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The Relationship Between Nutritional Status (BMI) and Age at Menarche Among Junior High School Adolescent Girls

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ABSTRAK

Menarche adalah haid pertama kali yang dialami oleh seorang remaja perempuan. Pada abad terakhir ini usia *menarche* telah menurun ke usia lebih muda yang akan menimbulkan dampak negatif pada kesehatan. Status gizi (IMT) dianggap menjadi faktor yang paling dominan mempengaruhi usia *menarche*. **Latar Belakang**: Terjadinya pergeseran usia *menarche* diluar usia normal tersebut dapat berdampak pada kesehatan seorang wanita pada saat dewasa. Wanita yang mengalami *menarche* sebelum 12 tahun memiliki 23% risiko lebih tinggi terkena kanker payudara dibandingkan mereka yang pertama kali menstruasi pada 15 tahun atau lebih (Ameade dan Garti, 2016). **Tujuan** : untuk mengetahui hubungan status gizi (IMT) dengan usia *menarche* pada remaja putri di SMPN 3 Sungai Penuh. **Metode**: Penelitian kuantitatif dengan desain *cross sectional*, dilakukan di SMPN 3 Sungai Penuh pada bulan juli-agustus 2025. Subjek penelitian adalah remaja putri di SMPN 3 Sungai Penuh yang berjumlah 97 orang dengan teknik proportional random sampling. Pengumpulan data dengan cara pengukuran tinggi badan dan berat badan serta menggunakan kuesioner. Analisis data secara univariat dan bivariat menggunakan *Chi square* dengan *p value* ≤0,05. **Hasil**: Hasil penelitian menunjukkan sebagian besar responden (81.4%) memiliki usia *menarche* normal dan lebih dari separuh responden memiliki status gizi normal (63.9%). Hasil analisis bivariat menunjukkan terdapat hubungan yang signifikan antara status gizi (IMT) dengan usia *menarche* pada remaja putri di SMPN 3 Sungai Penuh (*p*= 0.001). **Kesimpulan**: Terdapat hubungan status gizi (IMT) dengan usia *menarche* pada remaja putri di SMPN 3 Sungai Penuh. Saran untuk remaja putri agar menjaga status gizi normal untuk mencapai usia *menarche* yang normal.

ABSTRACT

Menarche is the first menstrual period experienced by adolescent girl. In recent decades, The age of menarche is earlier which may have negative effects on health. Nutritional status (BMI) is considered to be the most dominant factor affecting the age of menarche. ***Background:*** *A shift in the age of menarche outside the normal range may have implications for women's health in adulthood. Women who experience menarche before the age of 12 have a 23% higher risk of developing breast cancer*

compared with those who experience their first menstruation at the age of 15 years or older (Ameade & Garti, 2016). ***Objective:*** *The purpose of this study was to know the relation of nutritional status (BMI) with the age of menarche in adolescent girls at SMPN 3 Sungai Penuh.* ***Methods:*** *Quantitative research with cross sectional design was conducted at SMPN 3 Sungai Penuh in July-August 2025. The subjects of this study were girls at SMPN 3 Sungai penuh. which amounted to 97 people with proportional random sampling technique. Data collected by high and weight body measurement and using questionnaires. Univariate and bivariate data analysis using Chi square with p value ≤0,05.* ***Results:*** *The results showed that most of the respondents (81.4%) had normal age of menarche and more than half of respondents had normal nutritional status (63.9%). The result of bivariate analysis showed that there was a significant correlation between nutritional status (BMI) with the age of menarche in adolescent girls at SMPN 3 Sungai Penuh (p<0.001).* ***Conclusion:*** *There is a relationship between nutritional status (IMT) with the age of menarche in adolescent girls at SMPN 3 Sungai Penuh. Advice for adolescent girls to maintain normal nutritional status to achieve normal age of menarche.*

INTRODUCTION

Adolescence is a transitional period between childhood and adulthood characterized by rapid physical growth (growth spurt), the development of secondary sexual characteristics, the attainment of reproductive maturity, as well as psychological and cognitive changes (Sawyer et al., 2018). These changes make adolescence a unique and critical phase of life for establishing a foundation of health in adulthood. The World Health Organization (WHO) defines adolescence as the age range of 10–19 years, while the National Population and Family Planning Board of Indonesia (BKKBN) defines adolescents as individuals aged 10–24 years who are unmarried (Ministry of Health of the Republic of Indonesia, 2015).

