KnE Medicine

ICMEDH
The International Conference of Medicine and Health (ICMEDH)
Volume 2022

Knowledge E
enriching | engaging | empowering

Conference Paper

Analysis of Body Composition Factors That Affect Trunk Muscle Mass in Late Adolescence

Anung Putri Illahika*, Risma Karlina Prabawati, Wiby Fahmi Wijaya, Nurul Choviyah Syaifudin, Aulia Choirunnisa

Medical Education, Medical Faculty, Muhammadiyah Malang University, Street. Sutami Dam No. 188, Malang, 65145, Indonesia

ORCID
Anung Putri Illahika: https://orcid.org/0000-0002-4385-8619

Abstract.
Adolescent nutritional status can be assessed by body mass index (BMI). BMI is related to muscle mass. It is associated with the overall body composition such as muscle mass, bone mass, and fat mass, and is packaged in a formula involving weight (BW) and height. Body composition can be different for each individual. The development of muscle mass is usually followed by an increase in muscle strength in adolescents. This study aimed to determine the body composition factors that affect trunk muscle mass in late adolescent males and females. This was an analytical observational study with a cross-sectional approach involving 50 male and female respondents, respectively, who were students at Muhammadiyah Malang University, selected using purposive sampling. The data recorded were height, BW, BMI and trunk muscle mass. The data obtained were analyzed using bivariate analysis through the Pearson correlation test (BW) and ANOVA (BMI), while multivariate analysis was conducted with linear regression. A significant correlation was found between BW and trunk muscle mass in the late adolescent males ($p < 0.05$, correlation coefficient = 0.939) and females ($p < 0.05$, correlation coefficient = 0.698). The findings also showed that for late adolescent males, the coefficient score for BW and BMI was 0.920, while for the late adolescent females it was 0.499. Weight and BMI had a correlation with muscle mass with a contribution of 92% in the males and 49% in the females.

Keywords: muscle mass, body height, body weight, adolescent, late adolescent

Corresponding Author: Anung Putri Illahika; email: putri@umm.ac.id

Published 15 September 2022

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICMEDH Conference Committee.

1. Introduction

Major risk factor of **a** more severe presentation and risk of covid 19 death is obesity, where obesity is a measurement of body composition. Body composition, includes body fat mass may change and differ from person to person. Body composition consists of four main components, namely total body fat tissue (total body fat), fat-free tissue (fat-free mass), bone minerals (bone minerals), and body fluids (body water). The two most commonly measured components of body composition are total body fat tissue and fat-free tissue [1].

In humans, skeletal muscle mass, fiber count, fiber size, and muscle strength vary widely. Individuals aged 18-29 years have muscle mass is 34 ± 6% (in women) and 42 ± 4% (in men) of the total body mass.[2] Adult men have greater muscle mass and stronger bones, while women tend to have a greater fat distribution [3].

Muscle is the main organ that plays a role in glucose metabolism.[4] Muscle mass has emerged as the most promising body composition parameter associated with health risks in aging and many chronic diseases. Based on the cut off population of Taiwan, muscle mass is said to be low if <8.87 kg/m∧2 in men and <6.42 kg/m∧2 in women. In Indonesia there is no cut off for diagnosing sarcopenia, so the Taiwan cut off is used because it has anthropometric characteristics and life expectancy that resembles the elderly population in Indonesia [5]. In body composition measurements, muscle mass is divided into extremity muscle mass and trunk muscle mass.

The muscle growth spurt is 3-6 months behind the weight growth spurt. Muscle is one of the constituent components of the human body that makes up the largest group of tissues and makes up about half of the body's weight. BW in men is made up of about 40% of skeletal muscle and about 32% in women. There are many factors that correlation the addition of muscle mass in each individual, one of which is the food factor. By consuming foods that contain high protein and reducing consumption of foods that contain high fat will greatly affect the development of muscle mass of a person. The second factor is the age factor, where age greatly affects the development of a person's muscle mass.

