Correlation between Body Mass Index and Waist to Hip Ratio with Flexibility in Elderly

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Abstract. The purpose of this study was to determine the relationship between body mass index (BMI) and waist-to-hip ratio with the flexibility of the elderly. This study involved 50 elderly consisting of 11 elderly men and 39 elderly women spread from the age of 46 years to 69 years. BMI is the ratio of body weight in kilograms to height in meters squared. Waist to Hip Ratio is one of the anthropometric measurements commonly used to determine the distribution of body fat. Waist to Hip Ratio was obtained from waist circumference (cm) divided by hip circumference (cm). Measurement of flexibility in the elderly was carried out using the chair sit and reach instrument. The results showed that the normality test with the one sample Kolmogorov Smirnov test showed that all variables had a significance value ($p>0.05$), BMI = 0.200, waist to hip ratio = 0.200 and chair sit and reach = 0.200. The Pearson correlation test was used to test the correlation between research variables which showed a significance value ($p>0.05$) on the relationship between BMI and flexibility ($p=0.098$) and waist to hip ratio with flexibility (0.603), so that the variables studied did not have a relationship. However, in this study, it can be seen that body mass index has a relationship with waist circumference, hip circumference and waist-to-hip ratio. Theoretically, flexibility is strongly influenced by the mobility and level of training of a person, including the elderly. Although the results of the study showed that there was no significant relationship between body mass index and waist-to-hip ratio with elderly flexibility, maintaining BMI in normal conditions and waist to hip ratio in conditions that were not obese was able to maintain the health of the elderly to avoid degenerative diseases and metabolic syndrome. Maintaining flexibility for the elderly is also important to support the mobility of the elderly.

Keywords: BMI • Waist to hip ratio • Flexibility • Elderly

1 Introduction

Elderly is the final stage of development in human life. Everyone who is able to reach this 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 loss and turning white, muscle volume shrinks, heart size decreases so that blood pumping power decreases, atherosclerosis, osteoporosis and also decreased flexibility.

Flexibility refers to the range of motion achieved at a joint group without causing injury [1]. Good body flexibility can make it easier for a person to carry out various daily activities and reduce the possibility of injury or pain in certain areas of the body such as the back. Insufficient flexibility of daily activities will be more difficult to do. Body flexibility can be trained from the age of children to adults, and with increasing age, the level of flexibility of a person's body will decrease. This flexibility can be trained by doing certain stretching movements on a regular basis. With regular practice, it will make the joint space become wider.

Physical limitations that occur in the elderly cause the elderly to refuse and tend to limit activities, even though physical activity is one of the efforts to improve the quality of life of the elderly [2]. Lack of knowledge is also the cause of the elderly tend not to actively participate in gymnastics [3]. In the elderly there are many setbacks, including elements of physical abilities, such as flexibility or flexibility. The limited range of motion of the joints will limit flexibility or flexibility resulting in limited functional activity. Entering the elderly will experience a physical decline, physical decline will result in a decrease in muscle mass and flexibility [4].

Bones, joints and muscles are interconnected. If the joint cannot be moved according to its Range of Motion (ROM), then the joint movement becomes limited. Adequate ROM in all parts of the body is very important to maintain musculoskeletal function, balance and agility in the elderly. Flexibility is a very important component for every human being to be able to reach maximum joint motion. For the elderly, flexibility is a very important component for making an exercise program. If a joint is not used, the muscles that cross the joint shorten and reduce ROM. Flexibility exercises can increase the strength of tendons and ligaments, maintain muscle strength across joints, reduce pain in cases of osteoarthritis so that ROM can be maintained.

Waist circumference was measured to determine the presence or absence of abdominal/central obesity. This type of obesity is very influential on the incidence of cardiovascular disease and diabetes mellitus, which recently is also closely related to the incidence of metabolic syndrome. Obesity is defined as excess fat content in adipose tissue. The limit for obesity is generally more than

20% of normal weight. According to the World Health Organization (WHO), obesity is an excessive or abnormal accumulation of fat tissue that can cause health problems. Central obesity is a state of excess adipose tissue that collects in the abdominal area (intra-abdominal fat), can be determined through abdominal circumference measurements with positive results for men more than 90 cm and women more than 80 cm.

Determination of central obesity is done by measuring the circumference of the abdomen using a measuring tape that does not stretch. The measurement is taken midway between the palpable rib margin and the top of the iliac crest. The sample was examined in a standing position with the hands by the side and the legs closed to each other. The sample was asked to relax before the measurement and take a deep breath, breathe normally before the measurement was taken and was measured during the normal expiratory phase. The results of the collection of abdominal circumference were then grouped into two groups of central obesity abdominal circumference (≥90 cm) and normal abdominal circumference (< 90 cm).