Adolescence is marked by the onset of puberty, which represents the initial stage of biological changes leading to sexual maturation. Puberty generally begins earlier in girls than in boys, with an onset age of approximately 8–13 years in girls and 9–14 years in boys. These differences are influenced by genetic factors, nutritional status, and environmental conditions. In adolescent girls, puberty is characterized by the development of secondary sexual characteristics, including breast development (thelarche), the growth of pubic hair (pubarche), and culminating in menarche as an indicator of reproductive maturation, which typically occurs at the age of 12–13 years (Dorn et al., 2019; Styne et al., 2017; WHO, 2022).

Menarche is the first menstrual period that marks the onset of reproductive function in females and is considered an important clinical indicator reflecting physical maturity, nutritional status, and reproductive health in adolescent girls. Several studies have demonstrated that improvements in nutritional status, socioeconomic conditions, and overall health contribute to a decline in the age at menarche, resulting in increasing variability in the timing of menarche among individuals and populations. Globally, the average age at menarche currently ranges from 12 to 13 years, although it remains influenced by genetic, environmental, and lifestyle factors (Parent et al., 2015; Karapanou & Papadimitriou, 2016; WHO, 2022).

Over the past several decades, numerous studies have reported a global trend toward a decreasing age at menarche, which has been associated with improvements in nutritional status, socioeconomic conditions, and environmental factors. In Indonesia, data from the 2018 Basic Health Research (Riskesdas) indicate that the average age at menarche among adolescent girls ranges from 12 to 13 years, with considerable variation and a tendency toward early menarche among some adolescents. Regional studies in Indonesia have also reported that the age at menarche ranges from 12.2 to 12.6 years and is influenced by nutritional status and environmental factors (National Institute of Health Research and Development, 2018; Susanti et al., 2020).

One commonly used indicator for assessing nutritional status in adolescents is the Body Mass Index (BMI), which is calculated based on the ratio of body weight to height. BMI is widely used because it is practical and provides a general description of nutritional status among adolescents. Numerous studies have shown that adolescent girls with higher BMI tend to experience menarche at a younger age compared to those with normal or lower BMI. Therefore, BMI is considered an important factor in the acceleration of reproductive maturation (Karapanou & Papadimitriou, 2016; Wang et al., 2019; WHO, 2022).

Although the relationship between nutritional status and age at menarche has been widely studied, most previous research has been conducted at the national level or in large urban areas. To date, there is limited research specifically examining the relationship between Body Mass Index (BMI) and age at menarche among junior high school adolescent girls in the Sungai Penuh area, particularly at SMPN 3 Sungai Penuh. Therefore, this study aims to analyze the relationship between nutritional status (BMI) and age at menarche among adolescent girls at SMPN 3 Sungai Penuh.

Based on a preliminary study conducted at SMPN 3 Sungai Penuh in June 2025 involving ten female students who had experienced menarche, the age at menarche was found to range from 10 to 14 years, with some students experiencing menarche at an earlier age. These preliminary findings indicate variability in the age at menarche that warrants further investigation, particularly in relation to the nutritional status of adolescent girls.

METHODS

This study obtained ethical approval from the Health Research Ethics Committee of STIKes Budi Mulia Sriwijaya. All respondents and their parents or legal guardians were provided with detailed information regarding the objectives, benefits, and procedures of the study and gave their consent by signing informed consent forms. The confidentiality of respondents' identities was maintained, and all data were used solely for research purposes. The study was conducted from July to August 2025 at SMPN 3 Sungai Penuh. The study population consisted of all female students at SMPN 3 Sungai Penuh, totaling 220 students.

This research employed an observational design with a cross-sectional approach, which examines the relationship between risk factors and outcomes through measurements conducted at a single point in time (point-time approach). Each study subject was observed only once, and all variables were measured simultaneously (Notoatmodjo, 2010). The sample size was calculated using the Lemeshow formula for cross-sectional studies with a finite population, resulting in a minimum required sample size of 93.24, which was rounded up to 94 respondents. To anticipate a potential dropout rate or incomplete data of 10%, the sample size was increased to 104 respondents. However, a total of 97 respondents met the inclusion criteria and participated fully in the study; thus, this number was considered sufficient to meet the sample adequacy requirement.

