The Relationship Between Nutritional Status and Age at Menarche Among Adolescent Girls at SD Islam Al Azhar 19 Sentra Primer and SMP Islam Al Azhar 22 Sentra Primer

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Abstract

Menarche, the first menstruation, is a key indicator of biological maturity in girls. The age at menarche varies due to factors such as genetics, environment, physical activity, socioeconomic conditions, and nutritional status. Proper nutrition is crucial for sexual maturation because it affects reproductive hormones. Poor nutrition can delay menarche, whereas overnutrition or obesity may lead to earlier menarche due to increased estrogen levels associated with higher body fat. This research aims to assess the relationship between nutritional status and age at menarche among students at *SD Islam Al Azhar 19 Sentra Primer* and *SMP Islam Al Azhar 22 Sentra Primer*. This analytical-descriptive study used a cross-sectional approach with 211 respondents selected through purposive sampling. Nutritional status was measured using anthropometric data (height and weight) and body mass index (BMI) calculation. Age at menarche was obtained through structured interviews. Statistical analysis was conducted to test the relationship between nutritional status and age at menarche, with significance set at $p < 0.05$. Most respondents had normal nutritional status, and the majority experienced menarche between the ages of 10–11 years. Statistical analysis revealed a significant relationship between nutritional status and age at menarche ($p < 0.001$), with normal nutritional status correlating with menarche at expected physiological ages. A significant relationship exists between nutritional status and age at menarche. Adequate nutrition is vital for timely menarche, and monitoring nutritional status while promoting balanced diets is essential for supporting adolescent growth, development, and reproductive health.

INTRODUCTION

Puberty is a transitional phase from childhood to adulthood that is characterized by the development of secondary sexual characteristics (Micangeli et al., 2023; Vertel et al., 2023; Vygotsky, 2022). In females, these changes include breast development, pubic hair growth, accelerated linear growth, and menstruation, or menarche (Kliegman et al., 2020). Menarche is the first menstrual period in adolescent girls and marks the beginning of reproductive capability (Marques et al., 2022). The age at menarche varies considerably, generally occurring within the range of 12–13 years, or more broadly between 9–16 years (Kliegman et al., 2020).

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In Indonesia, the 2018 Basic Health Research (Riskesdas) reported that the average age at menarche was 12.96 years, with the highest distribution occurring at ages 12–13 years (Riskesdas, 2018a). In the DKI Jakarta area, the age at menarche is earlier than the national average, with most cases occurring at ages 11–12 years (Riskesdas, 2018b). The age at menarche is influenced by a variety of factors, both direct and indirect. Direct factors, such as genetics, show that the age at which a mother experiences menarche is related to her daughter's age at menarche, where the daughter tends to experience menarche at an age similar to her mother. This factor is influenced by the expression of genes that regulate estrogen receptors, which can affect reproductive maturity in girls (Gultom et al., 2020).

In addition to genetic factors, nutritional status also plays an important role in determining the age at menarche (Jung et al., 2023; Reshetnikov et al., 2024). Adolescents with better nutritional status are more likely to experience earlier menarche, whereas poorer nutritional status is associated with delayed menarche. This relationship is linked to the role of the hormone leptin produced by adipose tissue. Leptin levels stimulate the release of Luteinizing Hormone (LH) and estradiol, which activate the hypothalamic–pituitary–ovarian axis and thereby trigger faster maturation of reproductive hormones (Hidana et al., 2022). On the other hand, malnutrition can delay the release of reproductive hormones due to energy limitations and impaired hormone synthesis (Athar et al., 2024; Iwasa et al., 2022; Obadimu et al., 2024).

Previous research has also shown that the consumption of foods high in fat and calories, such as junk food, can accelerate menarche by stimulating the production of the hormone leptin (Sari et al., 2019), whereas inadequate nutritional intake since childhood is associated with delayed menarche (Kedare et al., 2024). Indirect factors, such as environmental and socioeconomic conditions, also affect the age at menarche. Adolescents who grow up in families with high levels of stress tend to experience menarche earlier. This may lead to disruptions in hormone regulation and body metabolism, which can increase body weight and subsequently trigger earlier development of reproductive hormones (Kedare et al., 2024).

