

REVIEW ARTICLES

BODY FAT MASS AND MENARCHEAL AGE AMONG INDONESIAN GIRLS: NARRATIVE REVIEW

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ABSTRACT

Background: The onset of the first menstrual period, also known as menarche, indicates the maturity of female reproductive system. Many factors influence menarcheal age. The purpose of this paper was to investigate the association between body fat mass and menarcheal age based on research articles that have been published, focusing on girls in Indonesia.

Methods: The articles were encountered using Google Scholar, PubMed, and the Ministry of Education and Culture's Digital Reference. The inclusion criteria were articles published between 2017 and 2022, written in

Indonesian or English, original research, conducted in Indonesia.

Results: Five literature that met the inclusion and exclusion criteria were found. Four studies found a relationship between body fat mass and age at menarche. One study, however, showed the opposite conclusion.

Conclusion: An increase in body fat mass can be a factor in the acceleration of menarcheal age. Girls must have a healthy body composition from an early age.

Keywords: menarcheal age, body fat, Indonesian girls

INTRODUCTION

Puberty in girls is indicated by the growth of the breast bud, followed by the growth of pubic hair, body growth, and menarche. Menstruation will occur for the first time in a woman as a sign that her reproductive system has matured. This is known as menarche. Menarche usually occurs 2-3 years after the growth of the breast bud. Menarche, as evidence of maturity in woman's reproductive system can also signify that she is ready to ovulate and reproduce. On the other hand, menstrual cycles that occur several times after menarche are usually irregular and anovulatory. Some women require three years after menarche to have regular menstrual cycles every 21-34 days.¹

Menarche occurs when the hypothalamus-pituitary-ovarian axis matures, allowing hormonal processes in women to run smoothly and the endometrial wall to decay, allowing the egg to exit the uterus. The activity of the gonadotropin-releasing hormone (GnRH), the secretion of follicle stimulating hormone (FSH), the luteinizing hormone (LH), and estrogen hormone levels all have an impact on the regularity of the menstrual cycle. The hormone

progesterone, in addition to estrogen, influences the menstrual cycle. This cycle occurs monthly at intervals of 21-35 days.¹ Menarche occurs at a different age for each individual. According to data from the Indonesian Basic Health Research Report, the average girl in Indonesia reaches menarche at the age of 13, with a range of 9-20 years.² From 1970 to 2010, the average age of menarche in Indonesia decreased by 8-9 days per year, from 14.43 years to 13.63 years.³

Menarche age is influenced by parents' educational level, family economy, genetics, food type and amount, media exposure, physical activity, and nutritional status.⁴⁻⁷ Putra et al.⁸ conducted a study on elementary school students in Denpasar and discovered that nutritional status significantly affected menarche age. The study discovered that female adolescents with a higher body mass index (BMI) were more likely to experience menarche sooner than those with a normal BMI. High BMI and high body fat mass, including cholesterol, have a positive relationship. Cholesterol serves as a precursor for many hormones in the body, including sex hormones. High cholesterol levels can interfere with a woman's menstrual cycle because they affect sex hormone

levels. Adipocytes and liver cells store most of the body fat. Adipocyte cells' primary function is to store fat in the form of triglycerides, which are then converted into energy. Furthermore, adipocyte tissue produces heat and secretes hormones such as leptin and adiponectin. Increased fat stores in the body are linked to higher leptin levels. High levels of leptin stimulate the secretion of GnRH, which in turn stimulates the secretion of FSH and LH. This can cause ovulation to occur faster than usual, resulting in early menarche.^{9,10}

Gemelli et al. and Bubach et al. found that female adolescent body fat mass was related to menarche age.^{11,12} However, according to research conducted by Sodha et al. in India, the relationship between body fat mass and menarche age was insignificant.¹³ Because the findings of the studies are still contradictory, this study aims to investigate the association between body fat mass and menarcheal age in Indonesia.

texts of potentially eligible articles were retrieved. Titles, abstracts, and full texts were reviewed independently by two reviewers who crosschecked each other's data extraction. Disagreements were resolved through open discussion. We did not use certain applications or software when selecting studies. Articles that had been selected for analysis and interpretation will be evaluated. Eligible studies examined the association between menarcheal age and body fat.