The development of muscle mass is followed by an increase in muscle strength. Muscle strength is present from birth to adulthood and increases especially at the age of 20 to 40 years and generally decreases with increasing age. Muscle strength in young men is almost the same as in young women until near puberty. After that men will experience a significant increase in muscle strength compared to women, and the greatest difference occurs during middle age (21 to 40 years). This increase in strength is associated with an increase in muscle mass after puberty. The mass ratio growth between women and men is the same up to 16 years old, it is reinforced by the results of that the age factor affected muscle mass and strength .[6]

2. METHOD

This research used quantitative with an analytical observational design and a cross sectional approach. There awere two groups in this study, namely the group of men and women. This research will be carried out at the Physiology Laboratory of UMM

Medical Faculty. The population in this study were male and female students at the Medical Faculty, Muhammadiyah Malang University. The sample in this study were male and female adolescents at the Medical Faculty, Muhammadiyah Malang University who met the inclusion criteria. The sampling technique used purposive sampling, which is a type of non-probability sampling.

The inclusion criteria in this study were as follows:

1. Teenagers aged 17-20 years
2. Male and female gender

The exclusion criteria in this study were as follows:

1. Join the body building program
2. Take amino acid supplements
3. Testosterone deficiency in men identified from a hormonal questionnaire.

Respondents experienced a decrease in hormones if there was a 'Yes' answer to questions number 1 or 7 or other than numbers 1 and 7 but more than 3 answers.

The independent variable (independent variable) in this study was gender and percent of body fat while the dependent variable (dependent variable) in this study was the distribution of body fat.

The instruments in this research were

1. Bioelectrical Impedance Analysis (BIA) Tanita Body Composition Analyzer BC-418.
2. Informed Consent Sheet
3. Interview sheet
4. Anthropoemetric measurement sheet to record measurement results on research subjects.

This research used univariate analysis, bivariate and multivariate analysis. Univariate analysis was carried out with the aim of describing each research variable.

Univariate analysis in this study was about the characteristics of the respondents including the number of each gender, muscle mass, BW and BMI.

Bivariate analysis in this study purposed to:

1. To find the correlation between BW and muscle mass, it will show a correlation if the significance value was <0.005.

2. To find the correlation between BMI and muscle mass, it will show a correlation if the significance value was <0.005

3. The multivariate analysis in this study was to determine the most dominant factor, so a multivariate analysis was carried out, that was linear regression analysis.

3. RESULT

3.1. Univariate Analysis

Univariate analysis in this study used descriptive statistics in the form of frequency distribution on age and BMI data, while data on BW and Trunk muscle mass were presented in the minimum, maximum and mean (average) values.

Table 1: Descriptive Statistics Of Respondents Characteristics.

		Young men (n=50)	**Young women (n=50)**
Age, f (%)	17-18 years old	20 (40%)	28 (56%)
	19-20 years old	30 (60%)	22 (44%)
Body Weight, mean ± sd		68.48 ± 14.48	53.75 ± 8.65
BMI, f(%)	Underweight	6 (12%)	6 (12%)
	Normal	27 (54%)	35 (70%)
	Overweight	11 (22%)	8 (16%)
	Obese	6 (12%)	1 (2%)
Trunk muscle mass, mean ± sd		28.47 ± 3.08	16.90 ± 1.63

Based on the information in the table above, it was known that the majority of male students were 19-20 years old (60%), while the majority of female students were 17-18 years old (56%) with BMI of both groups of respondents being normal. The Trunk muscle mass of male students was 28.47 while the female was 16.90.

3.2. Bivariate Analysis

Bivariate analysis in this study aims to determine the correlation between age, weight, BMI and Trunk muscle mass. The tests were independent t test on the correlation between age and Trunk muscle mass in late adolescent, ANOVA test on the correlation between BMI and Trunk muscle mass in late adolescent and Pearson's correlation on the correlation between BW and trunk muscle mass in late adolescent. Normality test

was used on numerical data, that were BW and Trunk muscle mass with abnormal weight data results ($p < 0.05$).

3.2.1. Correlation between BW and Trunk muscle mass

Analysis of the correlation between BW and trunk muscle mass using Pearson correlation (one of the normal data) with the following results:

Table 2: Correlation between BW and Trunk muscle mass.

