

Correlation between Cardiorespiratory Fitness and Blood Pressure in Elderly

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ABSTRACT

Background: Due to its strong association with major morbidity and mortality in the elderly, such as heart attack, stroke, kidney disease, and death, hypertension is currently one of the health problems associated with non-communicable diseases. It is certainly influenced by various variables, one of which is one's cardiorespiratory fitness which can affect blood pressure. The study aims to find out if there is a correlation between cardiorespiratory fitness and blood pressure in the elderly.

Subjects and Method: The cross-sectional study was conducted in Pepe Village, Kwarasan, Juwiring, Klaten, Central Java. A sample of 31 elderly people was selected by using purposive sampling. The dependent variable was blood pressure. The independent variable was cardiorespiratory fitness. Cardiorespiratory fitness was measured by the Six Minute Walking Test (SMWT). Blood pressure was measured with a sphygmomanometer. The correlation between cardiorespiratory fitness and blood pressure was tested using Pearson correlation and Spearman rho with a 95% confidence interval and $p < 0.050$ statistical meaningfulness.

Results: Cardiorespiratory fitness lowered systolic blood pressure by 0.14 mmHg ($r = -0.14$; $p = 0.442$) and diastolic blood pressure by 0.55 mmHg ($r = -0.55$; $p = 0.771$), but both were statistically insignificant.

Conclusion: There was no relationship between blood pressure and physical fitness in the elderly.

Keywords: hypertension, blood pressure, cardiorespiratory fitness, six-minute walking test, elderly.

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BACKGROUND

The level of prosperity and health of a nation will increase as a result of technological advances discovered in the current millennium, including various medical inventions and advanced technologies. It leads to increased life expectancy, and the number of elderly in the country will also

increase. All humans must experience the aging process due to reduced organ function, ranging from muscles, and blood vessels, to internal organs (Tanisawa et al., 2017). In addition to chronological age, other factors should also be considered to determine whether a patient is elderly (Sieber, 2007).

According to Law Number 13 of 1998, a person is said to be elderly if he is 60 (sixty) years old or older. The elderly population is still growing along with medical advances. It is characterized by a longer life expectancy and a lower mortality rate. The number of elderly in Indonesia has increased by about two times in the last nearly 50 years (1971-2020), reaching 9.92 percent (26 million), with about one percent more female elderly than male elderly (10.43 percent versus 9.42 percent) (Badan Pusat Statistik, 2020).

Degenerative diseases make life expectancy decrease as well as increase the risk of various types of medical problems in the elderly. This affects the body's capacity to perform other activities using maximum energy, so it is referred to as physical fitness (Palar et al., 2015). Likewise, a study by Rockwood & Howlett (2011) states there are anatomical changes in the heart and blood vessels in the elderly as they age. The walls of the blood arteries undergo structural and functional changes along with decreased blood vessel elasticity, which will cause arterial stiffness, then affect blood pressure both systolic and diastolic. While diastolic blood pressure rises to the age of 50 years and above and then decreases, systolic blood pressure increases with age. The body's ability to function as it should decrease with age, leading to an increased risk of degenerative diseases in the elderly.

Kansagara et al., (2016), elaborates on the management of blood pressure in the elderly, since blood pressure is one of the risk factors for cardiovascular diseases, stroke, and kidney disease, and can cause death in the elderly. The effects of blood pressure management are very real. According to various studies, Rehman and Nelson, (2022) managing blood pressure can give advantages in lowering the risk of heart attacks and strokes and improving

the quality of life of the elderly. In addition, if not managed properly, blood pressure impact badly, such as being the second most preventable cause of death in the United States or hypertension which is the leading cause of death in the world. A timely and accurate diagnosis of hypertension is essential as this can be avoided or reduced through appropriate treatment (Rehman and Nelson, 2022) The inability of the elderly to carry out activities due to time, space, and opportunity constraints aggravates this condition (Barkley et al., 2020).

Therefore, it is particularly important to make efforts to maintain and develop physical fitness as an important component in the effort to improve the standard of living of the elderly. Sports are good exercise for the elderly (Listyasari, 2019). Types of sports, such as gymnastics and walking are cheap and simple to maintain their health and are also beneficial for the elderly (Listyasari, 2019). Exercise and walking are two exercise methods intended to improve cardiorespiratory fitness.

In line with a study (Hauer et al., 2011) that cardiovascular disease in physically healthy persons can be prevented by maintaining high levels of exercise. It will ultimately improve physical health and give a person freedom from physical constraints. Furthermore, it is supported by a study (Nes et al., 2011) that shows why cardiovascular fitness is the most important element of physical fitness. Cardiovascular fitness is also a key indicator of overall health as it lowers risk factors for chronic disease and mortality. Excellent cardiorespiratory fitness can also improve the body's ability to control stress and improve quality of life (Gerber et al., 2013).

