# Relationship between Anthropometric Status and Cardiopulmonary Endurance and Balance in the Elderly

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**Abstract.** Elderly is the final stage of development that humans will go through. Increasing age during the elderly will bring various compensations in terms of decreased function and increased prevalence of degenerative diseases in the elderly. Efforts that can be made to prevent a decline in function and an increase in the prevalence of degenerative diseases in the elderly are to maintain physical activity. Physical activity can also prevent metabolic syndrome. Increasing age is accompanied by changes in body composition which include an increase in fat mass, a decrease in fat-free mass and a decrease in bone mass. Anthropometrics is a method for measuring people's nutritional status. Apart from measuring nutritional status, anthropometry can also be used to screen for obesity. Several anthropometric indices include Body Mass Index (BMI), weight for age, height for age, weight for height, upper arm circumference, thickness of subcutaneous fat according to age and Waist to Hip Ratio. In this study, physical fitness was measured using a physical fitness measurement instrument specifically for the elderly, cardiopulmonary endurance was measured using the 2-minute step test instrument and balance with the 8-foot up and go test. The instruments used to collect anthropometric status data are scales to measure body weight, stadiometers to measure height, BMI, Waist circumference and hip circumference were measured using a measuring tape. The results of the study showed that there was no correlation between anthropometric status and physical fitness, especially cardiopulmonary endurance, and balance in the elderly.

**Keywords:** Anthropometrics, Cardiopulmonary Endurance, Balance, Elderly.

## 1 Introduction

Elderly is the final stage of development in human life. Every person who can reach old age will experience various changes. Increasing age in the elderly will bring various compensations in terms of decreased function and physical changes. Physical changes that occur in the elderly include wrinkled skin, hair falling out and turning white, muscle volume shrinking, heart size decreasing so that blood pumping power decreases, atherosclerosis, osteoporosis and also a decrease in the level of flexibility.


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There is an increase in the prevalence of degenerative diseases in the elderly. Hypertension is a form of degenerative disease that often occurs in the elderly. Hypertension is known as a silent killer because it is an important cardiovascular factor in the elderly. Hypertension in the elderly is at risk of causing stroke,

Increasing age is accompanied by changes in body composition which include an increase in fat mass, a decrease in fat-free mass and a decrease in bone mass. Epidemiologically, changes in body composition, especially an increase in the proportion and distribution of body fat, will cause an increase in central fat accumulation in the abdomen, resulting in abdominal obesity or central obesity [2]. The simplest and most frequently used method in screening to determine central obesity is anthropometric examination of waist circumference which is clinically considered practical and valid [3].

Anthropometrics is a method for measuring people's nutritional status. Apart from measuring nutritional status, anthropometry can also be used to screen for obesity. Several anthropometric indices include Body Mass Index (BMI), weight for age, height for age, weight for height, upper arm circumference, subcutaneous fat thickness for age and Waist to Hip Ratio (RLPP) [4]. Body Mass Index (BMI) is the most recommended measurement for evaluating obesity and overweight in children and adults. This is because apart from being easy and cheap, BMI level is related to body fat and risk factors for type II DM [5]. Apart from BMI, anthropometric measurements that can be used to screen for obesity are RLPP [6].

Central obesity is an important risk factor for cardiovascular disease, such as hypertension and coronary heart disease, kidney disease, metabolic syndrome, and inflammatory responses where obesity has a strong relationship with hypertension [7]. Several studies have used anthropometric indicators in assessing central obesity. Anthropometrics is an indicator that has long been and is often used in determining nutritional status. Anthropometric indices can be used to detect central obesity, one of which is measuring the Waist-Hip Circumference Ratio. Anthropometric index is an easy, fast, cheap, non-invasive, and quite accurate measurement in predicting body visceral fat which is closely correlated with metabolic syndrome [8].

Anthropometric measurements of central obesity are generally carried out to predict metabolic disorders. Various studies report that anthropometric indicators of central obesity such as waist-to-hip ratio and waist circumference are associated with metabolic syndrome, but several studies show inconsistent results. The existence of a strong correlation between anthropometric measurements and metabolic disorders in a person is also influenced by a person's metabolism, such as age, gender, race, ethnicity, religion, genetics, etc. Anthropometric measurements using both BMI and RLPP can be used as initial screening for elderly people who are able to carry out physical activity easily so that physical fitness can be maintained well.

## 2 Method

Contains the type of research, targets, research subjects, procedures, data and instruments, and data collection techniques, as well as data analysis techniques and other matters relating to the research method. This can be written under the sub-headings:

### 2.1 Study Design

This research is analytical observational research carried out using a cross sectional approach, namely a type of research that emphasizes the time of measurement or observation of data one time at a time which is carried out on the dependent and independent variables. Analytical observational research is carried out by conducting observations, without any treatment from the researcher.

### 2.2 Research Participants

Samples were taken using a consecutive sampling technique, with ages ≥ 50 years and those willing to take part in a series of physical fitness measurement and test activities in the research. This type of research is correlation. The group of elderly people involved in this research was the Association of Retirees of Yogyakarta State University (UNY), totaling 38 people.

