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Original Research

The Relationship Between Physical Activity and Nutritional Status with Early Menarche in School Age Children in Bekasi City

Hubungan Status Gizi dan Aktivitas Fisik dengan Menarche Dini pada Anak Usia Sekolah di Kota Bekasi

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Abstract: *Early menarche is the first menstruation in girls that occurs at the age of under 12 years. Early menarche is an important phenomenon that can affect the health and development of girls. Early menarche can cause several other health problems such as breast cancer in girls due to longer exposure to estrogen and progesterone. This study aims to analyze the relationship between nutritional status and physical activity with early menarche in school-age children in Bekasi City. This study was conducted in East Bekasi District, which is one of the districts in Bekasi City with a fairly heterogeneous female population with a sample of 122 female students taken using the consecutive sampling method. This study uses a quantitative approach with a cross-sectional design, which allows researchers to collect data simultaneously on independent variables (nutritional status and physical activity) and dependent variables (early menarche). Data were collected through questionnaires, and will be analyzed using appropriate statistical methods to determine the relationship between the variables studied. The results of this study showed a significant relationship between nutritional status and early menarche (p = 0.005), as well as between physical activity and early menarche (p = 0.041). Children with higher nutritional status were 3.12 times more at risk of experiencing early menarche than children with normal nutritional status. In addition, children with low physical activity were 2.451 times more at risk of experiencing early menarche than children with sufficient physical activity.*

Key word: Early Menarche, Physical Activities, Nutritional Status

1. INTRODUCTION

Adolescence is a transitional phase from childhood to adulthood that involves physical, psychological and socio-cultural changes. According to the World Health Organization (WHO) an adolescent is someone aged 10 to 19 years [1]. Adolescents experience rapid physical, cognitive and psychosocial growth. This affects the way they think, feel, interact with the world around them and make decisions. During this phase, adolescents form patterns of behavior – such as physical activity, diet, substance use and sexual activity – that can protect their health and the health of others around them, or endanger their health now and in the future [1].

One of the problems that often occurs in adolescence is related to puberty, especially in adolescent girls who have just had their first period or what is called menarche. Menarche that is currently a problem is menarche that occurs earlier than the age it

should. It is said to be early menarche if blood comes out of the reproductive organs for the first time experienced by a woman before the age of 12 years. Early menarche is caused by the hormone estrogen which is produced faster than other women who are genetic and have no abnormalities in their reproductive organs [2].

Based on the results of the 2023 Indonesian Health Survey, in Indonesia, 4.6% of children aged 9-10 years experienced menarche. Based on the province, the following provinces occupy the highest positions for the number of children aged 9-10 years who experienced menarche: Riau Islands (8.6%), DKI Jakarta (8.1%), and West Java (6.9%) [3]. The results of the 2023 Indonesian Health Survey in West Java experienced an increase from the results of the 2010 Riskesdas, the percentage of women who experienced menstruation at the age of 9 to 10 years was 1.7% [4]. As time goes by, the age of menarche decreases, this is in line with the results of research conducted by Sudikno in 2018 [5].

Early menarche can cause other problems that can interfere with daily life. Based on the results of previous studies that discussed girls with menarche ages of 10 and 11 years, they were more likely to show poor self-assessment of health, high psychological stress, and sexual initiation compared to children who experienced menarche at the age of 12 years [6]. In addition, early menarche can also cause earlier menopause, this is supported by research conducted by Tutin Marlia in 2021 with the results of the study stating that most respondents experienced menarche age ≤14 years and experienced early menopause by 86.36% [7].

In addition, early menarche can increase the risk of breast cancer, namely by increasing exposure to estrogen and progesterone hormones longer because of earlier menstruation[8]. Based on the Global Cancer Observatory (WHO), breast cancer is the most common cancer case in Indonesia, which is 30.1% [9]. Menarche that is too early can also have an impact on the birth rate, in women with a young age of first menstruation, and underage marriage, lengthening the reproductive age range of women and affecting the number of children born [4].

Early menarche can be caused by several factors such as nutritional status, body fat percentage, physical activity, and even exposure to mass media. Based on the results of previous studies, there is a significant relationship between body fat percentage and nutritional status with the incidence of early menarche [10]. In line with the results of research conducted by Rita et al., (2022) there is a relationship between exposure to mass media and age of menarche because mass media can accelerate the onset of puberty and is also related to the age of menarche in adolescent girls[11]. Physical activity is also related to the incidence of early menarche because physical activity can affect the productivity of sex hormones [12]. A systematic review and meta-analysis study showed a link between obesity and menarche. In addition, the duration of physical activity is also related to menarche. In a study comparing groups of athletes and non-athletes, a longer age of menarche was also found in the athlete group. However, the age of menarche is also influenced by modifications of other factors such as diet and lifestyle. In a study conducted in Jambi, it was shown that physical activity was not related to menarche, but rather nutritional status was related to menarche [13].