Quality evaluation

We critically appraise the literature to be studied before reviewing it and used the Joanna Briggs Institute Critical Appraisal Tools to evaluate the literature. The process done by manually.¹⁴

Data extraction

From each study, we extracted a predetermined set of data, including name of the first author, year of publication, sample characteristics, study settings, follow-up details, effect measures, and confounders. Descriptive analyses were used to determine the menarcheal age.

METHODS

Search strategy and study selection

The articles were searched using Google Scholar, PubMed, and the Ministry of Education and Culture's Digital Reference (Garuda) using a combination of keywords. The PICO method approach was used to simplify the search. The following search terms were used as Boolean combinations: girl, girls, woman, women, female, body fat, fat mass, menarch, menarcheal age, puberty, Indonesia. The inclusion criteria were articles published between 2017 and 2022, written in Indonesian or English, original research, conducted in Indonesia. We excluded letters, editorials, reviews, notes, and studies conducted on animals. Duplicates were removed by manually. Titles and abstracts were initially screened for meeting eligibility criteria. Full

RESULTS

The search result in 43 literature, which then screened one by one. The selection process, based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)¹⁵ guidelines is detailed in Figure 1. Finally, we will study five articles of literature. The four found literatures used a cross-sectional research design and one used a case control research design. The study took place in Banjar (South Kalimantan), Gresik (East Java), Central Jakarta, Bakauheni Lampung (Sumatra), and Semarang (Central Java). These places represent rural (Banjar and Gresik) and urban areas (Lampung, Central Jakarta, and Semarang).

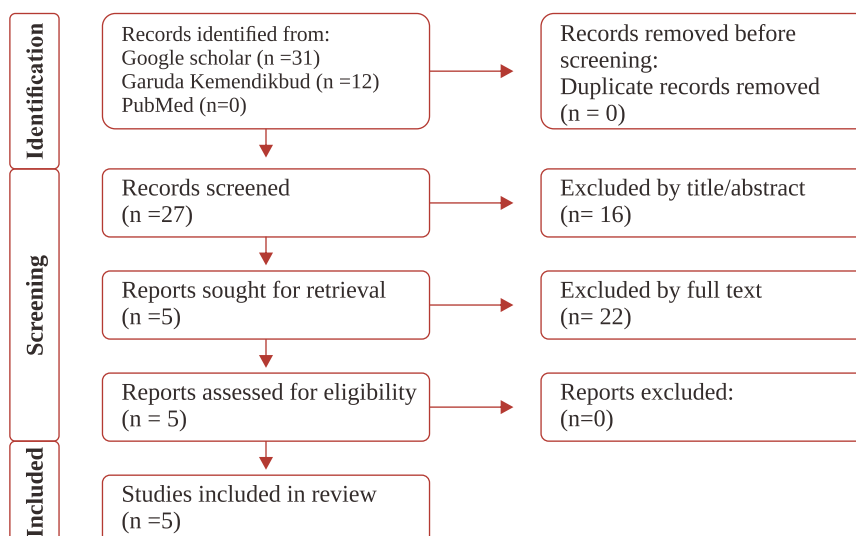


Figure 1. Flow diagram showing the search strategy used in the current review.

Study characteristics

We summarize the studies in the form of a table that includes the following information: number, study title, author's name, year of publication, study design, location, number of subjects, subject characteristics, variables, and research results (Table 1). Eight of the ten critical appraisal checklists were met by one study with a case control research design. The limitation of this study was that one of the

variables was measured using secondary data eight months ago, and it was not stated in the literature how long the case data were collected. Six of the eight critical appraisal checklists were met by four studies using a cross-sectional research design. The distracting variables were not identified in the four literatures, and no strategy was included to eliminate the effects of the distracting variables on the study.

Table 1. Studies of menarcheal age and fat mass.