Sampling was performed using a simple random sampling method in each class, employing a lottery technique based on students' attendance numbers.

Age at menarche was defined as the age at which the respondent experienced her first menstruation, expressed in years and obtained through a self-administered questionnaire. Age at menarche was categorized into early menarche (<11 years) and normal menarche (11–16 years), based on adolescent reproductive health standards from the World Health Organization (WHO), supported by clinical and epidemiological studies on normal age at menarche among adolescent girls (WHO; Parent et al., 2015; Karapanou & Papadimitriou, 2016).

Nutritional status was assessed using Body Mass Index (BMI) based on BMI-for-age (BMI/A) Z-scores according to WHO standards. For univariate analysis, nutritional status was classified into five categories: obese, overweight, normal, thin,

and severely thin. However, for bivariate analysis using the Chi-square test, BMI categories were combined into three groups: obese–overweight, normal, and thin–severely thin. This categorization was performed as a statistical rationale to meet the assumptions of the Chi-square test, particularly to avoid cells with expected counts less than five, and to enhance the stability of the analysis and interpretation of the relationship between nutritional status and age at menarche.

Data analysis was conducted using univariate analysis to describe the distribution of each variable and bivariate analysis to examine the relationship between nutritional status (BMI) and age at menarche using the Chi-square test, with a significance level set at $p \leq 0.05$. This study has several limitations, including the lack of statistical control for potential confounding factors that may influence age at menarche, such as chronological age, physical activity, genetic factors, and socioeconomic conditions. Therefore, the findings of this study describe the bivariate relationship between nutritional status and age at menarche and are not intended to establish a causal relationship. Future studies are recommended to employ multivariate analytical designs to control for these confounding variables.

RESULT

SMP Negeri 3 Sungai Penuh is a junior high school located on Depati Parbo Street, Koto Lebu Subdistrict, Pondok Tinggi District, Sungai Penuh City, Jambi Province, Indonesia. The school was established on January 1, 1970 and operates as a public school providing lower secondary education. SMP Negeri 3 Sungai Penuh has been accredited with an “A” rating based on the 2023 decision of the National Accreditation Board for Early Childhood Education, Primary Education, and Secondary Education, which is valid until 2028, indicating a high standard of educational quality.

The school is equipped with facilities and infrastructure that support the teaching and learning process. Although detailed official data regarding land area and building size are not publicly available in online sources, the school provides adequate facilities such as classrooms, a library, laboratories, and other learning areas that meet the standards for junior high school education.

The school’s vision is reflected in its commitment to producing graduates who possess strong moral values, demonstrate academic achievement, and are able to adapt to dynamic social environments. Teaching and learning activities at SMP Negeri 3 Sungai Penuh are conducted in a structured manner to support students’ academic and character development through the national curriculum.

The respondents in this study consisted of 97 female students from SMPN 3 Sungai Penuh. The respondents were drawn from 18 classes, ranging from Grade VII to Grade IX. The distribution of respondents was relatively even across classes, with an average of approximately six female students per class. The largest number of respondents came from Grade IX-3, with eight respondents, while the smallest number of respondents came from Grade IX-2, with two respondents.

Tabel 1. Frequency Distribution of Respondents' Characteristics by Age

Respondents' age	Number N	Percentage %	Mean±SD
13	44	54.4	13.69±0.727 years
14	40	41.2	
15	12	12.4	
16	1	1.0	
Total	97	100	

Table 1 presents the age characteristics of the respondents. The mean age of the respondents was 13.69 years, with a standard deviation of 0.727 years. The youngest respondent was 13 years old, while the oldest respondent was 16 years old.

Univariate Analysis

Univariate analysis was conducted to describe the frequency distribution of the dependent variable (age at menarche) and the independent variable (nutritional status (BMI)) examined in this study.

Age at Menarche

The age at menarche variable is described based on its mean distribution as follows:

Tabel 2. Mean Age at Menarche of Respondents

Variable	Mean±SD	Minimum-Maximum
Age at Menarche (years)	11.84±1.264	9-15

Table 2 shows that the mean age at menarche of the respondents was 11.84 years.