Based on this description, researchers are interested in finding out more about physical activity and nutritional status associated with early menarche. The study was conducted in Bekasi City as one of the cities in West Java Province. West Java itself is

recorded as one of the three largest provinces with the highest number of early menarche ages.

2. METHODS

This study is part of a larger study entitled "Assessment of Snack Consumption and Nutritional Content of Snacks in Elementary Schools in Bekasi City". The research team obtained ethical review approval from the STIKes Banis Saleh Research Ethics Commission (No: EC. 143/KEPK/STKBS/VII/2024). This study used a quantitative approach and cross-sectional design. This study started from August 2024 to December 2025.

The location of this study was an elementary school in East Bekasi, data collection was taken on a large scale to prevent data homogeneity. East Bekasi District is also a district with the 3rd largest female population after North Bekasi and West Bekasi in Bekasi City, which is 128,205 female residents. In addition, according to data from the Ministry of Education, Culture, and Higher Education (2023), East Bekasi District is also a district with the largest number of female students in Bekasi City, which is 13,272 female students.

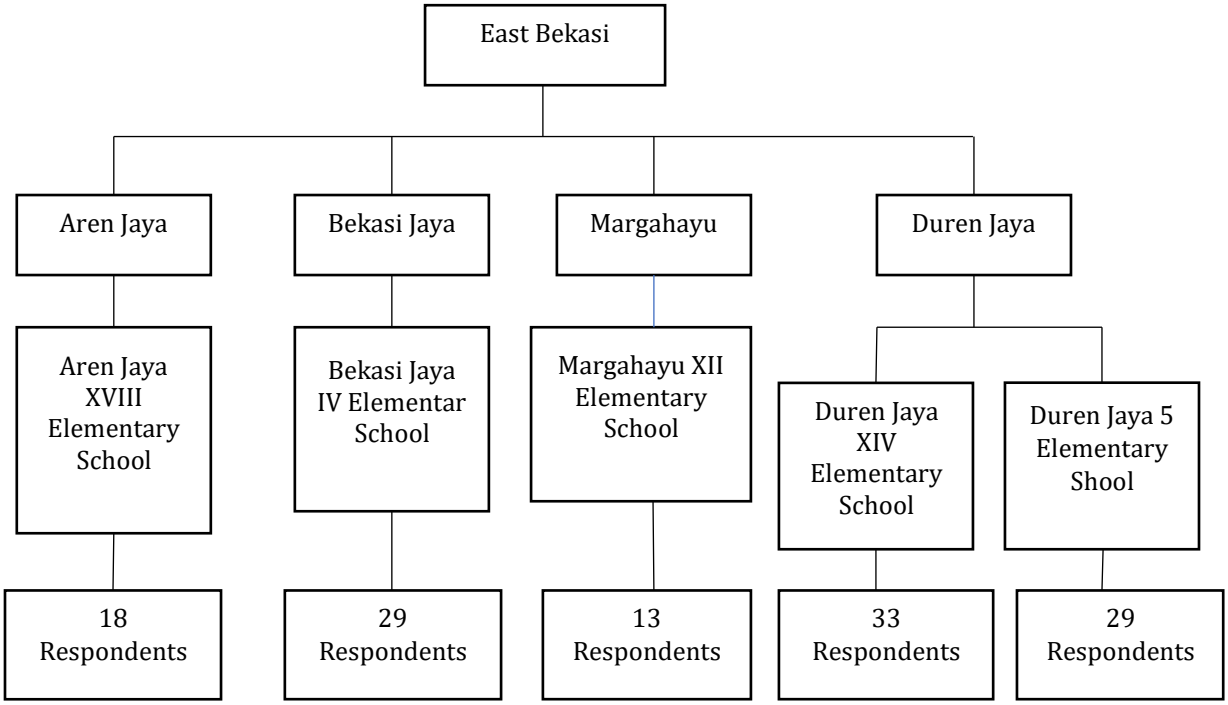

Figure 1. Distribution of Respondents Based on Research Location

In this study, the following elementary schools were selected: SDN Duren Jaya XIV and SDN Duren Jaya 5 (representative of Duren Jaya Village), SDN Aren Jaya XVIII (representative of Aren Jaya Village), SDN Margahayu XIII (representative of Margahayu Village), SDN Bekasi Jaya IV (representative of Bekasi Jaya Village). The elementary schools selected were based on public schools with the most students in East Bekasi. In this study, researchers took samples using non-probability sampling techniques using the consecutive sampling method to select samples by setting

boundaries based on the characteristics of the subjects to be used as research samples, such as demographics, gender, occupation, age, and so on [14]. Sample criteria: 1. Active female students, 2. Female students who are under 12 years old; 3. Female students who are willing to be respondents.

