Inclusion Criteria
1. FK UKI students class of 2021 who are registered as Active students
2. Age range 19 to 22 years
3. Willing to be a subject in research and follow research procedures

Exclusion Criteria
Subjects who meet the inclusion criteria must be excluded from the study if they meet any of the following exclusion criteria:
1. Have a history of sleep disorders or insomnia.
2. Consuming caffeine.

Research Variables
The variables used based on type are:
Independent Variables: The Harvard Step Test
Dependent Variables: Blood Pressure and Pulse Rate

Research Instruments
This research uses primary data as a research instrument. Primary data was obtained from direct observations of Indonesian Christian University Faculty of Medicine students class of 2021

Research Procedure
Collecting Data
Data collection is carried out using primary data from observations of students at the Faculty of Medicine, Indonesian Christian University class of 2021. Researchers will select the data according to the inclusion criteria and exclusion criteria that have been determined, so as to produce data that will be used in this research.

Data Processing Methods
Processing the collected data will use the SPSS ver.22 for Windows (Statistical Package for the Social Science) program with the following management steps:
1. Editing stage
Check the completeness of the data from the observation results that have been obtained.
2. Coding

This is done to change the data obtained by providing codes in the form of numbers to facilitate the data processing process.

3. Entry

At this stage, the data will be processed by computer.

4. Tabulation

The data has been processed, presented in graphical form, and analyzed to see whether there is a relationship between the Harvard Step Test and an increase in blood pressure.

Data Analysis

This research uses univariate and bivariate analysis. Univariate analysis will identify data sets in the form of frequencies, highest values, minimum values and maximum values of the research variables. Bivariate analysis was used to analyze the relationship between the Harvard Step Test variable and the variable increased blood pressure.

RESULT AND DISCUSSION

Research result

There is a research sample according to the inclusion criteria, namely 57 students from the class of 2021. In this case, the data has been obtained from direct research conducting the Harvard Step Test at the Faculty of Medicine, Indonesian Christian University. The research results will be described through univariate and bivariate analysis.

Univariate Analysis

Univariate analysis will identify the characteristics of the data set in the form of frequency, highest value, minimum value and maximum value of the influence of the Harvard Step Test on blood pressure based on gender and age. The results of the univariate analysis are shown in figures Table 1 to Table 7

1. Characteristics of Respondents Based on Gender

Patient characteristics based on gender can be seen in table 1 below:

Table 1. Patient Gender Data

Gender	Frequency (People)	(Percentage)
Male	29	50,9%
Female	28	49,1%
Total	57	100%

Table 1 shows the gender characteristics of respondents with a total of 57 patients. It was found that 29 respondents were male (50.9%) and 28 respondents were female (49.1%).

2. Respondent Characteristics Based on Age

In Table 2 below, data on the characteristics of respondents based on age is presented.

Table 2. Respondent Age Data

Age	Frequency (People)	Percentage (%)
18 year	7	12.3 %
19 year	33	57.9 %
20 year	14	24.6 %
21 year	3	5.3 %
Total	57	100%

Table 2 shows the age characteristics of patients; respondents were found to be 18 to 21 years old, with the most common being 19 years old, namely 33 people (57.9%), followed by 20 years old. As many as 14 people (24.6%), followed by 18-year-olds with seven people (12.3%), and the fewest found at 21-year-olds, namely one person (5.3%).

3. Blood Pressure Data

Blood Pressure Data Before Taking the Harvard Step Test

Blood pressure data before the Harvard Step Test is presented in Table 3 below:

Table 3. Blood Pressure Data Before Taking the Harvard Step Test

	Frequency	Percentage (%)
Normal	14	24.6
Pre Hypertension	29	50.9
Mild Hypertension	14	24.6
Total	**57**	**100.0**

Table 3 above shows the blood pressure before the total number of respondents was 57 patients. The frequency in normal conditions was 14 patients (24.6%), followed by prehypertension with 29 patients (50.9%) and mild hypertension with 14 patients (24.6%).

Blood Pressure After 1 Minute of Using the Harvard Step Test

Blood pressure after 1 minute of using the Harvard step test is presented in Table 4 below:

Table 4. Blood Pressure After 1 Minute of Using the Harvard Step Test

	Frequency	Percentage (%)
Normal	8	14
Pre Hypertension	23	40,4
Mild Hypertension	26	45,6
Total	**57**	**100.0**

Table 4 shows blood pressure after 1 minute with 57 patient respondents where the frequency in normal conditions was eight patients (14%), followed by pre-hypertension with 23 patients (40.4%) and mild hypertension with 26 patients (45.6%).