### 2.3 Data Collection and Instrumentation

In this study, physical fitness was measured using a physical fitness measurement instrument specifically for the elderly, cardiopulmonary endurance was measured using the 2-minute step test instrument and balance with the 8-foot up and go test. The instruments used to collect anthropometric status data were scales to measure body weight, stadiometers to measure height, BMI, waist circumference and hip circumference were measured using a measuring tape.

The classification of body mass index in this study uses an instrument created by the Ministry of Health of the Republic of Indonesia with classification levels divided into severe thinness, mild thinness, normal, mild obesity, severe obesity.

**Table 1.** National BMI classification [10].

| Classification | | BMI |
|---|---|---|
| Thin | Heavy | <17.0 |
| | Light | 17.0 – 18.4 |
| Normal | | 18.5 – 25.0 |
| Overweight | Light | 25.1 – 27.0 |
| | Heavy | >27 |

Classification of the waist-to-hip circumference ratio is based on the WHO cut-off point for Asian populations, namely a waist-to-hip ratio value of >0.95 for men and >0.80 for women indicating abdominal obesity.

One way to measure balance for the elderly is to use the 8-Foot Up and Go test. This test is carried out by getting up from a sitting position, walking 8 feet (2.44 m), turning around, and returning to a sitting position, then the time (seconds) is recorded.

The table below is the normal score range for the 8-Foot Up and Go test for men and women, seniors who score above this range will be considered above average and those below the range as below average (below average).

**Table 2.** Normal norm 8-Foot Up and Go [11]

| Age | Gender | |
|---|---|---|
| | Man | Woman |
| 60-64 | 5.6 - 3.8 | 6.0 - 4.4 |
| 65-69 | 5.7 - 4.3 | 6.4 - 4.8 |
| 70-74 | 6.0 - 4.2 | 7.1 - 4.9 |
| 75-79 | 7.2 - 4.6 | 7.4 - 5.2 |
| 80-84 | 7.6 - 5.2 | 8.7 - 5.7 |
| 85-89 | 8.9 - 5.3 | 9.6 - 6.2 |
| 90-94 | 10.0 - 6.2 | 11.5 - 7.3 |

(Jones & Ricli, 2002)

The table below is the normal score range for the 2 – Minute Step Test for men and women. Elderly people who score above this range will be considered above average and those below the range as below average. -average (below average).

**Table 3.** Normal norm 2 – minutes Step Test [11]

| Age | Gender | |
|---|---|---|
| | Man | Woman |
| 60-64 | 87 - 115 | 75 - 107 |
| 65-69 | 86 - 116 | 73 - 107 |
| 70-74 | 80 - 110 | 68 - 101 |
| 75-79 | 73 - 109 | 68 - 100 |
| 80-84 | 71 - 103 | 60 - 91 |
| 85-89 | 59 - 91 | 55 - 85 |
| 90-94 | 52 - 86 | 44 - 72 |

### 2.4 Statistical Analysis

Statistical tests in this study used normality tests and correlation tests. Data processing uses Statistical Program for Social Science (SPSS) software. The Normality Test uses normal distribution analysis, the Kolmogorov-Smirnov Test and the Correlation Test uses the Pearson correlation test.

## 3 Results

This research involved 38 elderly samples consisting of 23 men and 15 women. The ages in this study ranged from seniors aged 60 to 74 years. All elderly people in this

study had anthropometric measurements and physical fitness tests. Anthropometric measurements include height, weight, body mass index, waist circumference, hip circumference and waist-to-hip ratio.

Descriptive analysis of research variables includes minimum value, maximum value, mean, number and standard variation.

**Table 4.** Descriptive analysis of research subjects based on gender.

| Gender | Amount |
|---|---|
| Man | 23 |
| Woman | 15 |

**Table 5.** Descriptive analysis of research subject variables

| Variable | N | Min | Max | Sum | Mean | Elementary school | Variance |
|---|---|---|---|---|---|---|---|
| Age (years) | 38 | 60 | 74 | 2491 | 65.55 | 5,593 | 31,281 |
| Waist circumference (cm) | 38 | 73 | 106 | 3443 | 90.61 | 9,264 | 85,813 |
| Hip circumference (cm) | 38 | 80 | 115 | 3741 | 98.45 | 8,258 | 68,200 |
| Waist to hip circumference ratio | 38 | .81 | 1.12 | 34.97 | .9203 | .06424 | ,004 |
| Height (cm) | 38 | 144.0 | 171.0 | 5986.5 | 157,539 | 6.8016 | 46,262 |
| Body weight (kg) | 38 | 41.8 | 92.5 | 2383.7 | 62,729 | 12.0663 | 145,595 |
| body mass index | 38 | 18.2 | 34.4 | 954.6 | 25,121 | 3.7474 | 14,043 |
| 2 – minutes Step Test(reps) | 38 | 35 | 99 | 3074 | 80.89 | 11,923 | 142.151 |
| 8-Foot Up and Go Test(second) | 38 | 2.70 | 15.54 | 319.44 | 8.4063 | 2.69421 | 7,259 |
| Valid N (listwise) | 38 | | | | | | |

Descriptive data on elderly people based on the body mass index of elderly people who took part in a series of physical fitness and measurement tests can be seen in the table 6.

