Prevalence of Hypertension and Risk Factors among Adolescent High School Girls

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ABSTRACT
Background: The health of adolescent girls is important. Teenage girls have a vital role in giving birth to a new generation (future mothers).
Purpose: The research aimed to determine the description of blood pressure in adolescent girls and to analyze what factors were associated with the incidence of hypertension in adolescent girls.
Methods: This research used a cross-sectional method with a descriptive approach. The sample of this research, a total of 1,193 adolescent girls at Jembrana Regency, Bali, Indonesia, from 5 high schools and vocational schools, was selected using purposive sampling. The adolescent girls were 15 to 19 years old with an average age of 16.5 years old. Blood pressure was categorized in children and adolescents by using four categories: normal, pre-hypertension, hypertension I, and hypertension II.
Results: The research results on 1,193 adolescent girls showed that the majority of respondents had blood pressure in the normal category, totaling 1,031 individuals (86%). A total of 149 adolescent girls (12%) were in the pre-hypertension category, while stage 1 and stage 2 hypertension were found in 13 respondents (1%). The average systolic blood pressure of respondents was 116.3 mmHg (SD ±12.3), and diastolic blood pressure was 71.3 mmHg (SD ±9.8). The average age of respondents was 16.5 years (SD ±0.7). Bivariate analysis results showed that nutritional status based on BMI and mid-upper arm circumference (MUAC) had a significant relationship with the incidence of hypertension in adolescent girls (p < 0.05). Adolescents with overweight, obesity, and chronic energy deficiency (CED) status were more frequently found in the pre-hypertension and hypertension groups.
Conclusions: It was concluded in this research that the majority of adolescent girls at Jembrana Regency, Bali-Indonesia had normal blood pressure. To prevent hypertension, adolescent girls have to maintain their health and change risk factors by optimizing their nutritional status.

Keywords: adolescent girls, blood pressure, hypertension

BACKGROUND

Adolescence is the age of transition from childhood to adulthood, starting from the age of 10 years old to 19 years old. which is up to 1.2 billion in the world and constitutes 18% of the world's population (WHO 2022). On a national scale, the number of people aged 10 – 24 years old is 66.74 million or 24.2 percent of 275.77 million of the total population of Indonesia in 2022.(BPS Statistic Indonesia n.d.) The large proportion of adolescents should be a special concern, especially from a health perspective. Adolescent health is important in the continuity of a nation, and no disturbing health problems occur. Especially true of adolescent girls, who are more numerous than adolescent boys and have a very important role in giving birth to a new generation (future mothers).

Hypertension is one of the health problems that needs to be watched out for in adolescence. The number of cases of hypertension in adolescents aged 15-25 years old occurs in 1 out of 10 people, while the pre-hypertension and hypertension rate in adolescents aged 20-30 years old was 45.2% (Mardianti, Rachmawati, and Suprajitno 2020). Based on Riskesdas data in 2013, it was found that hypertension in adolescence was 5.3%, and the prevalence of hypertension in 2018 at the age of 18-24 years old reached 13.2% (Ministry of Health of Republik Indonesia 2018). It can be said that hypertension in adolescents has experienced a high increase in numbers in five years, which is 7.9%. Then, the prevalence of hypertension in Bali is around 0.77% of people suffer from hypertension (Dinas Kesehatan Propinsi Bali 2024). Meanwhile, the incidence rate of hypertension among adolescent girls in Jembrana Regency is not yet available. The occurrence of hypertension in adolescents can be influenced by unhealthy lifestyles, diet, physical activity, smoking, and obesity.

Adolescents who develop hypertension may continue into adulthood and have a higher risk of morbidity and mortality. Thus, many children are diagnosed with hypertension after developing severe conditions or are only recognized in adulthood. Hence, the importance of early and accurate diagnosis, given the long-term health impact. Hypertensive conditions that are slow to be diagnosed and not properly treated become a fact that hypertension in children is a diagnostic indicator for several serious medical conditions (Wójcik et al. 2023). Efforts to reduce mortality rates include blood pressure control (Akhter 2010). The inclusion of blood pressure measurement in the routine examination of adolescents will allow the discovery of significant asymptomatic hypertension due to unknown diseases and reinforces the assertion that mild increases in blood pressure are common in adolescents.

Other than blood pressure control, a comprehensive understanding of relevant risk factors is also required. However, there is still debate regarding the risk factors for hypertension in adolescents. Therefore, a screening that can be used to evaluate these risk factors in a representative population is needed. We conducted this study to estimate the prevalence of hypertension in adolescent girls aged 15 to 18 and identify relevant risk factors.

