

# The Relationship between Triceps Skinfold Thickness and Age at Menarche of Adolescent Girls in Surakarta Junior High School

Soebhita Hema Kumala\*, Septin Widiretnani , Annang Giri Moelyo

Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

Correspondence: soebhitahema@student.uns.ac.id

## ABSTRACT

**Introduction:** Triceps skinfold thickness is one of the anthropometric measurements that can indicate the nutritional status of overweight and obesity. Girls with obesity have 2.42 times the possibility of experiencing early menarche than girls with normal nutritional status. So it is estimated that the thicker triceps skinfold thickness, the earlier age at menarche in girls, but this opinion raises pros and cons through several studies, therefore the researcher wants to see the relationship between the two variables.

**Methods:** This research is a cross-sectional observational analytic study with a purposive sampling method. All samples were asked to read the informed consent form and fill out a questionnaire regarding the age at menarche and measurements were made on the triceps skinfold thickness in the upper arm area using a skinfold caliper. Then the variables were analyzed univariate and bivariate using the Spearman test.

**Results:** Based on the results of the Spearman correlation test between triceps skinfold thickness and age at menarche, it can be seen that the age at menarche has a significant relationship with triceps skinfold thickness as seen from  $p < 0.05$  ( $p = 0.012$ ). From the correlation test, it was found that there was a negative correlation between the sample's age at menarche and triceps skinfold thickness ( $r = -0.188$ ).

**Conclusion:** There is a significant relationship between the age at menarche and triceps skinfold thickness in girls (age 11-16).

**Keywords:** *age at menarche; adolescent girl; triceps skinfold thickness*

## INTRODUCTION

Menarche is the onset of the menstruation cycle in all girls. The average age for a female to experience menarche was 12.4 years old, and it can occur too early or too late<sup>1</sup>. Each girl experiences menarche at different ages depending on race, genetics, environment, and nutritional status. Nutritional status is closely related to the incidence of menarche, where nutrient consumption can affect hormone production. Data shown by Indonesia's Basic Health Research 2018 showed that 16% of adolescents aged 13-15 years and 13.59% of

adolescents aged 16-18 years were overweight and obese<sup>2</sup>.

A study in Indonesia stated that there was a downtrend in the age at menarche, where females born in 1955 experienced menarche at the age of 14.14 years. And those who were born in the 1990s got menarche at the age of 13.54 years, this downward trend is associated with changes in the past and present nutritional intake<sup>3</sup>. The results showed that urban communities have an earlier age at menarche (18%)<sup>4</sup>. This is due to the nutrition consumed by girls in urban areas, which is dominated by junk food, meat, and other fatty foods. According to Sulayfiyah and

Mukhoirotin, girls with obesity have 2.42 times the chance to get menarche early<sup>5</sup>.

Assessment of nutritional status itself can be done by measuring the Triceps Skinfold Thickness (TSF), this measurement is used to determine the state of overweight and obesity, by looking at the thickness of subcutaneous fat<sup>6</sup>. According to Eaton-Evans, measurement triceps skinfold thickness is often used as an indicator in women and children<sup>7</sup>.

In a study by Bratke et al, in adolescent girls aged 8-15 years in Norway, there was a correlation between TSF and age at menarche, where low TSF values were associated with late menarche, and high values of TSF correlates with early menarche<sup>8</sup>. However, according to Leitão et al., TSF doesn't have a significant correlation with the age at menarche<sup>9</sup>.

There are pros and cons regarding the relationship between TSF and the age at menarche in adolescent girls. Through out this study researchers want to see the correlation between triceps skinfold thickness and the age at menarche of adolescent girls in Surakarta Junior High School. We hypothesized the sooner menarche, the thicker triceps skinfold.

## METHODS

This research is a cross-sectional study. The study included girls aged 11 to 16 years from Junior High School 8 Surakarta, who had experienced menarche, and was willing to take part in this study by signing the informed consent, parents consented, and were present. In this research we exclude girls who have not experienced menarche; have chronic diseases such as cancer, autoimmune, metabolic disease (type 1 diabetes), kidney disease, and other diseases with symptoms of edema in the upper arm (triceps folds); have a history of undergoing treatment for chronic diseases such as chemotherapy or exposure to radiation; a physical disability resulting in an

inability to bend the arm; and recently did vigorous physical exercise, sitting in the sauna, swimming, showering after strenuous exercise, and soaking in warm water before taking measurements.

This research used a total study sample with purposive sampling of students from Junior High School 8 Surakarta. Where the measurement of the independent variable is triceps skinfold thickness and the dependent variable is the age at menarche.