Nutritional status is a determining factor that plays an important role in the timing of menarche in adolescent girls. Adolescents with higher nutritional status are more likely to experience earlier menarche, whereas undernutrition can delay menarche (Arban et al., 2024). Nutritional status can be measured using Body Mass Index (BMI)-for-age and compared with the CDC growth charts, after which it is categorized by percentile into underweight, normal weight, overweight, or obese (CDC, 2000).

This assessment is important because nutritional status is a direct indicator related to reproductive health, including age at menarche. Thus, menarche is an important indicator not only of reproductive health but also of adolescents' nutritional status and lifestyle. Based on this background, this study aims to analyze the relationship between nutritional status and age at menarche among students at SD Islam Al Azhar 19 Sentra Primer and SMP Islam Al Azhar 22 Sentra Primer. The benefit of this study is to provide further understanding of the relationship between nutritional status and age at menarche in adolescent girls. This research may provide a clearer picture of how nutritional status affects puberty, as well as offer important information for parents and healthcare professionals in managing adolescent health, particularly in terms of nutrition and reproductive health.

METHOD

This study is an analytical observation with a cross-sectional design. Samples were taken from students in grades 4-6 of SD Islam Al Azhar 19 Primary Center and grades 7-9 of SMP Islam Al Azhar 22 Primary Center in East Jakarta who had experienced menarche. Students who were not present at the time of data collection, did not complete the questionnaire completely, and had a history of chronic diseases that may affect nutritional status or menarche, such as diabetes mellitus, tuberculosis, celiac disease, congenital heart disease, and inflammation of the intestine will be excluded from the study. The determination of the nutritional status of children is carried out by measuring weight and height. Furthermore, the Body Mass Index (BMI) was calculated using the formula BB/TB^2 (kg/m²) and then the results were classified based on CDC 2000 for children aged 5-18 years. Menarche age data was obtained through a questionnaire filled out by respondents. Univariate and bivariate analyses used chi square tests to see whether there was a relationship between nutritional status and menarche age in students at Al Azhar Islamic Elementary School 19 Primary Center and Al Azhar Islamic Junior High School 22 Primary Center.

RESULTS AND DISCUSSIONS

The results of the data were obtained from a questionnaire through a google form given to students at Al Azhar Islamic Elementary School 19 Primary Center and Al Azhar Islamic Junior High School 22 Primary Center, and obtained as many as 211 respondents who met the inclusion and exclusion criteria.

Table 1. Respondent Characteristics

Variable	Frequency	Percent (%)
Age		
9 Years	9	4,3
10 Years	34	16,1
11 Years	49	23,2
12 Years	42	19,9
13 Years	24	11,4
14 Years	28	13,3
15 Years	25	11,8
Total	211	100,0
Education Level		
Grade 4	42	19,9
Grade 5	45	21,3
Grade 6	36	17,1
Grade 7	27	12,8
Grade 8	32	15,2
Grade 9	29	13,7
Total	211	100,0

Source: Survey data from Al Azhar Islamic Elementary School 19 and Al Azhar Islamic
Junior High School 22

Table 1 shows the distribution of respondents' demographic characteristics. The majority of respondents were 11 years old, namely 49 female students (23.2%), followed by 42 female students (19.9%), 10 years old as many as 34 female students (16.1%), 14 years old as many as 28 female students (13.3%), 15 years old as many as 25 female students (11.8%), 13 years old

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as many as 24 female students (11.4%) and 9 years old as many as 9 students (4.3%). Based on education level, the most female students came from grade 5 as many as 45 female students (21.3%) and grade 4 as many as 42 students (19.9%).

Nutritional Status

Table 2. Frequency Distribution of One Hundred Nutrients of Respondents Based on CDC 2000

Nutritional Status	Frequency	Percent (%)
BB Less	14	6,6
Normal	141	66,8
Excess BB	25	11,8
Obesity	31	14,7
Total	211	100,0

Source: Nutritional status data from Al Azhar Islamic Elementary School 19 and Al Azhar Islamic Junior High School 22

The results in Table 2 show that the frequency of the most respondents' nutritional status is normal with a total of 141 students (66.8%) and the least frequency is only 14 students (6.6%) with a low weight nutritional status. There were 25 students with overnutrition status (11.8%) and 31 students with obesity (14.7).