Nutritional status was determined by taking anthropometric measurements of body weight and height. Body weight was obtained by weighing using a calibrated digital scale. Height was obtained by measuring using a microtoise. Furthermore, the anthropometric data was calculated as the z-score of body mass index (BMI) according to age (BMI/A). The group was categorized as not obese if the z-score value was ≤ 1 SD, and obese if > 1 SD. Activity was measured using the PAQ-C (Physical Activity Questionnaire - Children) questionnaire which has been validated by previous research (Jati, 2024). The classification of activities obtained was as follows: Light physical activity: value ≥ 1 to <2; moderate activity: value ≥ 2 to <5; and heavy activity: value 5. History of menarche was obtained using an early menarche questionnaire developed by previous researchers.

The results of the study were analyzed using the bivariate chi-square test and continued with the multivariate logistic regression test. The variables were concluded to be related if the test results showed a p-value <0.05. In addition, researchers also determined the strength of the variable risk by finding the odd ratio (OR) value.

3. RESULTS

Respondent Characteristic

Univariate analysis was conducted to determine the distribution of data such as age, class, nutritional status, father's education, mother's education, and village. Respondent characteristics are as follows.

Table 1. Respondent Characteristic

Respondent characteristics	Amount (n)	Precentage(%)
Age		
1. 9 years	1	0.8
2. 10 years	35	28.7
3. 11 years	86	70.5
Mother's educational history		
1. No school	1	0.8
2. No graduated from elementary school	2 5	1.6 4.1
3. Graduated from elementary school	13	10.7
4. Graduated from junior high school	39	32
5. Graduated from senior high school	16	13.1
6. Graduated form collage	46	37.7
7. Don't know		
Father's educational history		
1. No school	0	0
2. No graduated from elementary school	3 5	2.5 4.1
3. Graduated from elementary school	13	10.6
4. Graduated from junior high school	26	21.3
5. Graduated from senior high school	19	15.6
6. Graduated form collage	56	45.9
7. Don't know		
Mother's Job		

Respondent characteristics	Amount (n)	Precentage(%)
1. Have no job	57	46.7
2. PNS/TNI/Polri/BUMN/BUMD	10	8.3
3. Employees	17	13.9
4. Self-employed	17	13.9
5. Farmer	0	0
6. Fisherman	0	0
7. Laborer/driver/domestic helper	19	15.6
8. etc	2	1.6
Father's Job		
1. Have no job	4	3.3
2. PNS/TNI/Polri/BUMN/BUMD	13	10.7
3. Employees	48	39.3
4. Self-employed	26	21.3
5. Farmer	2	1.6
6. Fisherman	1	0.8
7. Laborer/driver/domestic helper	20	16.4
8. etc	8	6.6
Early Menarche		
Yes	43	64.8
No	79	35.2
Physical activities		
Moderate	27	22.1
Light	95	77.9
Status Gizi		
Obesity	35	28.7
No obesity	87	71.3

n = 122

In this study, the respondents used were female elementary school students under 12 years old. If the students who became respondents had experienced menstruation, it can be said that the students experienced early menarche. Based on the results of data collection, there were 43 female students (35.2%) who had experienced menarche. It can be concluded that 43 respondents experienced early menarche, while students who had not experienced menstruation were 79 (64.8%). Based on their physical activity, the majority of respondents had light activity, namely 95 (77.9%) and students who had moderate physical activity were 27 (22.1%). Meanwhile, based on their nutritional status, the majority of respondents were not at risk of obesity, namely 87 (71.3%) students and students who had nutritional status at risk of obesity were 35 (28.7%) students.