Hip circumference is an indicator to determine abdominal obesity obtained through the measurement of the length of the circumference measured at the maximum circumference of the buttocks and at the top of the symphysis pubis. Waist to Hip Ratio is one of the anthropometric measurements commonly used to determine the distribution of body fat. Waist to hip ratio is obtained from waist circumference (cm) divided by hip circumference (cm) [5]. In contrast to BMI which is used to determine obesity in general, waist to hip ratio is used to measure central/abdominal obesity where visceral fat tissue is stored. Clinical evidence suggests that there is a stronger relationship between central obesity and decreased glucose tolerance,

Waist to Hip Ratio is the ratio obtained from

$$\text{Waist to hip ratio} = \frac{\text{waist circumference (cm)}}{\text{hip circumference (cm)}}$$

Measurements are made with a measuring tape in cm. Waist circumference was measured in an upright position with the clothes removed, measured between the crista iliaca and rib XII. Measurement of hip circumference was carried out in an upright standing position with the clothes removed, measured at the top of the symphysis pubis and the maximum part of the buttocks [5]; [7]. Read the results to an accuracy of 0.1 cm. Measurements were repeated twice and then averaged. The classification of patients based on the WHO cut-of-point Waist to hip ratio for Asian populations, namely Waist to hip ratio values >0.95 for males and >0.80 for females indicates abdominal obesity [8].

Waist circumference was measured using a measuring tape. Measured in an upright and calm standing position. Dress or measuring barrier removed, Place the measuring tape on the top edge of the crista iliaca dextra. The measuring tape is looped around the abdominal wall between the crista iliaca and rib XII. Make

sure that the tape measure is not pressing the skin too tightly and parallel to the floor. Measurements were taken at the end of a normal expiration. Read the results at an accuracy of 0.1 cm [9].

Measurement of hip circumference has the same procedure as measuring waist circumference, only differs in the anthropometric point measured. In measuring the hip circumference, the tape measure is wrapped around the top of the symphysis pubis and the maximum part of the gluteus. Make sure that the tape measure is not pressing the skin too tightly and parallel to the floor. Read the measurement results at an accuracy of 0.1 cm.

2 Materials and Methods

2.1 Participants

This study involved 50 elderly consisting of 11 elderly men and 39 elderly women spread from the age of 46 years to 69 years.

2.2 Experimental Procedures

BMI is the ratio of body weight in kilograms to height in meters squared. Waist to Hip Ratio is one of the anthropometric measurements commonly used to determine the distribution of body fat. Waist to hip ratio is obtained from waist circumference (cm) divided by hip circumference (cm). Measurement of flexibility in the elderly was carried out using the chair sit and reach instrument.

2.3 Statistical Analysis

Analysis of the data used in this study using the Pearson correlation test by applying the Statistical Program for Social Science SPSS software. The variable has a correlation if the significance value shows the number $p < 0.05$. Before being tested using the correlation test, a normality test was performed using the One-Sample Kolmogorov-Smirnov Test. The variable has a normal category if it is indicated by a significance value of $p > 0.05$. In this study also presented descriptive analysis to determine the minimum value, maximum value, mean and standard deviation of each variable studied.

3 Results

3.1 General Characteristics

This study involved 50 elderly consisting of 11 elderly men and 39 elderly women. The mean age of the research subjects was 58.80 ± 7.24, the mean BMI

was 24.17 ± 3.21, the mean waist-to-hip ratio was 0.89 ± 0.06 and the mean flexibility was 17.33 ± 7.56.

Table 1. Descriptive Analysis of Research Subjects

Variables	Minimum	Maximum	mean	Std. Deviation
Age (years)	46	69	58.80	7,248
BMI (kg/m2)	16.21	29.05	24.1778	3.21988
Waist(cm)	63.0	105.0	85,840	9.2303
Hips (cm)	84.0	107.0	96,400	6.3019
Waist to hip ratio	.72	1.03	.8900	.06691
Flexibility (cm)	2.00	30.00	17.3300	7.56914

BMI, body mass index.

3.2 Normality Test

The normality test in this study used the One-Sample Kolmogorov-Smirnov Test. The results of the normality test showed that all variables had a significance value (p>0.05), BMI = 0.200, Waist to hip ratio = 0.200 and chair sit and reach = 0.200.

Table 2. Normality Test

		BMI	waist	hip	Waist to hip ratio	flexibility
Normal Parameters	mean	24.1778	85,840	96,400	.8900	17.3300
	Std. Deviation	3.21988	9.2303	6.3019	.06691	7.56914
Most Extreme Differences	Absolute	.094	.084	.086	.100	.104
	Positive	.094	.081	.060	.064	.104
	negative	-.070	-.084	-.086	-.100	-.098
Test Statistics		.094	.084	.086	.100	.104
asymp. Sig. (2-tailed)		.200	.200	.200	.200	.200

3.3 Correlation Test

The person correlation test was used to test the correlation between research variables which showed a significance value (p>0.05) on the relationship between BMI and flexibility (p=0.098) and Waist to hip ratio with flexibility (0.603), so that the variables studied did not have a relationship. The person correlation test was used to test the correlation between research variables which showed a significance value (p>0.05) on the relationship between BMI and flexibility (p=0.098) and Waist to hip ratio with flexibility (0.603), so that the variables studied did not have a relationship.

