CORRELATION BETWEEN BODY MASS INDEX AND AGE OF PUBERTY IN ADOLESCENT GIRLS IN INDONESIA

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ABSTRACT~~~~~~

Changes in the age of puberty have now occurred in various parts of the world including in Indonesia. One of the factors causing this is the state of nutrition which can be assessed by body mass index (BMI) experiencing changes that result in early puberty. The purpose of this study was to determine the relationship between body mass index in adolescent girls. Respondents of this study were 76 adolescent girls with Simple Random Sampling technique. The research was conducted on April 22, 2024 to April 29, 2024. Univariate analysis to see the age of puberty obtained from questionnaires and body mass index measuring height and weight. The results at the age of puberty are dominated at the age of 10 years, with an age range of 8 years to 12 years. The results on Body Mass Index found that 35 adolescent girls (46.1%) were underweight, 31 adolescent girls (40.8%) were normal, 6 adolescent girls (7.9%) were overweight, 3 adolescent girls (3.9%) were obese, and 1 adolescent girl (1.3%) was found with type II obesity status. Bivariate analysis to see the relationship between Body Mass Index and the age of puberty showed a p value of 0.014 (<0.05). It has a relationship between other factors, so adolescent girls must maintain a balanced nutritional diet.

Keywords: **Body Mass Index; Age of Puberty; Adolescent; Puberty**

ABSTRAK~~~~~~

Perubahan umur pubertas saat ini telah terjadi di berbagai belahan dunia termasuk di Indonesia. Salah satu faktor penyebabnya adalah keadaan nutrisi yang dapat dinilai dengan indeks massa tubuh (IMT) mengalami perubahan yang mengakibatkan pubertas dini. Tujuan penelitian ini adalah untuk mengetahui hubungan indeks massa tubuh pada remaja putri. Responden penelitian ini 76 remaja putri dengan teknik Simple Random Sampling. Penelitian dilakukan pada 22 April 2024 hingga 29 April 2024. Analisis univariat untuk melihat umur pubertas didapatkan dari kuesioner dan indeks massa tubuh mengukur tinggi badan serta berat badan. Hasil pada umur pubertas didominasi pada umur 10 tahun, dengan rentang umur 8 tahun sampai umur 12 tahun. Hasil pada Indeks Massa Tubuh didapatkan bahwa 35 remaja putri (46,1%) status kurus, 31 remaja putri (40,8%) status normal, 6 remaja putri (7,9%) dengan status kelebihan berat badan, 3 remaja putri (3,9%) status obesitas, dan 1 remaja putri (1,3%) ditemukan dengan status obesitas tipe II. Analisis bivariat untuk melihat hubungan Indeks Massa Tubuh dengan umur pubertas didapatkan hasil p value 0,014 (< 0,05). Hal itu memiliki hubungan diantara faktor lainnya, sehingga remaja putri harus menjaga pola makan gizi seimbang.

Keywords: **Indeks Massa Tubuh; Umur Pubertas; Remaja; Pubertas**

INTRODUCTION

Puberty in adolescents is a crucial phase due to physical, mental, and sexual organ maturity changes. Some literature reveals that there is a tendency for puberty to occur earlier. Puberty generally occurs in the age range of 10-14 years. The onset of puberty in individuals is influenced by genetic factors, gestation period, nutrition, and lifestyle (Fadila & Nugroho, 2018). Adolescents who have problems in the development of puberty are found to be overweight. Overweight/obesity in adolescence is widely considered a risk factor for comorbidities in adolescence, such as type two diabetes, hypertension, dyslipidemia, coronary heart disease, liver and orthopedic problems, and psychosocial comorbidities. Research from Zhou suggests that overweight/obesity in adolescence may also adversely affect the pubertal process (Zhou, 2022).

Longitudinal studies suggest that girls who have a higher body mass index tend to go through puberty earlier than normal weight girls. The adverse effects of early puberty on reproductive and physical health later in life include lower fertility, higher risk of type two diabetes, cardiovascular disease, and cancer (Zhou, 2022). Lasmi's research shows that early puberty can accelerate the growth of bone maturation processes that lead to short stature. Short stature is more likely to occur if puberty starts very early, that is, before the age of 6 years, than if it starts early enough, that is, the age of 6-8 years (Lasmi, 2022).