Blood Pressure After 5 Minutes of Using the Harvard Step Test

After 1 minute of using the Harvard step test, blood pressure is presented in Table 5 below.

Table 5. Blood Pressure After 5 Minutes of Using the Harvard Step Test

	Frequency	Percentage (%)
Normal	18	31.6
Pre Hypertension	32	56.1
Mild Hypertension	7	12.3
Total	57	100.0

Table 5 shows blood pressure after 5 minutes with 57 patient respondents. The frequency in normal conditions is as high as 18 patients (31.6%), followed by pre-hypertension in 32 patients (56.1%) and mild hypertension in 7 patients (12.3%).

4. Pulse Data

Pulse Rate Data before Carrying out the Harvard Step Test

Pulse rate data before carrying out the Harvard Step Test is presented in Table 6 below:

Table 6 shows the pulse rate before the total number of respondents was 57 patients. The frequency in a low pulse state was as many as 53 patients (93.0%), while in Normal conditions, there were four patients (7%).

Table 6. Pulse Rate Data Before Carrying Out The Harvard Step Test

	Frequency	Percentage (%)
Low	53	93.0
Normal	4	7.0
Total	**57**	**100.0**

Pulse Rate Data After Carrying Out the Harvard Step Test

Pulse rate data after carrying out the Harvard Step Test is presented in Table 7 below:

Table 7. Pulse Rate Data After Carrying Out the Harvard Step Test

	Frequency	Percentage (%)
Low	38	66.7
Normal	19	33.3
Total	57	100.0

Table 7 shows the pulse rate after 57 patient respondents. The frequency in low pulse conditions was 38 patients (66.7%), while in normal conditions it was 19 patients (33.3%).

5. Body Mass Index

Body Mass Index Data is presented in Table 8 below:

Table 8. Body Mass Index

	Frequency	Percentage (%)
Tin	6	10.5
Normal	45	78.9
Fat	6	10.5
Total	57	100.0

Table 8 shows the body mass index of 57 patient respondents categorized as thin, normal or fat. Patients with a thin BMI were six patients (10.5%), and 45 patients were normal (78.9%). Meanwhile, the frequency of obese patients was six patients (10.5%),

6. Bivariate Analysis

Bivariate analysis is used to analyze the relationship between variables Harvard Step Test with variable Increase in blood pressure.

Table 9. Results of Bivariate Analysis of Blood Pressure After 1 Minute

		IKJ_PFI			
		Lack of Ability	Ability Currently	Ability Good	Total
Blood Pressure After 1 Minutes	Normal	5	3	0	8
	Pre Hypertension	7	15	1	23
	Mild Hypertension	2	11	13	26
Total		14	29	14	57

Table 10. Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.251[a]	4	.000
Likelihood Ratio	24.278	4	.000
Linear-by-Linear Association	18.082	1	.000
N of Valid Cases	57		

Based on the output table above, the Asymp value is known. Sig. The Pearson chi-square test is 0.000. Because the value of Asymp. Sig. $0.000 < 0.05$, then based based on decision-making above, it can be concluded that H0 is rejected and Ha is accepted. Thus, it can be interpreted that "There is a relationship between blood pressure after 1 minute and IKJ.

7. DISCUSSION

The Harvard Step Test assessment table shows more or less ability categories than the moderate and good ability categories. The inability to do anything is caused by several factors, such as poor body condition (due to lack of nutrition or food intake), lack of rest, and lack of regular exercise. In addition, the test takers were not in the correct posture position, or they did not warm up enough before the test. It is hoped that those with medium and good abilities who live a healthy lifestyle and exercise regularly and in a balanced manner will be able to achieve the goals of their performance abilities by carrying out tasks continuously over a long period. Students who perform poorly in their experiments may be influenced by factors outside their control, such as being assigned a large amount of work and not being given enough time to warm up before starting. Moreover, Harvard's rise and fall occurred at a rate lower than the theoretical maximum.