No	Title	Authors	Design	Location	Year of publication	Number of subjects	Subject characteristics	Variables	Results
1	Nutritional Status and Body Fat Percent with Early Menarche in Elementary School Students.	Taufiqur rahman, et al	Cross-sectional	Kab. Banjar (South Kalimantan)	2018	153	Students in grades 4-6, aged 10-12 years, have experienced menarche, have not been sick for the last 3 months.	Fat mass measured using BIA	There was a significant relationship between percent body fat and early menarche. Subjects with a higher body fat mass have a 4.06 times greater chance of experiencing early menarche, according to the OR value of 4.06.
2	Nutritional Status and Percent of Body Fat Associated with Menarche Age in Elementary School Children at SD Muhammadiyah GKB 1 Gresik.	Makarimah et al	Cross-sectional	Gresik (East Java)	2017	37	Students in grades 5-6 who were already menstruating.	Fat mass measured using BIA	There was a weak significant relationship between percent body fat and menarche (r=0.328; p=0.048).
3	Age at Menarche and Body Fat.	Pulungan et al	Cross-sectional	Jakarta Pusat	2019	32	Adolescent girls aged 10-15 years who have experienced menarche, and nobody changes >5% in the last 3 months.	Fat mass measured using BIA	There was no correlation between fat mass and menarcheal age (p=0.7).
4	Relationship between Nutritional Status and Body Fat Percentage Level with the Incidence of Menarche in Grade 5-6 Students at SDN 2 Bakauheni in 2021.	Indriyanti et al	Cross-sectional	Bakauheni, Lampung	2021	81	Students in grades 5-6 who had experienced menstruation and were in good health.	Fat mass measured using BIA	The statistical test results revealed p=0.002 and a correlation coefficient of 0.716, indicating a significant strong relationship between body fat mass and menarcheal age.
5	Relationship of Intake of Sugar-sweetened beverage and Body Fat Mass with the incidence of early menarche.	Amelia et al	Case control	Semarang	2017	Each 20 in the case group and control group	Girls aged 10.1-11.9 years who know exactly when their menarche was and did not have chronic and genetic diseases.	body mass index, sugar-sweetened beverage intake data, physical activity data, birth weight, maternal menarcheal age	There was a strong relationship between fat mass and early menarcheal age. subjects with a body fat mass greater than 28.2% were 2.667 times more likely to experience early menarche.

The five studies polled their subjects' menarche ages using a questionnaire. Menarcheal age was determined from recall by estimating the amount of time between the subject's first period and her birth date. The mean of menarcheal age in five publications were in range 10-11 years old. Fat mass data of four studies used obtained by measuring bioelectrical impedance analysis (BIA).¹⁶⁻¹⁹ The regression equation to calculate body fat percentage based on body mass index (BMI) was used by one researcher.²⁰ Two studies did not categorize based on the amount of body fat^{16,20}, while three studies categorized it into low, normal, high, and very high.¹⁷⁻¹⁹ The cut-off for high fat mass also varies between >28% to >30%. A significant association between fat mass and menarcheal age has been found in four studies.¹⁷⁻²⁰ Three

of five studies found a strong relationship between body fat mass and age at menarche, one found a weak relationship between body fat mass and age at menarche. One study, however, showed the opposite conclusion.¹⁶

DISCUSSION

The subject menarcheal age occurs at a younger age, this is in accordance with the theory, that age at menarche is accelerating over time. The prevalence of early menarche significantly increased. The menarcheal age decreased by 0.11 years every ten years in Ghana.²¹ Similar to Korea, early menarche prevalence grew noticeably from 1.8% in 2006 to

3.2% in 2015.²² A decrease of over one month each decade was found, pointing to a secular decline in Indian women's menarche age.²³ From 13.66 years old in 1955 to 13.15 years old in 1997 and 13.05 years old in 2009, the median age of menarche in Dutch girls fell noticeably. Girls of Turkish and Moroccan ethnicity experienced a greater decline in the median age of menarche between 1997 and 2009 compared to Dutch girls. The age at menarche dropped from 12.80 to 12.50 in Turkish girls and from 12.90 to 12.60 in Moroccan girls.²⁴ According to data from the 2018 Indonesian Basic Health Research Report, 13.6 years old is the median age at menarche.² The average age at menarche was similar to the results of the study by Gemelli et al. that the average age at menarche was 11.5 years in the Brazilian Amazon region.¹¹ It does, however, differ from the study by Sodha et al. menarche occurred at an average age of 12.7 years in India.¹³ The average age of menarche for female students in Palembang's fifth through ninth grades was 12 years old.²⁵

Premature menopause, adolescent psychology issues like not being prepared if one must menstruate while friends have not started, adolescents' physical readiness to clean themselves during menstruation, understanding menstruation, dysmenorrhea, and pre-menstrual syndrome that is felt, can all be impacted by an earlier menarche. Moreover, early menarcheal age was linked to a greater prevalence of several non-communicable diseases, including hypertension, cardiovascular diseases, and arthritis.²⁶ Women who begin menstruating before the age of 12 have a 30% higher risk of having breast cancer.²⁷