Adolescents	Variables	P Value	Correlation coefficient (r)	Information
Male	Body Weight and Trunk muscle mass	0.000	0.939	Had Correlation + significant
Female		0.000	0.698	Had Correlation + significant

The results of the Pearson correlation test between BW and Trunk muscle mass of late adolescent young men at the Medical Faculty, Muhammadiyah Malang University, obtained a sig value of 0.000 (sig < 0.05) and a correlation coefficient = 0.939 which can be concluded that there was a significant positive correlation between BW and Trunk muscle mass. In other words, the higher the BW, the higher the late adolescent young men Trunk muscle mass at the Medical Faculty of Muhammadiyah Malang University. The strength of the correlation was very strong.

In late adolescent young women at the Medical Faculty, Muhammadiyah Malang University, the value of sig 0.000 (sig < 0.05) with a correlation coefficient = 0.698 could be concluded that there was a significant positive correlation between BW and Trunk muscle mass. In other words, the higher BW, the higher Trunk muscle mass of late adolescent young women at the Medical Faculty, Muhammadiyah Malang University. The strength of the correlation was strong.

3.2.2. Correlation between BMI and Trunk muscle mass

The correlation between BMI and Trunk muscle mass was analyzed by using ANOVA test with homogeneous data results (p value > 0.05) for both male and female adolescents.

The results showed that in late adolescent young men at the Medical Faculty, Muhammadiyah Malang University, the average Trunk muscle mass was obtained with an increasing trend with high BMI. The p-value obtained is 0.000 (p <0.05) which indicates

Table 3: Correlation of Age and Trunk muscle mass.

	BMI	**Trunk muscle mass**	P Value
Male	Underweight	24.80 ± 1.55	0.000
	Normal	27.34 ± 2.25	
	Overweight	31.40 ± 1.52	
	Obese	31.88 ± 1.97	
Female	Underweight	14.72 ± 0.74	0.000
	Normal	16.78 ± 1.29	
	Overweight	18.96 ± 1.05	
	Obese	18.00 ± -	

that there is a correlation between BMI and the Trunk muscle mass of adolescent young men at the Medical Faculty, Muhammadiyah Malang University.

In late adolescent young women at the Medical Faculty, Muhammadiyah Malang University, the average Trunk muscle mass was also obtained with an increasing trend with high BMI. However, in the obese group, only 1 respondent obtained so that at the time of ANOVA test, she was not compared with other BMI groups. The p value was obtained 0.000 ($p < 0.05$) which indicates that there was a correlation between BMI and the Trunk muscle mass of adolescent young women at the Medical Faculty, Muhammadiyah Malang University. Then, a Bonferroni post hoc test was conducted to see which BMI categories were different.

Table 4: Post Hoc Test.

Adolescent		BMI	P Vslue
Male	Underweight	Normal	0.046
		Overweight	0.000
		Obese	0.000
	Normal	Overweight	0.000
		Obese	0.000
	Overweight	Obese	0.000
Female	Underweight	Normal	0.001
		Overweight	0.000
	Normal	Overweight	0.000

The results of the post hoc test showed that in late adolescent young men at the Medical Faculty, Muhammadiyah Malang University, each BMI resulted a significant difference in Trunk muscle mass, as well as in late adolescent young women ($p < 0.05$).

3.3. Multivariate Analysis

Based on the results of the bivariate test, it is known that BW and BMI are significantly related to muscle mass in late adolescent at the Medical Faculty, Muhammadiyah Malang University. A multivariate analysis was carried out, that was linear regression analysis to find out the most dominant factor. The results obtained were as follows

Table 5: Results of Adolescent Young men Multivariate Analysis.

Adolescent	Variabel	B	T count	Sig
Male	Constanta	12.427		
	Body Weight	0.290	15.150	0.000
	BMI	-1.629	-5.071	0.000
F count = 284.277				
Sig F = 0.000				
Adjusted R square = 0.920				

The results of linear regression analysis obtained the following equation below:

Y = 12,427 + 0.290 BW – 1,629 BMI

From these equations it was known that: The weight regression coefficient was 0.290 with a sig test value of t = 0.000 which means that there was an effect of BW on the Trunk muscle mass in late adolescent young men at the Medical Faculty, Muhammadiyah Malang University. The positive regression coefficient shows that the higher the BW, the higher the Trunk muscle mass of late adolescent young men.