A study by Kokkinos, (2014) reports that there is a significantly decreased blood pressure in elderly individuals with stage 1

and 2 hypertension. Evidence also suggests that the blood pressure response during exercise or physical activity can modulate the structure of the left ventricle for the better. Moderate-intensity exercise can improve cardiovascular function and health, help with daily functional tasks, and improve brain processes, among other health benefits for the elderly or geriatrics (Kardi et al, 2020).

As a result of the large number of elements that affect the quality of life of the elderly, this study aims to: (1) discover if there is a relationship between cardiorespiratory fitness and blood pressure.

Almost a third of all deaths worldwide are caused by cardiovascular diseases. To reduce cardiovascular events, it is factually important to improve exercise capacity and cardiorespiratory fitness. According to the American Heart Association, the fourth risk factor for coronary artery disease is decreased physical activity. (Al-Mallah et al., 2018) talks about how cardiorespiratory fitness has predictive significance in various demographics of patients and cardiovascular disorders. Higher cardiorespiratory fitness is associated with longer life spans, lower rates of cardiovascular disease, and fewer comorbidity conditions such as atrial fibrillation, hypertension, diabetes, and diabetes mellitus, thus helping to lower cardiovascular morbidity and mortality.

The study aims to identify the correlation between cardiorespiratory fitness and blood pressure in the elderly.

SUBJECTS AND METHOD

1. Study Design

It was an analytical observational study with cross-sectional study design that was conducted in Dukuh Pepe, Kwarasan Village, Juwiring Sub-District, Central Java.

2. Population and Sample

The target population in this study was a total of 50 elderly. The sampling technique used was purposive sampling. The cross-sectional was used to determine the study sample and obtained 31 respondents who met the inclusion criteria. The exclusion criteria were elderly with uncontrolled high blood pressure (systolic pressure >140 mmHg or diastolic pressure >90 mmHg), having a fever or receiving medical treatment, bed rest, and having a condition of kidney failure, heart failure, or dementia.

3. Study Variables

The dependent variable was blood pressure. The independent variable was cardiorespiratory fitness.

4. Operational definition of variables

Cardiorespiratory fitness is a condition of the ability of the circulatory system to supply oxygen during physical activity. The 6-minute walking test (6MWT) is a commonly used test for the objective assessment of exercise capacity function for the management of patients with moderate to severe pulmonary disease.

Blood pressure is a vital sign that guides acute and long-term clinical decision-making. There are 4 classifications of blood pressure, namely normal blood pressure, high blood pressure, stage 1 hypertension, and stage 2 hypertension.

5. Study Instruments

Cardiorespiratory fitness was measured on a Vo₂Max scale in units of ml/Kg/min. Physical fitness was measured using the Six Minute Walking Test and the measurement results are in the unit of beats/min. Blood pressure was measured using an aneroid sphygmomanometer. The other data were collected using questionnaires.

6. Data analysis

The sample characteristics of continuous data were described in the values of frequency (n), mean, standard deviation (SD),

minimum, and maximum. The sample characteristics of categorical data were described in frequency (n) and percent (%). The correlation between cardiorespiratory fitness and blood pressure was tested with Pearson correlation and Spearman rho with a 95% confidence interval and a statistical significance of $p < 0.050$.

7. Research Ethics

The study obtained ethical clearance from the Health Research Ethics Committee (KEPK) of the Faculty of Medicine of Universitas Muhammadiyah Surakarta No. 4537/B.2/KEPK-FKUMS/X/2022, on 15 October 2022.

RESULTS

1. Sample Characteristics

Table 1 shows the average weight of the elderly was 54 kg (Mean= 54.77; SD= 11.35) and the average height was 154 cm (Mean= 154.9; SD= 8.54). The average random blood sugar level was 136 mg/dL (Mean= 136.03; SD=119), uric acid was 7 mg/dL (Mean= 7.06; SD=3.08), 6 MWT score was 172 beats (Mean= 172.66; SD= 23.45), and SpO₂ level was 97% (Mean= 97.38; SD= 1.72). The average systolic blood pressure was 125 mmHg (Mean= 125.16; SD= 15.88) with the highest blood pressure was 160 mmHg and the lowest was 90 mmHg. Average diastolic blood pressure was 92

mmHg (Mean= 91.29; SD= 12.31) with the highest blood pressure was 120 mmHg and the lowest was 60 mmHg. The average cardiorespiratory fitness score in the elderly was 32.57 (Mean=32.57; SD=4.49).

More than two-thirds of the sample were female (71%), 41.9% worked as laborers, and 25.8% were farmers. Two-thirds of the samples had a normal category of body mass index (61.3%). Meanwhile, 9.7% of the elderly were included as overweight, 16.1% as obese, and 12.9% as underweight (Table 2).