**Table 6.** Descriptive elderly data based on national BMI.

| Classification | | Gender | | Amount |
|---|---|---|---|---|
| | | Man | Woman | |
| Thin | Heavy | 0 | 0 | 0 |
| | Light | 0 | 1 | 1 |
| Normal | | 10 | 8 | 18 |
| Overweight | Light | 5 | 3 | 8 |
| | Heavy | 8 | 3 | 11 |

The results of the balance test using the 8-Foot Up and Go test instrument showed that 3 elderly people were in the category Above average, 3 elderly people have the average category and 32 elderly people have the balance category Below average.

**Table 7.** 8-Foot Up and Go Results

| Category | Gender | | Amount |
|---|---|---|---|
| | Man | Woman | |
| Above average | 1 | 2 | 3 |
| Average | 2 | 1 | 3 |
| Below average | 20 | 12 | 32 |

The results of the cardiopulmonary endurance test using the 2 – minutes Step Test instrument, showed that 17 elderly people were in the average category and the remaining 21 elderly people were in the below average category.

**Table 8.** Results 2 – minutes Step Test

| Category | Gender | | Amount |
|---|---|---|---|
| | Man | Woman | |
| Above average | | | 0 |
| Average | 7 | 10 | 17 |
| Below average | 16 | 5 | 21 |

Of the 38 elderly people involved in the research, 23 elderly people were categorized as obese based on the waist-to-hip circumference ratio.

**Table 9.** Waist-hip ratio category

| Waist-hip ratio hip circumference category | Gender | | Amount |
|---|---|---|---|
| | Man | Woman | |
| Obesity | 8 | 15 | 23 |
| Not Obese | 15 | 0 | 15 |

The results of the normality test using SPSS show that all variables have a normal distribution as indicated by a significance value > 0.05.

**Table 10.** Normality test results within groups

| | Kolmogorov-Smirnova | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| Variable | Statistics | df | Sig. | Statistics | df | Sig. |
| Waist to hip circumference ratio | .114 | 38 | ,200* | ,948 | 38 | ,077 |
| body mass index | ,086 | 38 | ,200* | ,979 | 38 | ,680 |
| 2 – minutes Step Test | .123 | 38 | ,158 | ,891 | 38 | .131 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8-Foot Up and Go | .144 | 38 | ,046 | ,957 | 38 | ,155 |

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The correlation test results show a significance value of more than 0.05 for all variables tested. This shows that there is no relationship between the variables tested.

**Table 11.** Pearson correlation test results

| | | 2 – minutes Step Test | 8-Foot Up and Go |
|---|---|---|---|
| Waist to hip circumference ratio | Pearson Correlation | -.214 | ,185 |
| | Sig. (2-tailed) | ,197 | ,267 |
| | N | 38 | 38 |
| body mass index | Pearson Correlation | -.058 | -.126 |
| | Sig. (2-tailed) | ,729 | ,453 |
| | N | 38 | 38 |

## 4 Discussions

The results of the study showed that there was no relationship between anthropometric status and physical fitness, especially cardiopulmonary endurance and balance. Physical fitness is an individual's ability to meet ordinary needs and unusual demands in daily life effectively without feeling too tired and still having energy left for leisure and recreational activities [12].

Cardiorespiratory endurance, cardiorespiratory fitness, or aerobic capacity is determined by the maximum amount of oxygen that the human body can utilize (oxygen uptake) per minute of physical activity (VO2max). This value can be expressed in liters per minute (L/min) or milliliters per kilogram per minute (mL/kg/min). Relative values in mL/kg/min are most often used because total body mass (weight) is expressed in kilograms. Cardiorespiratory endurance measurement for the elderly uses the 2-minute Step Test.

Balance is the ability to maintain equilibrium while moving [13]. So body balance is very necessary for a person to maintain a position, whether still or moving. Balance is related to the attitude of maintaining a state of balance (equilibrium) when still or moving. One way to measure balance for the elderly is to use the 8-Foot Up and Go test. This test is carried out by getting up from a sitting position, walking 8 feet (2.44 m), turning around, and returning to a sitting position, then the time (seconds) is recorded.

Physical activity such as exercise has great benefits because it can improve the elements of physical fitness, namely the heart and respiratory system, joint flexibility and muscle strength. Exercise can reduce the incidence and severity of heart and blood vessel disease, obesity, DM, hypertension, several joint, muscle and bone disorders, and also stress.

Exercise is said to reduce blood pressure in hypertension, increase stroke volume (the amount of blood ejected by the heart in one beat), increase red blood cell production, reduce LDL and increase HDL and speed up recovery after physical activity. Physical activity recommended for the elderly is aerobic exercise, flexibility training, muscle strength and balance training. The World Health Organization has recommended a minimum of 150 minutes of physical activity every week at moderate intensity to achieve health for the elderly [14] .

## 5 Conclusion

The results of the study showed that there was no relationship between anthropometric status and physical fitness, especially cardiopulmonary endurance and balance. However, many studies show that it is important for the elderly to maintain their anthropometric status and physical fitness.

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