The BMI regression coefficient is -1.629 with a sig test value of t = 0.000 which means that there was an effect of BMI on the Trunk muscle mass in late adolescent young men at the Medical Faculty, Muhammadiyah Malang University. The negative regression coefficient shows that the higher the BMI, the lower the Trunk muscle mass of late adolescent young men.

The magnitude of the coefficient of determination was 0.920 which indicated BW and BMI had a contribution to the Trunk muscle mass of 92%.

Table 6: Results of Adolescent Young women Multivariate Analysis.

adolescent	Variables	B	T count	Sig
female	constanta	10.466		
	Body weight	0.089	2.887	0.006
	IMT	0.786	1.763	0.084

F count = 25,374

Sig F = 0.000

Adjusted R square = 0.499

The results of linear regression analysis obtained the following equation:.

Y = 10,466 + 0.089 BW + 0.786 BMI

From these equations it was known that:

The weight regression coefficient is 0.089 with a sig test value of t = 0.006, which means that there was a correlation of BW on Trunk muscle mass in late adolescent young women at the Medical Faculty, Muhammadiyah Malang University. The positive regression coefficient showed that the higher the BW, the higher the Trunk muscle mass of late adolescent young women.

The BMI regression coefficient was 0.786 with a sig test value of t = 0.084, which means that there is no significant effect between BMI on Trunk muscle mass in late adolescent young women at the Medical Faculty, Muhammadiyah Malang University.

The magnitude of the coefficient of determination was 0.499 which indicated BW and BMI had a contribution to the Trunk muscle mass in the number of 49.9%.

4. DISCUSSION

Body composition is composed of fat mass (fat mass) and non-fat mass (free fat mass). Body composition such as fat, muscle, body fluids, skeleton may change. BW will increase because energy from food will be stored as fat reserves (Storage Fat). Decrease in physical work activity occurs simultaneously with the accumulation of fat reserves (Storage Fat) which will affect body composition [5].

Body composition, including body fat mass, may change and differ from person to person. Body composition consists of four main components, namely total body fat tissue (total body fat), fat-free tissue (fat-free mass), bone minerals (bone minerals), and body fluids (body water). The two most commonly measured components of body composition are total body fat tissue and fat-free tissue[7].

The results showed that there was no difference between the Trunk muscle mass in samples aged 17-20 years, but there was a difference between male and female sexes, where male muscle mass was 59.36% greater than female. This is in accordance with the literature review which states that the ratio of growth period between women and men up to 16 years was the same. After puberty, men's muscle mass is 50% greater, so the overall body mass ratio is greater. The increase in muscle mass after puberty affects muscle strength. Men have greater muscle strength than women. This difference was due to the fact that in men there is an increase in the secretion of the hormone

testosterone. The same conclusion was also obtained from the results of the study by Wijaya, 2018 which stated that there were differences in the distribution of muscle mass between men and women.

In this study, it was also found that the higher the BW, the higher the Trunk muscle mass of late adolescent young men and young women at the Medical Faculty, Muhammadiyah Malang University. The theory that supports this is that body composition consists of body fat mass and non-fat body mass. Non-fat body mass consists of muscle, bone, organs and fluids. About 40% of BW is skeletal muscle, while the other 5-10% is smooth muscle and cardiac muscle [6]. The above statement shows that changes in trunk or skeletal muscle mass will also change the weight of individuals, both men and women.

Another result of this study showed that in late adolescent young men and young women at the Medical Faculty, Muhammadiyah Malang University, the average Trunk muscle mass was obtained with an increasing trend with high BMI. The existence of a positive correlation between BMI and muscle mass shows that the greater the BMI value of the elderly, the greater the muscle mass, and vice versa. This is related to the fact that both BMI and muscle mass both represent body composition. BMI is an assessment of overall body composition such as muscle, bone, and fat, meaning that in the component of the BMI assessment there is also muscle, so that if the BMI increases or decreases, it was likely to be followed by a decrease or increase in muscle mass in the elderly. The results of that study were also obtained in this study which used adolescents as the sample. BMI measurement involves weight and height, with a formula that is often used, it can be understood that the greater the weight with the same height, the greater the BMI. If changes in Trunk muscle mass affect changes in BW, it will also indirectly affect changes in BMI.