2. Bivariate Analysis

Table 3 shows the correlation between cardiorespiratory fitness and systolic blood pressure in the elderly. Cardiorespiratory fitness was negatively correlated to systolic blood pressure. An increase of 1 unit of cardiorespiratory fitness score lowered systolic blood pressure by 0.14 mmHg, however, it was statistically insignificant ($r = -0.14$; $p = 0.442$).

Table 4 shows the correlation between cardiorespiratory fitness and diastolic blood pressure in the elderly. Cardiorespiratory fitness was negatively correlated to diastolic blood pressure. An increase of 1 unit of cardiorespiratory fitness score lowered diastolic blood pressure by 0.55 mmHg, however, it was statistically insignificant ($r = -0.55$; $p = 0.771$).

Table 1. Sample characteristics (continous data)

Variables	Mean	SD	Min.	Max.
Age (years)	58.45	6.33	50	76
Weight (Kg)	54.77	11.35	39	87.2
Height (cm)	154.96	8.54	136.0	170.0
Random blood glucose (mg/dL)	136.03	48.24	83.0	237.0
Uric Acid (mg/dL)	7.06	3.08	3.70	17.30
Body Mass Index (kg BW/m ²)	22.93	22.00	15.00	36.0
Six-Minute Walking Test (beats/minute)	172.66	23.45	102	216.5
SpO ₂ (%)	97.38	1.72	92.0	99.0
Systolic blood pressure (mmHg)	125.16	15.88	90.00	160.00
Diastolic blood pressure (mmHg)	91.29	12.31	60.00	120.00
Cardiorespiratory fitness	32.57	4.49	22.27	45.63

Table 2. Sample characteristics (categorical data)

Characteristics	Category	Frequency	Percentage
Sex	Female	22	71.0%
	Male	9	29.0%
Occupation	Laborer	13	41.9%
	Farmer	8	25.8%
	Housewife	4	12.9%
	Civil servant	2	6.5%
	Merchant	2	6.5%
	Unemployed	2	6.5%
Body mass index	Underweight	4	12.9%
	Normal	19	61.3%
	Overweight	3	9.7 %
	Obese	5	16.1%

Table 3. Correlation of cardiorespiratory fitness on systolic blood pressure in the elderly

Independent Variable	r	p
Cardiorespiratory fitness score	-0.14	0.442

Table 4. Correlation of cardiorespiratory fitness on diastolic blood pressure in the elderly

Independent Variable	r	p
Cardiorespiratory fitness score	-0.55	0.771

DISCUSSION

Researchers discovered no correlation between cardiorespiratory fitness and blood pressure. It is also explained in the study (Guerra et al., 2002) that cardiorespiratory fitness is not an important correlation of blood pressure variations across age groups and genders. Cardiorespiratory fitness is not the only thing that can lower blood pressure, this opinion is reinforced by (He et al., 2020) who state there is another thing that can support the decrease in blood pressure, which is the skeletal muscle mass index that can affect the correlation between cardiorespiratory fitness (oxygen pulse, VO₂Max, and MET max) and the prevalence of coronary artery disease in the elderly. Other factors that can affect cardiorespiratory fitness, such as cardiorespiratory provide benefits to the quality of life of obese respondents, although these benefits

are largely influenced by differences in age, sex, and BMI. Improved good physical quality of life is associated with high cardiorespiratory fitness. (Kolotkin et al., 2011) there was an increase in diastolic blood pressure after the implementation of a combined exercise between the Six Minute Walking Test and a 12-week exercise program in the form of strength, endurance, and balance in elderly individuals (McKune et al., 2017).

Two patterns can be identified in the study (Gil-Extremera et al., 2012) namely (a) increased systolic and diastolic blood pressure, and (b) systolic hypertension. There is a clinical picture of the disease as well as the pathophysiological profile of hypertension in the elderly population. It supports the findings of a study by Emmaus (2011) and Shaikh (2011), that discovered a trait correlation between blood pressure

and cardiorespiratory fitness. According to a study (Buford, 2016) along with age, the incidence of hypertension, which becomes a relatively common disease, is one example of several important mechanisms that have an impact on the development of elderly blood pressure or Vascular Health. As it is adduced by (Heckman and McKelvie, 2008) the lack of physical activity is a major risk factor for epidemics of chronic diseases and disabilities that the elderly endures. Many age-related changes in cardiovascular function result from physical activity. The benefits of regular exercise include the prevention of cardiovascular events, disability, and cognitive impairment. Age is not a contraindication to exercise, which usually can be safely started in the elderly. On the other hand, according to (Hernawan et al., 2017) in his study that there is an effect of cardiorespiratory fitness in the form of the implementation of hypertension gymnastics on the blood pressure of the elderly.

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CONFLICT OF INTEREST

The authors state that the study was conducted in the absence of commercial or financial relationships that could be construed as a potential conflict of interest.

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