Triceps skinfold thickness was measured by the researcher at the midpoint of non-dominant upper arm (between acromial process and olecranon) with the arm extended freely and the measurements were taken without being covered. The skinfold is clamped with a finger about 1 cm, then measured with a Slim Guide skinfold caliper with an accuracy of 0.5 mm. The measurements were repeated three times and the average was used for analysis. TSF analysis uses a ratio scale and is expressed in millimeters. The variable age at menarche expressed in years was analyzed using a ratio scale, data collection was carried out using a questionnaire on the age at menarche, which was filled out by the respondent.

The data obtained were analyzed univariate and bivariate using a non-parametric Spearman Rho test for data with the abnormal distribution. Our independent and dependent variables analyzed their relationship with confounding variables such as; gynecological age, maternal age at menarche, parental income using questionnaires, and physical activity data collection using PAQ-C ( $\leq 12$  years) and PAQ-A ( $> 12$  years). Data analysis was performed using SPSS 25.0 for Windows. This research has been approved by the Ethics Committee of Moewardi Hospital Surakarta with ethics number 268/II/HREC/2022.

## RESULTS

### Characteristics of the Sample

Based on research on 177 girls aged 11-16 years from Junior High School 8 Surakarta, the average age at menarche was 11.99 years (SD 0.938) with the majority (46.3%) of students experiencing menarche at the age of

12 years. The average TSF size was 24,585 mm (SD 8.004) (Table 1).

Most of the samples were classified as having low gynecological age and came from high-income families (>Rp.2,031,810). In addition, most students are classified as having low activity. The characteristics of the subjects are described in Table 2.

Table 1. Characteristics of Subjects Based on Descriptive Statistics

	Min	Max	Average	SD
Age at Menarche Sample (yrs)	10	14	11.990	0.938
TSF (mm)	10	48	24.585	8.004
Gynecological Age (yrs)	0	5	2.180	1.049
Age at Menarche of mother (yrs)	10	18	13,030	1.520
Family Income( rupiah)	600. 000	40.000.000	3.236.050,629	3.628.023,108

Table 2. Characteristics of Subjects

Characteristics	N (%)
Age at Menarche (yr)	
10	11(6.2)
11	36( 20.3)
12	82(46.3)
13	39(22.0)
14	9(5.1)
Gynecological Age	
Low ( $\leq 3$ years)	156(88.1)
High ( $>3$ years)	21(11.9)
Age at Menarche Mother (yr)	
10	5(2.8)
11	14(7.9)
12	49(27.7)
13	58(32.8)
14	24(13.6)
15	19(10.7)
16	1 (0.6)
17	3(1.7)
18	4(2.3)
Family Income	
Low ( $\leq$ )	76(42.9)
High ( $>$ )	101(57.1)
Physical Activity	
Low	122(68.9)
Medium	54(30.5)
High	1(0.6)

### Results

We analyzed the correlation between triceps skinfold thickness with the age at menarche. Through Spearman correlation, we found that there was a significant correlation between TSF and age at menarche where  $p < 0.05$  ( $p = 0.012$ ), which had a weak negative correlation ( $r = -0.188$ ) because the correlation coefficient was not close to 1.

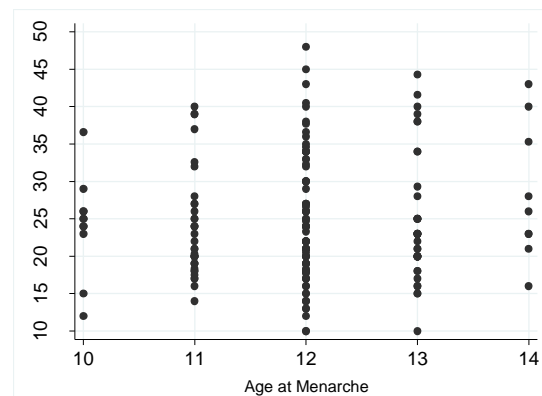


Figure 1. Correlation Between Triceps Skinfold Thickness and Age at Menarche

## DISCUSSION

### Prevalence of Age at Menarche in Junior High School Girls

In a study of 177 students of Junior Highschool 8 Surakarta, it was found that the average age at menarche for junior high school girls in Surakarta is 11.99 years with a SD of  $\pm 0.938$ . Where the lowest age at menarche is at the age of 10 years (6.2%) and the highest at the age of 14 years (5.1%), with the highest frequency of menarche occurring at the age of 12 years (46.3%).