High body mass index, physical inactivity, longer sleep duration, strong socioeconomic standing, genetics, mother's menarcheal age, and environmental variables like urban areas are all factors that are linked to menarche occurring earlier in life.^{28,29} This review focuses on body fat mass, one of the variables connected to menarche age. Those who have a high body fat percentage typically go through menarche earlier. High body fat levels are a sign of obesity. The upper limit for appropriate body fat ranges from under 28% to 30%. The categorization will be impacted by how this cutoff is decided. The average body fat mass throughout menarche and 27 years was 24%, according to a study by Bandini et al. that assessed teenage body fat mass from before menarche to four years after menarche.³⁰

The obese group showed the highest prevalence of the early menarche trend. Serum leptin levels rise as body fat percentage increases. A hormone called leptin is produced by fat cells to control hunger balance. By stimulating the hypothalamic release of gonadotropin-releasing hormone, which in turn stimulates the gonads' downstream release of sex hormones, leptin also plays a significant role in reproduction. Timing of the leptin signal is crucial for prepubertal growth. Serum leptin levels are important for the

reproductive cycle, puberty, and metabolic health. The hypothalamus is the main location where leptin controls the reproductive process. The cells in the hypothalamus that produce GnRH have leptin receptors. Through signaling kisspeptin (Kiss1) neurons to promote gonadotropin-releasing hormone (GnRH) neurons, leptin operates on ventral pre mammillary neurons. Leptin directly affects kiss1 neurons, releasing kisspeptin, which then triggers the release of GnRH. Increased leptin levels cause an increase in serum LH, which functions in the ovaries to secrete the hormones estrogen and progesterone. The oocyte must grow and mature normally for leptin to be effective. Leptin is present in the follicular fluid of the growing Graafian follicle, and its concentration is influenced by the levels of leptin in the serum. This results in a condition in which the amount of the hormones estrogen and progesterone in the ovaries increases earlier than it should, resulting in earlier reproductive maturity, one of which is marked by the first menstruation.³¹

In addition to leptin, adiponectin is also produced by adipose tissue. However, adiponectin inhibits the secretion of kisspeptin and GnRH in the hypothalamus and LH in the pituitary, thereby inhibiting the onset of puberty. Subjects with central precocious puberty had lower total adiponectin levels than those with normal onset of puberty. However, high molecular weight (HMW) adiponectin was increased in adolescent females who experienced central precocious puberty. Additionally, obese individuals may experience increased inflammatory cytokines such as TNF- α and IL-6, inhibiting adiponectin production and hasten puberty's onset.³²

This study has some limitations. In this study, due to database limitations, only five references were reviewed and the study scope was only Indonesia. Furthermore, most literature designs were cross-sectional designs with low levels of evidence. Self-reporting by adult women or girls was frequently used to collect data on menarche age, but this may introduce recall bias. The data could be inaccurate because the respondent forgot to indicate the precise time of menarche. The data should be gathered from objective observations, such as those made through the cohort study method. A cohort study will follow participants with high fat mass and those with normal or low fat mass until the onset of the first menstruation. There it can be clearly seen the impact of high fat mass on the incidence of menarche.

CONCLUSION

The average of menarcheal age in Indonesia over the past five years was in range 10-11 years old. There was an association between body fat mass and menarcheal age, consistent with the hypothesis that increased body fat mass may be a factor that accelerates age at menarche. Body fat mass can affect age at menarche, through leptin production

increasing as body fat mass increases. Leptin affects the hypothalamic-pituitary-gonadal axis and increases GnRH, LH, and estrogen, thereby accelerating menarcheal age. In addition to leptin, adiponectin is also produced by adipose tissue. However, it was found that elevated adiponectin inhibits puberty. Further research can be done using a more extensive database. We also recommend using a cohort or case-control study design so that study results are more valid. Combating childhood obesity may aid in the prevention of early pubertal onset. Communities are expected to maintain a way of life that enables them to maintain a healthy body composition, particularly for girls, to avoid early menarche, which can raise the risk of health issues in adulthood.

CONFLICT OF INTEREST

All authors in this article declare there is no conflict of interest.

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