OBJECTIVE

The purpose of the study was to identify the prevalence of high blood pressure in adolescent girls.

METHODS

This cross-sectional research was conducted in five high schools and vocational schools In Jembrana District, Bali, Indonesia. The selection of schools was based on the appointment of the health center and the Jembrana Regency Health Office.

The number of samples in the research was 1,193 adolescent girls. The inclusion criteria in this research were 16-19 years old adolescent girls, not fasting, not having infectious

diseases, not taking medications that will alter BP, and consent to be a research subject. The variables in this research were age, body weight, height, BMI, MUAC, BP, and Hb level. The type of data used in this research was primary data which was collected through interviews and direct measurement assisted by health care students who had been trained previously. The research flow is shown in Figure 1.

Data collection was conducted by researchers and five trained students. Data collection was conducted through several measurements and assessments of measurement results. The measurements conducted were BP, body weight, height, BMI, MUAC, and HB levels. While the assessment of measurement results in nutritional status and anemia assessment.

Blood pressure was measured using a digital sphygmomanometer and stethoscope with the subject in a sitting position and the right arm lying on the table. Measurements were taken three times with an interval of 5 minutes and the average measurement results were calculated, after which they were classified (Table 1).

Table 1. Blood pressure is categorized in adolescents based on the American Academy of Pediatrics Clinical Practice Guideline (2017)

Blood Pressure Category	Adolescents Aged ≥13 years old
Normal	Systolic <120mmHg and Diastolic <80mmHg
Pre-hypertension (Pre HT)	Systolic 120-129mmHg and Diastolic <80mmHg
Hypertension (HT) I	Systolic 130-139mmHg and Diastolic 80-89mmHg
Hypertension (HT) II	Systolic ≥140mmHg and Diastolic ≥ 90mmHg

Body weight (BW) in kilograms (kg) was measured using a digital scale, and height and MUAC in centimeters (cm) were measured using a microtoise stature meter. The nutritional status of adolescent girls was determined by calculating the Body Mass Index (BMI) value with the following formula:

$$\text{BMI} = \frac{\text{Body Weight (Kg)}}{\text{Height } (m^2)}$$

The BMI value obtained was then used to determine the nutritional status of adolescent girls. BMI categories and cut-off points in MUAC in Table 2 are as follows:

Table 2. BMI categories and cut-off point MUA

Category	Value
BMI	
Underweight	<18,4
Normal	18,5 -25,0
Overweight	25,1-27,0
Obese	>27,1
MUAC	
Normal	≥23,5
CED (Chronic Energy Disease)	<23,5

Examination of hemoglobin levels with a digital Hb checker by taking 1 *ul* of blood from the finger using a lancet, placing it on a strip, and then attaching it to the Hb checker. The value came out after being left to stand for 10 minutes. After that, it was analyzed with a range of values (Table 3).

Table 3. Classification of anemia (WHO, 2011)

Category	Value (gr/dl)
Normal (non-anemia)	12
Anemia	<12
Mild Anemia	11,0 – 11,9
Moderate Anemia	8,0 – 10,9
Severe Anemia	< 8,0

Data analysis was done in two ways, which were descriptive data analysis with frequency distribution, mean, minimum, and standard deviation. The second analysis was to identify risk factors using the Chi-square test and 95% confidence interval. Descriptive and inferential statistical analyses were performed using the SPSS version 22.0 software package (SPSS Inc., Chicago, IL, USA).

This research used primary data that had been reviewed and approved by the ethics committee of Stikes Kesdam IX/Udayana, Bali-Indonesia, with the decision number 05a/EC/-KEPK-SK/II/2024. For the ethical protection of the participants, information about the research process, such as the purpose and content of the study, research ethics, and data collection methods, was provided in easy-to-understand language. In addition, the researcher's contact information was included in the explanation so that the research participants could contact the researcher at any time if they had any questions about the study. Participants who voluntarily agreed to participate in the study were informed that they could refuse to participate in the study at any time, and there would be no harm.

RESULTS

The characteristics of the respondents are illustrated in Table 4. Out of 1.193 adolescent girls with an average age of 16.5 years old, most adolescents were aged 16-17 years old (50.1% and 40.2%). The average weight of adolescents was 52.5 kg (SD ±10.9), and the average height was 156.9 cm (SD ±5.8). The calculation of BMI in adolescents had an average of 21.3 Kg/m^2 (SD ±4.1).