Another study from Busch says that there is currently a trend towards earlier puberty in children. Early puberty has an impact on final height, as children who puberty too early tend to be shorter due to faster bone maturation. Adolescents are on average 10.5 years old going through puberty. Girls this year are on average 9.5 years old going through puberty with the risk factor of obesity. Obese adolescent girls are twice as likely to experience precocious puberty (Eckert Lind, 2020).

Adolescent obesity is a common global public health problem in both developing and developed countries. In China, 19.2% of adolescents aged 7-18 years are overweight or obese. The prevalence of obesity in adolescents aged 6 to 11 years increased from 7% in 1980 to nearly 18% in 2012 in the United States. The percentage of obese individuals in adolescents aged 12 to 19 years increased from 5 to almost 21%, in 2016 it was found that more than 340 million adolescents aged 5-19 years were overweight or obese worldwide (Zhou, 2022).

There were 1 in 5 school-aged children at 20% or 7.6 million, 1 in 7 adolescents at 14.8% or 3.3 million and 1 in 3 adults at 35.5% or 64.4 million overweight or obese in 2018 in Indonesia. Cases of overweight or obesity in adolescents aged 5-12 years in Bali are ranked

6th out of 34 provinces in Indonesia. In data on overweight or obesity in adolescents aged 13-15 years, Bali is ranked 3rd out of 34 provinces in Indonesia (Colozza, 2019).

Various studies have shown that the age of puberty has a relationship with body mass index. Excess weight causes adolescents to experience accelerated puberty. Bruzzi's research shows that changes in the timing of puberty caused by overfeeding is a factor that allows the onset of puberty (Bruzzi, 2022). Excess weight affects the timing of pubertal maturation which triggers breast growth before pubic hair growth which shows the first manifestation of puberty. This study aims to analyze the relationship between body mass index and age at puberty.

METHODS

This research is a correlative analytic study, one of the statistical analysis techniques to determine the relationship between two quantitative variables. This research was conducted in the Ungasan Village, South Kuta Sub-district, Badung Regency, Bali, Indonesia which is the working of four elementary school, SDN 1 Ungasan, SDN 3 Ungasan, SDN 4 Ungasan and SDN 8 Ungasan. The population were adolescents who attended classmate four, five and six grades and totaling 76 samples after clouting the correlative formula were selected if they met the inclusion and exclusion criteria. Inclusion criteria were adolescent girls who are already experiencing signs of puberty, willing to be a respondent and have signed the informed consent. Exclusion criteria is respondents who were not cooperative and were deemed to hinder the research process. Sampling type using simple random sampling technique. The tool used in this study is the GEA ZT-120 scale which has the function of measuring body weight and height simultaneously. The data collection instruments to be used include written statements in the form of questionnaire. Univariate analysis was conducted to describe the characteristics of each menarche, age of menarche, breast growth, age of breast growth, genital hair growth, age of genital hair growth and peer support the median value, minimum value, maximum value were obtained. Bivariate analysis was conducted to analyze the relationship between each variable using the Contingency Coefficient test because the data were not normally distributed after the data normality test using the Chi-Square test. This study has received ethical approval from the Ethics Commission of the Denpasar Health Polytechnic with No. DP.04.02/F.XXXII.25/0482/2024.

RESULTS

1. Respondent Characteristics
   The characteristics of respondents in this study are presented in table 1 as follows:

Table 1. Respondent Characteristics

Characteristics	Result		
	Frequency (f)	*Percentage (%)*	*Median*
Age Of Respondent			
10 Years	2	2.6	
11 Years	21	27.6	
12 Years	51	67.1	12 Years
13 Years	2	2.6	
Menarche Status			
Already Menarche	73	96.1	
Not Yet Menarche	3	3.9	
Menarche			
10 Years	14	18.4	
11 Years	46	60.5	
12 Years	13	17.1	11 Years
Not Yet Menarche	3	3.9	
Breast Growth			
Already Growing	74	97.4	
Not yet grown	2	2.6	
Breast Growth Age			
8 Years	1	1.3	
9 Years	2	2.6	
10 Years	34	44.7	
11 Years	30	39.5	10 Years
12 Years	7	9.2	
Not yet grown	2	2,6	
Genital Hair Growth			
Already Growing	73	96.1	
Not yet grown	3	3.9	
Genital Hair Growth Age			
8 Years	3		
9 Years	13	3.9	
10 Years	38	17.1	11 Years
11 Years	19	50.0	
12 Years	3		
Not yet grown			