Tabel 3. Frequency Distribution of Respondents by Age at Menarche

Age at Menarche	Frequence(n)	Precentage(%)
Early Menarche (<11 tahun)	18	18.6
Normal Menarche (11-16 tahun)	79	81.4
Total	97	100

Based on Table 3 above, it can be seen that out of 97 respondents, the majority had a normal age at menarche (81.4%).

Nutritional Status (BMI)

The nutritional status (BMI) variable is described based on the distribution of the mean BMI-for-age (BMI/A) Z-score as follows:

Tabel 4. Distribution of the Mean BMI-for-Age (BMI/A) Z-Score among Respondents

Variable	Mean±SD	Minimum-Maximal
BMI-for-Age (BMI/A) Z-Score (SD)	0.0958 ±1.37560	(-3.11)-(3.05)

Table 4 shows that the mean BMI-for-age (BMI/A) Z-score of the respondents was 0.0958, which falls within the normal category.

The frequency distribution of nutritional status (BMI) among female students at SMPN 3 Sungai Penuh is presented as follows:

Tabel 5. Frequency Distribution of Respondents by Nutritional Status (BMI)

Nutritional status (BMI)	Frequencei(n)	Precentage(%)
Obese	5	5.2
Overweight	22	22.7
Normal	62	63.9
Thin	7	7.2
Severely thin	1	1.0
Total	97	100

Table 5 shows the results of the respondents' nutritional status measurements, indicating that more than half of the respondents had normal nutritional status (63.9%).

For univariate analysis, the five nutritional status categories were grouped into three categories. The first category consisted of obese and overweight, the second category was normal, and the third category consisted of thin and severely thin. The distribution of nutritional status based on these three categories is presented as follows:

Tabel 6. Frequency Distribution of Respondents Based on the Three-Category Classification of Nutritional Status (BMI)

Nutritional status (BMI)	Frequencei(n)	Precentage(%)
Obese and Overweight	27	27.8
Normal	62	63.9
Thin and Severely thin	8	8.2
Total	97	100

Based on Table 6, it was found that respondents with nutritional status classified as obese, overweight, thin, and severely thin were still present, accounting for 36.1% of the total respondents.

Bivariate Analysis

According to the BMI-for-age (BMI/A) Z-score growth chart, nutritional status is classified into five categories: obese, overweight, normal, thin, and severely thin. However, for bivariate analysis using the Chi-square test, the researcher combined categories to form three groups. The results are presented as follows:

Tabel 7. Analysis of the Relationship between Nutritional Status (BMI) and Age at Menarche

Nutrtional status (BMI)	Frequance(n)				Total		OR	*p Value*
	Early Menarche (<11 years		Normal Menarche (11-16 years)					
	f	%	f	%	f	%		
Obese and Overweight	14	51.9	13	48.1	27	100	32.31	0.001

Normal	2	3.2	60	96.8	62	100	1.00
Thin and Severely thin	2	25	6	75.0	8	100	
Total	18	18.6	79	81.4	97	100	

Table 7 presents the results of the analysis of the relationship between nutritional status (BMI) and age at menarche. The percentage of respondents who experienced early menarche was higher among those with obese and overweight nutritional status (51.9%) compared to respondents with normal nutritional status (3.2%) and those who were thin or severely thin (25%).

The bivariate analysis indicated that adolescent girls with obese and overweight nutritional status had a substantially higher likelihood of experiencing early menarche than those with normal nutritional status. Based on the calculated Odds Ratio (OR = 32.31), adolescent girls who were obese or overweight had approximately 32 times higher odds of experiencing early menarche (<11 years) compared to those with normal nutritional status. The Chi-square statistical test yielded a p-value of 0.000 ($p < 0.05$), indicating that the relationship between nutritional status (BMI) and age at menarche was statistically significant.

DISCUSSION

Age at Menarche

The results of this study indicate that the mean age at menarche among the respondents was 11.84 years, and the majority of respondents experienced menarche at a normal age compared to those who experienced early menarche. These findings are consistent with previous studies conducted by Simamora (2015) and Wulandari et al. (2017) among junior high school female adolescents. Simamora (2015), in a study conducted at SMP Amal Luhur Medan, reported that most respondents experienced menarche at a normal age (88.1%). Similarly, Wulandari et al. (2017) found that the proportion of respondents with normal age at menarche (83.8%) was higher than those with early menarche.