The onset of menarche varies in each girl, this is influenced by genetics, parental education level, family income, nutritional status of obesity, high-fat foods consumption, increased subcutaneous fat composition, high body mass index, and exposure to mass media<sup>10,11</sup>. The occurrence of menarche is associated with an increase in estrogen levels which is triggered by the hypothalamus during puberty and affects the HPO axis. Increased estrogenic activity causes a series of physical changes that prepare the body for the onset of reproduction<sup>12</sup>.

This research is supported by previous study by Mutasya *et al.*, in 72 Adabiah Padang Junior High School students where there were variations in the age at menarche, as many as 2 students experienced menarche at the age of 10 years, 13 students at the age of 11 years, 27 students at the age of 12 years, 22 students at the age of 13 years, and 8 students at the age of 14 years<sup>10</sup>.

### Prevalence of Triceps Skinfold Thickness in Junior High School Girls

In a study of 177 female students of Junior Highschool 8 Surakarta, the average TSF was 24,585 mm with SD  $\pm 8.004$ . Where the smallest TSF is 10 mm and the largest TSF is 48 mm. In measuring skinfold thickness or subcutaneous fat fold, the most method used is measuring triceps skinfold thickness. Triceps Skinfold Thickness (TSF)

can estimate the total body fat of women and children<sup>7</sup>. Measurement of skinfold thickness makes it possible to determine the thickness of the subcutaneous fat and the percentage of body fat. Body fat consists of essential body fat and reserve body fat. Essential body fat is fat that is important for reproductive function. Essential fats are relatively larger in women due to hormonal and the demands of childbirth. Reserved body fat represents fat accumulation in adipose tissue and helps protect internal organs<sup>13</sup>. The size of each person's TSF can vary depending on the thickness of the subcutaneous fat layer, there are genetic factors which are one of the internal factors that can affect body composition, and external factors such as nutrition, culture, and physical activity also affect differences in the distribution of subcutaneous fat<sup>14</sup>.

### Relationship between Triceps Skinfold Thickness and Age at Menarche

We found that there was a significant relationship between triceps skinfold thickness and age at menarche where p-value = 0.012 with a weak negative correlation ( $r = -0.188$ ) between the two variables. Our findings supported by previous study by John *et al.*, in 400 female students in India with an average age at menarche at the age of 12.38 years and an average TSF of 19.56 mm. John *et al.*, stated that there was a significant relationship ( $p = 0.012$ ) with positive correlation ( $r = 0.113$ ) between age at menarche and TSF<sup>15</sup>. However, our findings was different from the previous study by Pulungan *et al.*, in Jakarta which did not find a correlation between the age at menarche and the distribution of segmental (extremity) fat<sup>16</sup>.

According to Rašić *et al.*, thicker TSF indicates excess body fat composition which increases the level of the adipocyte-derived hormone leptin in the blood<sup>17</sup>. The hormone leptin produced by adipocytes, which acts by binding to receptors on the ovaries,

hypothalamus, and anterior pituitary. Body fat deposits send signals to the brain to regulate reproduction by secreting leptin. Leptin will increase the release of Gonadotropin-Releasing Hormone (GnRH) which stimulates the production of Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) from the anterior pituitary so it regulates reproductive function which initiates the onset of puberty and menarche. With increasing levels of serum leptin, the onset of puberty and the age at menarche becomes earlier, an increase of 1 ng/ml of serum leptin will cause the age at menarche a month faster<sup>1</sup>.

#### Limitations of the study

The study was conducted during the Covid-19 pandemic when children tend to be at home and have low physical activity, so the data is less varied. Data on age at menarche and physical activity that measured by the Physical Activity Questionnaire (PAQ) were obtained by relying on the memory of the sample which is very prone to led to recall bias. Data on families income relies heavily on the honesty of parents and samples because the researcher did not ask for evidence, which causes the researcher unable to know the actual economic condition of the sample's family. In addition, many samples do not know the income of their parents or their parents do not want to tell it in detail which is only based on the Surakarta UMK (Rp.2,031,810). In addition, researchers did not analyze the influence of diet, which is one of the factors that can affect the results of anthropometric measurements.

For further study on the relationship between the age at menarche and the anthropometric index of triceps skinfold thickness, a cohort study can be use to explain better relationship of the variables studied. Further study can be carried out on subjects from different populations and geographies with larger sample.

#### CONCLUSION

This study at Surakarta Junior High School proven that there is a significant relationship between triceps skinfold thickness and the age at menarche in adolescent girls with various ages at menarche from 10-14 years, with the highest prevalence is 12 years old (46.3%) .