The Relationship between Nutritional Status and Early Menarche in School-Age Children in Bekasi City

This section aims to determine the relationship between nutritional status and early menarche using bivariate and multivariate tests, with the following research results:

Table 2. The Relationship between Nutritional Status and Early Menarche in School-Age Children in Bekasi City

Nutritional Status	Early Menarche				Total		*p-value*[1]	COR (95% CI) [1]	*p-value*[2]	OR (95%CI)[2]
	Yes		No							
	n	%	n	%	n	%				
At risk of obesity	19	54,3	16	45,7	35	100	0,005	3,12 (1,38 – 7,04	0,008	

No risk of obesity	24	27,6	63	72,4	87	100		3,095 (1,351 – 7,089)

[Source : Primary Data (2024); n=122; a :Chi-Square; significant if (p-values <0,05) b : Logistic Regression; significant if (p-value < 0,05)]

The analysis of the relationship between nutritional status and early menarche in school-age children in Bekasi City revealed that 19 (54.3%) obese students experienced early menarche. There were also 24 (27.6%) non-obese students who experienced early menarche.

The chi-square test yielded a p-value of 0.005, concluding that there is a difference in the proportion of early menarche between obese and non-obese students, indicating a significant relationship between nutritional status and early menarche in school-age children in Bekasi City. The analysis also found a Correlation Odds (COR) of 3.12. Therefore, students with obese nutritional status have a 3.12 times greater risk/odds of experiencing early menarche compared to non-obese students. In addition, a multivariate test with logistic regression was also conducted, resulting in a p-value (0.008) < 0.05, indicating that the variable most associated with early menarche was nutritional status with an OR (95%CI) of 3.095. Thus, students with obese nutritional status were 3.095 times more likely to experience early menarche than students who were not obese.

The Relationship between Physical Activities and Early Menarche in School-Age Children in Bekasi City

This section aims to determine the relationship between physical activities and early menarche using bivariate and multivariate tests, with the following research results:

Table 3. The Relationship between Physical Activities and Early Menarche in School-Age Children in Bekasi City

Physical Activitiy	Early Menarche				Total		*p-value* [1]	COR (95%CI) [1]	*p-value* [2]	OR (95%CI) [2]
	Yes		No							
	n	%	n	%	n	%				
Light	14	51,9	13	48,1	27	100	0,041	2,451 (1,025 – 5,862)	0,054	2,425 (0,984 – 5,977)
Medium	29	30,5	66	69,5	95	100				

[Source : Primary Data (2024); n=122; a :Chi-Square; significant if (p-values <0,05) b : Logistic Regression; significant if (p-value < 0,05)]

Based on the table above, the analysis of the relationship between physical activity and early menarche in school-age children in Bekasi City revealed that 14 (51.9%) students with light physical activity experienced early menarche. The results also showed that 29 (30.5%) students with moderate physical activity experienced early menarche.

The chi-square test yielded a p-value of 0.041, concluding that there is a difference in the proportion of early menarche in students with light physical activity compared to those with moderate physical activity, indicating a significant relationship between physical activity and early menarche in school-age children in Bekasi City. The analysis also found a COR (95% CI) of 2.451. Therefore, students with light physical activity are 2.451 times more likely to experience early menarche than students with moderate physical activity. In addition, a multivariate test was also carried out with logistic regression, which obtained a p-value (0.054) < 0.05, thus indicating that the physical activity variable did not have a significant relationship with early menarche.

4. DISCUSSION

The Relationship between Nutritional Status and Early Menarche in School-Age Children in Bekasi City

Bivariate test results indicate a relationship between nutritional status and early menarche in school-age children in Bekasi City. Girls with a higher Body Mass Index (BMI) tend to experience menarche at an earlier age. This condition is associated with increased levels of the hormone leptin, which is generally higher in individuals with a higher BMI. Leptin plays a role in regulating reproductive function and can accelerate reproductive system maturation, thus triggering earlier menarche. Nutritional status that puts one at risk for obesity can be a contributing factor to earlier menarche. A person's nutritional status plays a role in the secretion of hormones that trigger secondary sexual development, which are produced by the hypothalamus, pituitary, and ovaries. In girls with excessive nutritional status, these hormones can be triggered to form earlier [15].

Adolescent girls with higher nutritional status tend to have more body fat, which increases leptin levels. Elevated leptin stimulates the hypothalamus to release Gonadotropin-Releasing Hormone (GnRH), leading to the secretion of Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH) from the pituitary gland. These hormones promote estrogen production and follicle maturation, accelerating the onset of menarche. Thus, higher BMI and leptin levels are associated with earlier menarche, while girls with normal nutritional status experience it later [16]. In the hypothalamus, leptin directly accelerates GnRH secretion, while in the anterior pituitary, leptin stimulates the release of LH and FSH, which then trigger the follicular phase. Furthermore, leptin plays a role in influencing reproductive system function through the presence of leptin receptors expressed on the surface of follicular cells in the ovaries. During the follicular phase, this activity contributes to increased estrogen production, which can ultimately accelerate the onset of menarche[17]

The findings of this study are consistent with research (Taufiqurrahman,2018) which explains that individuals with a higher body mass index (BMI) produce greater amounts of leptin compared to individuals with a lower BMI, which can lead to an earlier age at menarche [10]. Similarly, research (Wahyuningsih, 2023) states that optimal nutrition can help accelerate the growth and development of sexual organs, while inadequate nutrition can result in delayed sexual maturation and stunted growth. Meanwhile, overnourished adolescents also experience earlier menarche [18].