Menarche Age

Table 3. Frequency Distribution of Menarche Age of Respondents

Menarche Age	Frequency	Percent (%)
Not Yet Menarche	47	22,3
9 Years	40	19
10 Years	51	24,2
11 Years	53	25,1
12 Years	18	8.5
13 Years	2	0.9
Total	211	100,0

Source: Data from structured interviews at Al Azhar Islamic Elementary School 19 and Al Azhar Islamic Junior High School 22

The results of table 3 show that the results of the frequency of menarche age obtained through questionnaires and direct interviews are the highest number of 11-year-olds as many as 53 students (25.1%) and 10-year-olds as many as 51 students (24.2) while the least frequency is only 2 students (0.9%) with a menarche age of 13 years. There were several students who had not experienced menarche as many as 47 students (22.3%), 40 students (19%) at the age of 9 years menarche and 12 years old menarche as many as 18 students (8.5%).

Tabulation Them

Table 4. Cross-Tabulation of Nutritional Status with Menarche Age

Status Nutrition	Menarche Age		p-value
	Not Yet Menarche	Normal Menarche	
BB Less	13	1	<0.001

Normal	31	110
Excess BB	2	23
Obesity	1	30

Source: Cross-tabulation data from Al Azhar Islamic Elementary School 19 and Al Azhar Islamic Junior High School 22

The results of table 4 above are the result of cross-tabulation between nutritional status and menarche age. The chi square person test on the cross-tabulation between nutritional status and menarche age showed that the p value had a value of <0.001 (p<0.05) which means that there is a statistically significant relationship between nutritional status and menarche age.

In the frequency of the nutritional status of female students at SD Islam Al Azhar 19 Primary Center and Al Azhar Islamic Junior High School 22 Primary Center with the highest number is normal and the least frequency with low weight nutritional status. This is in line with Riskesdas (2018) data in East Jakarta, which shows that 63.04% of school-age children have normal nutritional status, while 1.56% are very thin, 6.09% are thin, 10.64% are obese, and 12.65% are obese (Riskesdas, 2018b).

Nutritional status is the result of a balance between energy intake and expenditure in the body. When the energy that comes in through food is proportional to the energy that is released through physical activity, then the nutritional status tends to be normal. There are many factors that affect a person's health condition, one of which is daily food intake. This intake is greatly influenced by family economic factors, where parental work and income play an important role in meeting family food needs.

Food intake such as junk food and fast food can cause nutrients in the child's body to not be adequately sufficient, which causes various nutritional statuses in these respondents. Physical activity such as being active in extracurricular sports can also help balance food intake with the energy used, so that normal nutritional status occurs.

Data from Riskesdas (2018) shows that the prevalence of nutritional status in school-age children in East Jakarta of 1.56% is classified as very thin, 6.09% are thin, 63.04% have normal nutritional status, 10.64% are obese and 12.65% are obese. This data shows that the nutritional status in the East Jakarta area is in line with the results of the researcher's research, where there are still students with under- or over-nutritional status.

At the frequency of menarche age, it shows that the majority, namely 164 female students (77.7%) have experienced menarche with the youngest age being 9 years old and the oldest being 13 years old. The most menarche age occurred at 11 years old (25.1%), while the average age of the respondents' menarche was 11 years. This result was younger than the national average reported age of menarche of 12.96 years. Respondents who have not yet menarche generally come from a younger age group (grades IV and V of elementary school). Biologically, it is still within reasonable limits because the normal age of menarche according to Nelson (2020) is in the range of 9–16 years, with 95% of girls experiencing it at the age of 10.5–14.4 years. Therefore, respondents who have not yet menarche cannot be categorized as late, but are still in the puberty transition phase. The difference in menarche age between respondents can be influenced by various factors. Genetic factors are the main determinants that play a role in the time of puberty. Girls tend to experience menarche at the same age as their mothers or sisters (Gultom et al., 2020).