#### ACKNOWLEDGMENTS

For the implementation of this research, we would like to express our deepest gratitude to dr. Irfan Dzakhir Nugroho, Sp.A, M. Biomed who has provided criticism and suggestions in the implementation of this research; Junior High School 8 Surakarta for allowing us to do research; and respondents who have been willing to serve as research subjects.

#### REFERENCES

1. Lacroix AE, Gondal H, Langaker MD. Physiology, Menarche. StatPearls [Internet]. 27 March 2021 [citation 23 August 2021]; Uploaded from: [URL: https://www.ncbi.nlm.nih.gov/books/NBK470216/](https://www.ncbi.nlm.nih.gov/books/NBK470216/)
2. Health RI. Results of Basic Health Research 2018. The Indonesian Ministry of Health. 2018;53(9):1689–99.
3. Sudikno, Sandjaja. The age at menarche for Indonesian women is getting younger: Results of the 2010 Riskesdas analysis. J Reproductive Health. 2019;10(2):163–71.
4. Handayani M, Dwirianti C, Riyadi H. Relationship between Body Composition and Nutritional Status with Sexual Development. 2013;8(9):181–6.
5. Sulayfiyah TN, Mukhoirotin M. Journal of Bionursing Analysis of Factors Associated with Early Menarche Incidence. 2020;2(1):33–8.
6. McGee S. Obesity. Evidence-Based Physic Diagnosis [Internet]. 1 January 2018 [citation 19 August 2021];85-88.e1. Uploaded from: [URL: https://linkinghub.elsevier.com/retrieve/pii/B9780323392761000135](https://linkinghub.elsevier.com/retrieve/pii/B9780323392761000135)
7. Eaton-Evans J. Nutritional Assessment: Anthropometry. Encycl Hum Nutr. January 1, 2013;3–4:227–32.
8. Bratke H, Bruserud IS, Brannsether B,

- Aßmus J, Bjercknes R, Roelants M, et al. Timing of Menarche in Norwegian Girls: Associations with Body Mass Index, Waist Circumference and Skinfold Thickness. *BMC Pediatrics*. 2017;17(1):1–6.
9. Leitão RB, Rodrigues LP, Neves L, Carvalho GS. Development of Adiposity, Obesity and Age at Menarche: An 8-year Follow-Up Study in Portuguese Schoolgirls. *Int J Adolesc Med Health*. 2013;25(1):55–63.
  10. Mutasya F, Edison E, Hasyim H. Factors Relating to Age at Menarche in Adabiah Junior High School Students. 2016;
  11. Lee H.S. Why should we be concerned about early menarche? Vol. 64, *Korean Journal of Pediatrics*. Korean Pediatric Society; 2021. p. 26–7.
  12. Vallengia CR, Núñez-de la Mora A. Human Reproductive Ecology. *Basics Hum Evol*. January 1, 2015;295–308.
  13. Ojo G, Adetola O. The Relationship between Skinfold Thickness and Body Mass Index in Estimating Body Fat Percentage on Bowen University Students. 2017;3(3).
  14. Illahika AP. Correlation Analysis of Skinfold (TLK) and Body Mass Index (BMI) of Madura Female Adolescents in Sumenep. *Magna Medica Berk Medical and Health Sciences*. 2019;6(1):65.
  15. John J, Verma M, Chhatwal J. Physiological variables, psychosocial factors and age at menarche among Punjabi girls. *Indian J Physiol Pharmacol* [Internet]. April 2, 2014 [citation needed May 18, 2022];58(2). Uploaded from:  
[URL:https://www.ijpp.com/IJPParchives/2014\\_5\\_2\\_Apr\\_-\\_Jun/2014\\_58\\_2\\_Full\\_text\\_141146.html](https://www.ijpp.com/IJPParchives/2014_5_2_Apr_-_Jun/2014_58_2_Full_text_141146.html)
  16. Pulungan AB, Nugraheni RP, Advani N, Akib AAP, Devaera Y, Sjakti HA, et al . Age at menarche and body fat in adolescent girls. *Indonesian Paediatrics*. 2020;60(5):269–76.
  17. Rašić L, Zrinušić D, Drenjančević I. Sex-related differences in correlation of overweight/obesity markers to blood pressure in prepubertal children in osijek-baranja county - a cross-sectional study. *Biol Period*. 2017;119(2):87–92.
  18. Ather U, Saleem M, Saleem A, Gul F. Relationship of serum leptin with menarche and pubertal stages in young girls. *Pakistan J Med Heal Sci*. 2017;11(4):1330–7.