The Relationship between Physical Activities and Early Menarche in School-Age Children in Bekasi City

The results of this bivariate study indicate a relationship between physical activity and early menarche in school-aged children in Bekasi City. The results of this study indicate that low physical activity can influence the occurrence of early menarche because individuals with low levels of physical activity tend to

have a higher Body Mass Index (BMI) compared to individuals with moderate or high levels of physical activity, which will affect leptin levels in body fat and occur earlier menarche. Girls with low levels of physical activity tend to have a higher body mass index (BMI) and body fat percentage compared to those who regularly engage in physical activity [17]. In addition, someone with low levels of physical activity also experiences menarche at a younger age. The accumulation of body fat mass in girls with low levels of physical activity is known to contribute to increased secretion of the hormone leptin, a hormone that plays a role in regulating energy balance and has an important role in accelerating sexual maturity, including accelerating the age of menarche.

In line with research (Larasati, 2019) found that physical activity plays a role in balancing nutrient intake and output, which also affects the reproductive hormone process[19]. Research conducted (Sulung, 2018) states that female students with light physical activity tend to experience faster endometrial maturation, which can accelerate the onset of menarche[20]. This is due to the tendency of young women with light physical activity to have higher levels of body fat, which plays a role in accelerating this process. High levels of fat also result in higher levels of leptin. Leptin contributes to regulating the maturation of reproductive organs through hormonal mechanisms that play a role in the initiation and maintenance of reproductive function, known as gonadarche, and stimulates increased secretion of adrenal androgens, or adrenarche. Based on previous research, light-intensity physical activity can physiologically reduce cortisol production. By reducing cortisol production, the number of ovarian follicle reserves can increase, which increases the likelihood of egg maturation [21].

The Relationship between Nutritional Status and Physical Activities with Early Menarche in School-Age Children in Bekasi City

This study tested each variable using a bivariate test and then a multivariate test, which involves testing two independent variables simultaneously to determine which variable most influences early menarche. Furthermore, with multivariate testing, each variable will influence the values of the others.

Multivariate analysis, which simultaneously tested independent variables against the dependent variable, revealed that the variable most associated with early menarche was nutritional status. This is because nutritional status plays a role in influencing the production of hormones that contribute to the development of secondary sexual characteristics, secreted by the hypothalamus, pituitary, and ovaries. Girls with overweight tend to experience earlier production of these hormones [22]. Increased nutritional status can lead to fat accumulation in subcutaneous tissue, which acts as a storage site for leptin. This increase in leptin levels then influences GnRH, which stimulates the release of FSH and LH in the ovaries. Both hormones play a role in follicle formation and estrogen production, thus accelerating the onset of menarche [23].

Meanwhile, physical activity did not show a statistically significant relationship in the multivariate analysis with early menarche. Although physical activity appeared to be associated with early menarche in the bivariate analysis, after controlling for nutritional status, the relationship became insignificant. This lack of significance is likely due to the presence of stronger confounding factors, such as nutritional status. Nutritional status directly influences early menarche through hormones. Furthermore, physical activity indirectly influences early menarche through body mass index and body fat composition [24].

Although this study did not show statistical significance, physical activity still plays a crucial role in overall health. Regular physical activity plays a role in maintaining the body's energy balance, thus helping individuals achieve and maintain a healthy weight, improving physical fitness, and supporting optimal child growth and development. Therefore, increasing physical activity remains essential as part of promotive and preventive efforts to mitigate the risk of early puberty.

5. CONCLUSION

Early menarche is a biological phenomenon that not only reflects physiological changes but is also influenced by various other factors. The findings of this study indicate that nutritional factors play a significant role in determining the timing of sexual maturity in girls. An imbalance in nutritional intake, particularly excess energy that results in increased body fat, can accelerate the hormonal system's adjustment process and lead to earlier-than-normal menarche.

Earning puberty due to nutritional factors can increase the risk of reproductive health problems in the future and require mental readiness that may not align with biological development. Therefore, interventions focused on preventing overnutrition during childhood need to be prioritized, especially in the context of urbanization and changing consumption patterns, as is occurring in Bekasi City.

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