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In addition, hormonal factors also play an important role, such as the activation of the hypothalamic-pituitary-ovarian axis (HPO axis) triggers an increase in the secretion of gonadotropins (FSH and LH), which is then followed by an increase in estrogen production by the ovaries. In the early phases of puberty, estrogen spikes give rise to signs of puberty to menarche (Kliegman et al., 2020)

Nutritional status, especially body fat levels, is also a significant factor. Leptin produced by fat tissue functions as a signal of puberty by activating the HPO axis. Children with a high body fat percentage tend to experience menarche earlier (Ganong et al., 2014). On the other hand, poor nutritional status, the presence of endocrine diseases, or excessive physical activity can delay the occurrence of menarche. Daily food intake also affects, especially the consumption of fast food that is high in fat and sugar and low in fiber. Such a diet can trigger an increase in body weight and fat, thereby accelerating puberty (Ganong et al., 2014).

The variation in menarche age found in this study reflects the complex interaction between biological, nutritional, hormonal, and environmental factors. Overall, although the age of menarche in most respondents was younger than the national average, all respondents were still within normal limits (9–16 years). Thus, this study did not find cases of abnormal menarche, but only variations in menarche age that were still within the normal physiological range. Based on the results of the analysis of the relationship between nutritional status and menarche age, it was shown that 14 underweight students had not menarched (93.3%), 1 student (6.7%) had underweighted, 110 students (78%) had menarched, 31 students (22%) had not metaphed, 92% of overweight students had experienced menarche and 8% had not. Also, 96.8% of obese students have experienced menarche and 3.2% have not.

From these results, it is known that there are a small number of respondents who have undernourished status but have experienced menarche and overnutrition status but have not experienced menarche. These results are due to many factors that can affect the age of menarche. Not only nutritional status, lack of weight due to excessive activity such as anorexia sufferers or female athletes can trigger puberty delays caused by lack of body fat reserves so that leptim production becomes less (Ganong et al., 2014).

Aurelia (2024) revealed in her research that high cholesterol levels in food can potentially increase the hormone estrogen which can ultimately accelerate the age of menarche (Aurelia Noa et al., 2024). Other factors such as maternal menarche age genetics and lesson stress can also affect the age at which menarche occurs (Gultom et al., 2020). The higher the nutritional status of a girl, the earlier the age of menarche tends to be. This is due to excess fat tissue causing an increase in leptin and the activity of the aromatase enzyme that works to convert androgens into estrogen. Estrogen is the main hormone that triggers puberty, including menarche (Kliegman et al., 2020).

The results of statistical analysis showed a P value of < 0.001 which means that there is a meaningful relationship between nutritional status (BMI) and menarche age. These findings are in line with the research of Arban (2024) with a P value = 0.014 and Rahayu (2023) with a P = 0.034 value which shows a significant relationship between nutritional status and menarche changes. Rahayu (2023) in his research emphasized that nutritional status is an important influencing factor, although other factors such as the environment, socio-economy, and media exposure also play a role (Rahayu et al., 2023).

Thus, it is concluded that nutritional status is closely related to the age of menarche. Children who are overweight and obese tend to experience menarche early, while underweight children experience delays or takes longer than children with overnutrition or obesity. However, other factors such as genetics, environment, physical activity, and hormonal sensitivity are contributing factors and need to be considered.

CONCLUSION

Nutritional status is significantly associated with the age at menarche in adolescent girls, with those who have better nutritional status tending to experience earlier menarche, while undernourished adolescents often experience delayed onset. Therefore, early nutrition monitoring and education are essential to support healthy growth and reproductive health. Schools and healthcare providers are encouraged to regularly assess adolescents' nutritional status and provide guidance on balanced diets to promote optimal development. Increasing awareness among parents and educators about the importance of proper nutrition for adolescent girls' reproductive health is also crucial. Future research should further investigate additional determinants—such as socioeconomic, environmental, and lifestyle factors—that may influence variations in the age at menarche.

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