The correlation between BW and BMI makes the authors continue to analyze the data in this study, namely to see how strong the correlation between BW and BMI is with Trunk muscle mass. The results of the multivariate test showed that in late adolescent young men BW and BMI contributed 92% to the Trunk muscle mass, while in young women the contribution was 49.9%. The theory stated that there was a small difference in body composition between young women and young men before puberty, but at puberty the difference becomes very large where young women have more fat deposits, while in young men more muscle tissue is formed[7].

There are differences between male and female anatomical structures, both morphologically and histologically. These differences begin to become apparent at the end of adolescence. The difference is in the muscle structure, where the muscle in men

contains less fat so that the muscle ability in men has the potential to have greater strength than women. The proportion of fat to muscle in women is 18:35, so that muscle strength is less and anatomically women are 7-10% smaller than men, while in men the proportion of fat to muscle in men is 18:42 so that maximal muscle strength and anatomy of men are 7-10% larger than women. This is in accordance with the results of previous research, that associated with age, there is an increase in total fat tissue only in women, while a significant increase in Percent Body Fat (PBF) in both sexes[8]. FFM, and specifically muscle mass in men, is generally considered to decrease throughout adult life seemed mainly due to limited ability to carry out routine daily activities. Our findings confirmed an earlier Aerobics Center Longitudinal Study (ACLS) in healthy men that showed an age-dependent decrease in FFM and an increase in PBF. On the other hand, accumulation fat mass appears to worsen functional disability and physical performance in older adults.[8]

5. CONCLUSION

1. BW and BMI had a strong correlation to muscle mass in late adolescent young men and young women.
2. The mean Trunk muscle mass of male students was 28.47
3. The mean Trunk muscle mass of female students was 16.90.

BW and BMI had a contribution to the Trunk muscle mass of late adolescent as much as 92% in young men, while in women the contribution was 49.9%.

References

[1] Gomez J, Silva AM, Mialich MS, Faccioli Sicchieri JM, Afonso A, Junior J, et al. 1-10 analysis of body composition: a critical review of the use of bioelectrical impedance analysis. International Journal of Clinical Nutrition [Internet]. 2014;2(1):1–10. Available from: http://pubs.sciepub.com/ijcn/2/1/1

[2] Verbrugge SA, Schönfelder M, Becker L, Nezhad FY, de Angelis MH, Wackerhage H. Genes whose gain or loss-of-function increases skeletal muscle mass in mice: A systematic literature review. Frontiers in Physiology. Frontiers Media S.A.; 2018.

[3] Brener A, Waksman Y, Rosenfeld T, Levy S, Peleg I, Raviv A, et al. The heritability of body composition. BMC Pediatr. 2021 May;21(1):225.

[4] Jung S, Park J, Seo YG. Relationship between arm-to-leg and limbs-to-trunk body composition ratio and cardiovascular disease risk factors. Sci Rep. 2021 Aug;11(1):17414.

[5] Dewi Suhada P, Widyastuti N, Candra A, Syauqy A. Korelasi Aktivitas Fisik dan Persen Lemak Tubuh dengan Indikator Sarkopenia Correlation Physical Activity and Body Fat Percentage with The Indicators of Sarkopenia. 2021;15–22.

[6] Goldspink G. Age-related loss of muscle mass and strength. Knight J, editor. Journal of Aging Research [Internet]. 2012;2012:158279. Available from: https://doi.org/10.1155/2012/158279.

[7] Spano MA, Kruskall LJ, Thomas DT. Nutrition for sport, exercise, and health. Spano Sports Nutrition Consulting, LLC.

[8] He X, Li Z, Tang X, Zhang L, Wang L, He Y, et al. Age- and sex-related differences in body composition in healthy subjects aged 18 to 82 years. Medicine (United States). 2018 Jun 1;97(25).