The mean age at menarche in this study (11.84 years) is relatively lower than the national average age at menarche in Indonesia, which ranges from 12 to 13 years according to the 2018 Basic Health Research (Riskesdas). This finding suggests a trend toward an earlier onset of menarche, which is presumed to be associated with nutritional status and environmental factors affecting female adolescents (National Institute of Health Research and Development, 2018).

Although the majority of respondents experienced menarche at a normal age, there were still respondents who experienced early menarche. The occurrence of early menarche may be influenced by nutritional status, as some respondents were classified as overweight or obese. Based on interviews conducted by the researcher, most respondents with overweight and obese nutritional status reported frequent consumption of high-fat foods such as instant noodles, fried chicken, ice cream, French fries, and other fast foods. Excessive consumption of high-fat foods can affect body weight and increase cholesterol levels in the body. Cholesterol serves as a primary precursor in estrogen synthesis, which plays an important role in accelerating sexual maturation and influencing the age at menarche.

Nutritional Status (BMI)

The results of this study show that the mean BMI-for-age Z-score among respondents was 0.0958, which falls within the normal category. The frequency distribution of nutritional status indicates that more than half of the respondents had a normal nutritional status.

This finding suggests that the majority of female adolescents at SMPN 3 Sungai Penuh have an adequate nutritional status. This condition may be attributed to improvements in educational level, nutritional knowledge, and household income in the Sungai Penuh area, enabling families to better meet the nutritional needs of their children. However, respondents with underweight, overweight, and obese nutritional status were still identified. Adolescents with underweight or severely underweight status may be influenced by excessive dieting behavior. Concerns about body image often lead adolescents to restrict food intake due to fear of gaining weight. In addition, lower levels of education, nutritional knowledge, and household income among certain families may limit their ability to meet adequate nutritional needs, which in turn affects adolescents' nutritional status.

Bivariate Analysis

The results of the bivariate analysis examining the relationship between nutritional status (BMI) and age at menarche among female adolescents at SMPN 3 Sungai Penuh (Table 5.8) showed that early menarche occurred more frequently among respondents with overweight and obese nutritional status compared to those with normal or underweight nutritional status. Statistical analysis using the Chi-square test yielded a p-value of 0.001 ($p < 0.05$), indicating a statistically significant relationship between nutritional status (BMI) and age at menarche among female adolescents at SMPN 3 Sungai Penuh.

Female adolescents with overweight or obese nutritional status tend to experience menarche at an earlier age compared to those with underweight nutritional status. This phenomenon is associated with differences in the amount of adipose tissue, which results in varying levels of leptin secretion. Increased leptin levels play a role in the activation of the hypothalamic–pituitary–gonadal axis, thereby accelerating pubertal development. This is supported by the findings of the present study, which showed that 14 out of 27 respondents with overweight and obese nutritional status experienced early menarche (<11 years).

CONCLUSIONS AND RECOMMENDATIONS

Based on the objectives of this study regarding the relationship between nutritional status and age at menarche among female adolescents at SMPN 3 Sungai Penuh, it can be concluded that both nutritional status and age at menarche showed considerable variation among the respondents. The majority of female adolescents had a normal nutritional status; however, the proportion of adolescents classified as overweight was higher than those classified as underweight. This condition indicates a growing tendency toward overnutrition problems among female adolescents in the school environment.

With regard to age at menarche, most female adolescents experienced menarche at a normal age. Nevertheless, this study also identified a proportion of

respondents who experienced menarche at an earlier-than-normal age, which may serve as an early indication of a shift toward earlier pubertal onset among adolescents. Statistical analysis demonstrated a significant relationship between nutritional status (Body Mass Index/BMI) and age at menarche among female adolescents at SMPN 3 Sungai Penuh. These findings indicate that nutritional status plays an important role in influencing the acceleration or delay of menarche in female adolescents.

Based on the findings of this study, active involvement from multiple stakeholders is required to improve the health of female adolescents. Schools and health institutions are expected to strengthen education on balanced nutrition and adolescent reproductive health, as well as to conduct regular monitoring of nutritional status as a preventive measure against early menarche. Parents also play a crucial role in preparing female adolescents for puberty by providing early reproductive health education and supervising dietary patterns and physical activity. Furthermore, future studies are recommended to examine other factors associated with age at menarche in order to obtain a more comprehensive understanding of the determinants of menarche among female adolescents.

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