The Harvard step test is a standard technique for determining a person's physical fitness level by having him or her rise and fall repeatedly for 5 minutes on a bench that is 47 centimeters high for men and 40 centimeters high for women. metronome beats. How long and how hard you exercise determines your fitness level category. Additionally, the Harvard step test is a cardiac stress test used to identify heart conditions. If the heart can return to normal as soon as possible, the body's condition will be better [35]

Sugianto & Nurhayati Having high cardiovascular endurance indicates a high level of physical fitness. This cardiovascular toughness allows a person to carry out their routine for long periods without feeling tired [36] Increased strength of the heart's cardiovascular muscles causes this condition by allowing the heart to pump more blood more efficiently to all body parts [36]

Heart rate is a useful indication of cardiorespiratory fitness. When blood leaves the heart, it flows through the arteries and creates waves that can be felt as a pulse. Contraction of the heart's left ventricle causes the blood in the arteries to vibrate, allowing us to detect a pulse. Most people feel the top of their thumb on their wrist to check their pulse [37]

At rest, a healthy adult's heart rate is between 60 and 100 beats per minute; however, in physically active people, resting heart rate may be as low as 50 to 60 beats per minute. A decrease in resting heart rate is an indicator of healthy cardiovascular fitness and optimal heart function [38]. A person's heart rate can

change depending on how active they are. Gender, age, smoking history, current weight, and physical activity level are just some of the variables that may influence heart rate. A lower heart rate or pulse rate is a sign of fitness compared to unhealthy people.

In this study, from the results of the Harvard Step Test on blood pressure in students of the class of 2021, Faculty of Medicine, Indonesian Christian University, based on the gender of the sample obtained, which showed gender characteristics in respondents with a total of 57 patients, it was found that 29 respondents were male (50, 9%) and 28 female respondents (49.1%).

Apart from gender, the next characteristic, namely age in the class of 2021, the students of the Faculty of Medicine, Class of 2021 who were sampled, showed that the age characteristics of the patients found by respondents were 18 to 21 years, with the most common being 19 years old, namely 33 people (57.9%), followed by 20 year olds with 14 people (24.6%), followed by 18 year olds with 7 people (12.3%), and the fewest were found at the age of 21 years, namely 1 person (5.3%). Then for the blood pressure of respondents before and after carrying out the Harvard Step Test for both 1 minute and 5 minutes, namely blood pressure after 1 minute with a total of 57 patient respondents. Where the frequency in normal conditions was 8 patients (14%), followed by pre hypertension with 23 patients (40.4%), and mild hypertension with 26 patients (45.6%). Blood pressure after 5 minutes with a total of 57 patient respondents. Where the frequency in normal conditions was 18 patients (31.6%), followed by pre hypertension with 32 patients (56.1%), and mild hypertension with 7 patients (12.3%). Apart from blood pressure, pulse rate is also differentiated when carrying out the Harvard Step Test, namely the pulse rate before and after carrying out the Harvard Step Test for 1 minute to see whether there is a change or not in the respondent's pulse rate. Pulse before with a total of 57 patient respondents. Where the frequency in low pulse conditions is 53

patients (93.0%), while in normal conditions it is 4 patients (7%) and pulse after with a total of 57 patients responding. Where the frequency in low pulse conditions was 38 patients (66.7%), while in normal conditions it was 19 patients (33.3%). Questionnaires were also distributed to respondents before carrying out the Harvard Step Test to fill in their weight and height, so they could find out their Body Mass Index. (BMI) of respondents, body mass index with 57 patients categorized as thin, normal or fat. Where patients with a thin BMI were 6 patients (10.5%), 45 patients were normal (78.9%). Meanwhile, the frequency of obese patients was 6 patients (10.5%).

Bivariate analysis was used to analyze the relationship between the Harvard Step Test variable and the variables increased blood pressure and pulse rate. Using the Pearson chi square test is 0.000. Because the value of Asymp. Sig. $0.000 < 0.05$, then based on the basis of decision making above, it can be concluded that H0 is rejected and Ha is accepted. Thus it can be interpreted that "There is a relationship between blood pressure after 1 minute and IKJ.

CONCLUSION

Based on the description of the research results and discussion regarding the effect of the Harvard Step Test exercise on blood pressure in students at the Faculty of Medicine, Indonesian Christian University, class of 2021, according to the results of the analysis of the relationship between the Harvard Step Test variable and the variable Increase in blood pressure and pulse rate, it can be concluded that there is a relationship between the effect of the Harvard Step Test on increasing blood pressure and pulse rate.

Conflict of Interest: The authors declare no conflict of interest.

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