Based on the table above, the age of the research subjects was dominated by respondents aged 12 years as many as 51 people (67.1%) with an age range of 10 - 13 years. Respondents who have experienced menarche as many as 73 people (96.1%), have experienced menarche mostly at the age of 11 years as many as 46 people (60.5%) with an age range of 10 - 12 years. Breast growth as many as 74 respondents (97.4%) have experienced breast growth and most of them experienced breast growth at the age of 10 years as many as 34 people (44.7%) with an

age range of 9-12 years. In the characteristics of genital hair growth, 73 people (96.1%) have experienced genital hair growth and most of the genital hair growth occurs at the age of 11 years as many as 38 people (50%) in the age range of 9 - 12 years.

Table 2. Body Mass Index

Body Mass Index (BMI)	Frequency (f)	Percentage (%)
Underweight	35	46.1
Normal	31	40.8
Overweight	6	7.9
Obesity	3	3.9
Obesity II	1	1.3
Total	**76**	**100**

Based on the table above, the research subjects were dominated by respondents with a thin BMI category as many as 35 people (46.1%) and the smallest respondent in the obesity II category was 1 person (1.3%).

Table 3. Age of Puberty

Age of Puberty	Frequency (f)	Percentage (%)
8 Years	1	1.3
9 Years	4	5.3
10 Years	39	51.3
11 Years	27	35.5
12 Years	5	6.6
Total	**76**	**100**

Based on the table above, most respondents experienced puberty at the age of 10 years (51.3%) and respondents who experienced early puberty at the age of 8 years (1.3%) in the age range of 8 - 12 years.

Table 4. Analysis of the Relationship between Body Mass Index and Age of Puberty

BMI	Age of Puberty										Total	
	8 Years		9 Years		10 Years		11 Years		12 Years			
	f	%	f	%	f	%	f	%	f	%	f	%
Underweight	0	0.0	0	0.0	14	35.9	17	63.0	4	80.0	35	46.1
Normal	0	0.0	3	1.6	19	48.7	9	33.3	0	0.0	31	40.8
Overweight	1	100	0	0.0	4	10.3	0	0.0	1	20.0	6	7.9
Obesity	0	0.0	1	25.0	1	2.6	1	3.7	0	0.0	3	3.9
Obesity II	0	0.0	0	0.0	1	2.6	0	0.0	0	0.0	1	1.3
Total	**1**	**100**	**4**	**100**	**39**	**100**	**27**	**100**	**5**	**100**	**76**	**100**

Source: ***Descriptive Test***

Based on the table above, respondents with thin BMI category were dominated by respondents aged 11 years as many as 17 people (63%), in the normal BMI category most were 10 years old as many as 19 people (48.7%), in the overweight BMI category dominated by respondents aged 10 years as many as 4 people (10.3%), in the obese BMI category as many as 3 people at the age of 9, 10, and 11 years, while in the obese BMI II category as many as 1 person (2.6%) aged 10 years. The minimum value of puberty age is 8 years, the maximum value is 12 years, and the median value is 10 years.

Table 5. Contingency Coefficient Test Results

Contingency Coefficient	Value	Approximate Significance
Body Mass Index - Age of Puberty	.538	0,014

Source: ***Contingency Coefficient Test***

Based on the test results using Coefficient Contingency which is used as an alternative because the Chi Square test does not meet the requirements. The results of statistical tests using Coefficient Contingency obtained p value = 0.014. The p value (<0.05) can be concluded that there is a relationship between body mass index and the age of puberty of adolescent girls in Ungasan Village.

DISCUSSION

1. Body Mass Index in Adolescent Girls

Based on the results of research on 76 adolescent girls whose weight and height were measured, the body mass index in thin adolescent girls was 35 people (46.1%), normal 31 people (40.8%), overweight 6 people (7.9%), obese 3 people (3.9%) and with type II obesity there was 1 person (1.3%). The causes of adolescent girls who are found with excessive nutritional status to reach obesity are due to many factors, including peer influence, parental role models, food availability, food preferences, cost, convenience, personal beliefs, culture, mass media, and body image. (Das, 2017). Adolescence is characterized by rapid growth rates. Adolescent nutrition and transition are closely intertwined due to eating patterns and behaviors. Diet is one of the ways individuals regulate the amount, frequency and type of food in one day. Improper intake of nutrients in the body can lead to unfavorable things (Ramadani, 2017).