Table 3. Pearson Correlation Test

		BMI	waist	hip	Waist to hip ratio	flexibility
BMI	Pearson Correlation	1	.725	.820	.341	-.237
	Sig. (2-tailed)		.000	.000	.015	.098
	N	50	50	50	50	50
waist	Pearson Correlation	.725	1	.738	.810	-.009
	Sig. (2-tailed)	.000		.000	.000	.949
	N	50	50	50	50	50
hip	Pearson Correlation	.820	.738	1	.206	-.126
	Sig. (2-tailed)	.000	.000		.152	.381
	N	50	50	50	50	50
Waist to hip ratio	Pearson Correlation	.341	.810	.206	1	.075
	Sig. (2-tailed)	.015	.000	.152		.603
	N	50	50	50	50	50
flexibility	Pearson Correlation	-.237	-.009	-.126	.075	1
	Sig. (2-tailed)	.098	.949	.381	.603	
	N	50	50	50	50	50

4 Discussion

This study aims to determine the relationship between body mass index and waist-to-hip ratio with flexibility in the elderly. The results showed that the body mass index and waist-to-hip ratio. has no relationship with flexibility in the elderly. These results are in line with research conducted by Akmal, MF et al., (2022) which aims to determine the relationship between body mass index and the ability of postural balance and flexibility in the body mass index category, namely ideal weight, overweight and obesity in school adolescents [10]. The study design used a cross-sectional study conducted on 30 school adolescents including 16 boys and 14 girls aged 12-17 years. Y-balance test is used to test postural balance and YMCA's sit-and-reach test for flexibility. The results of the postural balance test for adolescents in the obese category with an average of 84.46 (cm) were significantly different from the ideal weight category with an average of 92.28 and overweight with an average of 91.68 in the right anterior reach (P= 0.031). , but no difference was found between ideal weight with an average of 45.8 and overweight with an average of 45.5. Flexibility test scores for obese adolescents with an average of 31.9 (cm) also showed a significant difference with the ideal weight and overweight categories (P = 0.001). No correlation was generated between BMI, postural balance, and flexibility. The results of this study imply that an increase in BMI can reduce the ability to

balance in the anterior direction but not in the other direction. Increasing BMI can also reduce flexibility capabilities.

Another study conducted by Mahoney, G & Susilo, TE (2022) with the title The Relationship Between Body Mass Index and Lumbar Flexibility in Middle School Children in the Adaptation Era to New Post-Covid-19 Habits, the results showed that from a total sample of 206 the average was at Normal BMI category (21.47 ± 3.93) but has very poor lumbar flexibility (7.70 ± 5.44) [11]. Descriptive analysis data showed that on average the respondents had a normal BMI (21.48 ± 3.94) and had very poor lumbar flexibility (7.70 ± 5.45) for both men and women. The normality test showed that the two variables were not normally distributed ($p < 0.009$, $p < 0.002$), so a non-parametric test was carried out using the Spearman correlation test. The correlation test that has been carried out shows that body mass index and lumbar flexibility are not correlated ($p = 0.069$) and have a very weak positive relationship ($r = 0.127$). These results are in line with Arora's research in 2016 which stated that there was no relationship between BMI and Flexibility [12]. Where in the study with the subject used of 300 children and adolescents with an age range of 10 to 19 years from various schools and universities in India stated that confounding factors such as decreased physical activity may have a detrimental effect on lumbar/hamstring flexibility regardless of status. individual BMI. However, the growth in weight and height seen during the adolescent phase plays only a minor role in determining individual flexibility [12].

Although the results of some of the studies above state that there is no correlation between Body mass index with flexibility does not mean that one of the components of physical fitness is not important because flexibility is still needed in daily activities and is useful in preventing injuries during activities, especially in reaching movements, wearing clothes, or when lifting heavy objects [13].

5 Conclusion

The results showed that body mass index and waist-to-hip ratio had no relationship with flexibility in the elderly. Although the results of the study showed that there was no significant relationship between body mass index and waist-to-hip ratio with elderly flexibility, maintaining BMI in normal conditions and Waist to hip ratio in conditions that were not obese was able to maintain the health of the elderly to avoid degenerative diseases and metabolic syndrome. Maintaining flexibility for the elderly is also important to support the mobility of the elderly.

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