One of the causes of dietary changes is low nutritional knowledge, which results in the wrong diet. Fast food, consumption of sugar, salt and excess fat is one of the contributions of

adolescents affected by obesity which leads to the incidence of early puberty. Research conducted by Syam shows that adolescents who are thin experience puberty late while adolescents with overweight experience puberty faster. (Syam, 2022). Risk factors in children and adolescents in the 5-19 years age group include a wide range of behavioral or lifestyle risk factors related to diet and physical activity, many of which show alarming trends. Availability of data on food consumption and diet, including for foods high in sugar, salt and fat (Colozza, 2019).

According to the 2018 Riskesdas data, two-thirds (66.7 percent) of children and adolescents in this age group consume sugar-sweetened beverages, mostly drinks with added sugar 61.8% compared to carbonated drinks or soft drinks 3.2% and energy drinks 1.7% and about one-third of children and adolescents respectively consume sweets 50.5% and salty snacks 31.6% once or more per day, while most 96.7% get less intake of fruits and vegetables. Further data is available from the Individual Food Consumption Survey by the Indonesian Ministry of Health, showing that 67.3% of children aged 5-12 years consumed vegetables, 28.4% consumed fruits, 75.5% and consumed sugar and sweets, and 66.7% consumed instant and packaged beverages. (Colozza, 2019).

Fast food and modern food retail, such as supermarkets, minimarkets and convenience stores, are sometimes associated with an increased risk of unhealthy food and beverage consumption. The rapid growth of fastfood outlets over the past few decades. Number of fast food and beverage stores. This has an influence on the future of adolescent girls if not immediately handled appropriately will continue to be found obese adolescents. Obesity is a health problem through the Sustainable Development Goals (SDGs) program must decrease by 2030. One of the efforts that can be done through parental education to children about the intake of safe and nutritious food and drinks.

2. Age of Puberty in Adolescent Girls

Based on the results of research on 76 adolescent girls who were given questionnaire sheets related to the history of puberty through the age of adolescents first experiencing puberty. The results found that the signs of puberty of adolescent girls vary by individual. After answering the questionnaire questions, it was found that 39 adolescent girls experienced puberty at the age of 10 years (51.3%), age 11 years (35.5%) as many as 27 people, age 12 years (6.6%) there were 5 people, age 9 years (5.3%) there were 4 people and age 8 years (1.3%) there was 1 person.

The age of onset of puberty varies greatly influenced by various factors such as genetics, socioeconomics, nutrition and environment (Kaswandani, 2017). Cases of girls experiencing puberty earlier are characterized by the appearance of secondary signs and the occurrence of menarche earlier. Adolescents are said to have entered puberty if one of the signs of puberty has occurred. Puberty experienced early is associated with the risk of developing breast cancer, abdominal obesity, insulin resistance, fat accumulation in adipose tissue, risk of cardiovascular disease and hypertension (Maditias, 2015). The dangers posed to adolescents' impact into adulthood leading to death. Adolescents with a history of early puberty may start sexual activity earlier (Kaplowitz, 2020).

It is important for adolescents to know the signs of puberty that require guidance from parents, schools, and society in order to go through the transition from children to adults well. Information on aspects of reproductive health should be provided as early as possible so that adolescents can avoid reproductive health problems, sexual violence, and sexual exploitation. (Fadila & Nugroho, 2018).

3. Relationship between Body Mass Index and Age of Puberty

Based on the Coefficient Contingency test, it was found that there was a relationship between body mass index and age of puberty in adolescent girls. The results obtained in adolescent girls in elementary schools the incidence of early puberty is experienced at the age of 8 years with excess weight. In the results of the study, at the age of 9 years puberty with obesity there was 1 adolescent girl and with normal nutritional status there were 3 adolescent girls. At the age of 10 years there were 39 adolescent girls who experienced early puberty with varying nutritional status conditions, namely thin 14 people (35.9%), normal 19 people (48.7%), overweight 4 people (10.3%), obese 1 person (2.6%), and type II obesity 1 person (2.6%). In addition, a significance value of p value 0.014 ($p < 0.05$) was obtained, which means that there is a relationship between body mass index and the age of puberty in adolescent girls in Ungasan Village.

Based on the results of the study, the incidence of early puberty in adolescent girls in the Ungasan Village Area can be caused by overweight and obesity. This is seen based on nutritional status factors, overweight nutritional status which results in adolescents experiencing accelerated puberty. Bruzzi's research shows that changes in the timing of puberty caused by overfeeding are a factor that allows the onset of puberty (Bruzzi, 2022). (Bruzzi, 2022). Excess weight affects the timing of pubertal maturation which triggers breast growth

before genital area hair growth which shows the first manifestation of puberty. This pattern differs from that among normal-weight individuals (Bruzzi, 2022).

The results of this study are also in line with the research of Putra et al., (2016) with the title Relationship between Body Mass Index (IMT) and Menarche Age in SMP Negeri 1 Padang students, with the results showing a significant relationship between the two variables, namely body mass index and menarche age. The higher the value of body mass index results, the greater the possibility of experiencing menarche faster. According to Proverawati & Misaroh (2017) body mass index is one of the factors that influence the occurrence of menarche. In this study, the result of the coefficient contingency test is 0.499, which means that it has a moderate relationship closeness because there are still other factors that can affect the age of menarche including heredity / genetics (mother's menarche age), race / ethnicity, social environment, socioeconomic status, mass media exposure that is not controlled by researchers. This is in accordance with research conducted by Fitriany et al., (2018) which says nutritional status is only one of the factors influencing the age of menarche and there are still other factors that influence the age of menarche, namely genetic factors, chronic diseases, maternal menarche and children who often enjoy adult things.

Science and technology that is increasingly sophisticated is one of the triggers, such as electronic media. The existence of external influences such as free sex films, sex books or magazines, and temptation from the opposite sex directly provides sexual stimulation that will enter the five senses and then stimulate the puberty center for reproductive hormone maturity

CONCLUSION

Based on the results of research on the relationship between body mass index and age of puberty, it can be concluded that the body mass index in adolescent girls was found to have nutritional status with overweight, obesity and type II obesity. The age of puberty of adolescent girls who experience puberty predominantly starts at the age of 10 years with signs of breast growth as the first sign of puberty, signs of menarche and finally puberty signs of hair growth in the genital area. Body mass index with age of puberty has an association in adolescent girls who experience early puberty with overweight nutritional status.

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ETHICS OF STUDY

This research applies the following ethical principles:

1. Principle of beneficence

The research conducted is able to provide goodness for human life. In this study, the principles of goodness include freedom from harm, freedom from exploitation, benefit from research and considering the ratio between the benefits and risks obtained by respondents (the risk/benefit ratio). The benefits obtained by adolescent girls who become respondents, namely being able to find out the nutritional status and puberty status that is being experienced.

2. The principle of respect for human dignity

The principle of respecting human dignity that must be implemented by researchers, namely in terms of the right to determine willingness to participate (the right to self-determination) and the right to refuse participation (the right to full disclosure). In this study, the researcher explained the purpose and benefits of the research to the respondents and facilitated the informed consent sheet. There is no element of coercion in this case, if the respondent agrees to become a research subject, it is proven by signing the informed consent sheet.

3. Principle of justice

The principle of fairness concerns the distribution of benefits and burdens in research. In this research, respondents are entitled to equal treatment before, during and after participation in the research. In addition, researchers have an obligation to maintain the privacy of respondents.

CONFLICT OF INTEREST

There is no conflict of interest.

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AUTHOR'S CONTRIBUTION

1. Ni Ketut Ayu Sujani: concept and research question, conducting research, statistical analysis, report writing.
2. Ni Wayan Suarniti: concept and research question, verified the analytical methods, supervised the findings of this work, statistical analysis, report writing

3. Ni Wayan Ariyani: concept and research question, verified the analytical methods, supervised the findings of this work, statistical analysis, report writing
4. Sri Rahayu: concept and research question, verified the analytical methods, supervised the findings of this work, statistical analysis, report writing
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