Table 4. Characteristics of Research Respondents

No	Variable	Sample Quantity	Mean±SD	Min	Max
1	Age	1.193	16.5 years ±0.7	14 years	20 years
	15 (f, %)		38 (3.2)		
	16 (f, %)		598 (50.1)		
	17 (f, %)		482 (40.2)		
	18 (f, %)		70 (5.9)		
	19 (f, %)		5 (0.4)		
2	Body Weight	1.193	52.5 kg ±10.9	8 kg	162kg
3	Height	1.193	156.9 cm ±5.8	124.5 cm	183.5cm
4	Body Mass Index	1.193	21.3 kg/m^2±4.1	12,4	56,1
5	Upper Arm Circumference	1.193	25.6 cm ±3.4	14	42
6	Hb levels	1.193	13 gr/dl ±2.1	2,2	21,4

7	Systole	1.193	116.3 mmHg ±12.3	65	166
8	Diastole	1.193	71.3 mmHg ±9.8	41	118

Table 4 shows that the average upper arm circumference of adolescent girls was 25.6 cm (SD ±3.4). Hb level examination, adolescent girls had an average of 13 gr/dl (SD ±2.1). While blood pressure measurement in adolescent girls, the average systolic pressure was 116.3mmHg (SD ±12.3) and diastolic 71.3 mmHg (SD ±9.8)

Table 5. Blood pressure of Research Respondents

Blood pressure	**F**	**%**
Normal	1031	86
Pre-hypertension	149	12
Hypertension 1	12	1
Hypertension 2	1	0
Total	**1.193**	**100**

The prevalence of hypertension in adolescent girls in Jembrana Regency, Bali, Indonesia, is illustrated in Table 5. There were 162 people (13%) with pre-hypertension, as many as 149 people (12%), and 13 people who experienced HT 1 and HT 2 (1%).

Table 6. *Nutritional Status of* Research Respondents

Adolescent Nutritional Status	**F**	**%**
Body Mass Index (BMI)		
Underweight	294	24,64
Normal	729	61,11
Overweight	64	5,36
Obese	106	8,89
Middle Upper Arm Circumference (MUAC)		
Normal	870	72,93
CED (Chronic Energy Disease)	323	27,07
Total	**1.193**	**100**

Table 6 shows that the nutritional status of adolescent girls mostly had a normal BMI (61.1%) or as many as 729 people. The problem of nutritional disorders was also experienced by adolescent girls, who were Underweight and Obese, and a small proportion experienced being Overweight.

Table 7. Hb Level and Anemia Status

Hb Level and Anemia Status	**F**	**%**
Hb level		
Normal (No Anemia)	873	73,18
Anemia	320	26,82
Anemia (n = 320)		
Mild Anemia	162	51%
Moderate Anemia	139	43%

Severe Anemia	19	6%
Total	**1.193**	**100**

Based on Table 7, a small proportion of adolescent girls in Jembrana Regency, Bali, Indonesia, had anemia (26.82%), and almost half (43%) out of the adolescent girls had anemia in the classification of moderate anemia.

Tabel 8. Relationship between Age, Nutritional Status, Hb Status and Anemia Level with the Incidence of Hypertension in Adolescents

No	Variable	Normal		Pre-HT		HT-1		HT-2		p-Value
		f	(%)	F	(%)	f	(%)	f	(%)	
1	**Age**									
	15	34	3%	4	1%	0	0%	0	0%	0.89
	16	524	43%	66	5%	8	1%	0	0%	
	17	411	33%	67	5%	3	1%	1	0%	
	18	59	4%	9	2%	1	0%	0	0%	
	19	3	1%	3	1%	0	0%	0	0%	
2	**Nutritional Status (BMI)**									
	Underweight	272	23%	21	2%	0	0%	1	0%	0.00*
	Normal	643	54%	79	7%	7	1%	0	0%	
	Overweight	50	4%	14	1%	0	0%	0	0%	
	Obese	66	5%	35	3%	5	0%	0	0%	
3	**Nutritional Status MUAC**									
	Normal	740	62%	118	10%	12	1%	0	0%	0.01*
	CED	291	24%	31	3%	0	0%	1	0%	
4	**Hb Status**									
	Normal	754	63%	108	9%	10	1%	1	0%	0.79
	Anemia	277	23%	41	3%	2	0%	0	0%	
5	**Anemia Status (n = 320)**									
	Mild	141	44%	20	6%	1	0%	0	0%	0.99
	Moderate	120	38%	18	6%	1	0%	0	0%	
	Severe	16	5%	3	1%	0	0%	0	0%	

The results of the bivariate analysis are presented in Table 8. In general, several risk factors of hypertensive incidence in adolescent girls include nutritional status (BMI) and UAC with a significant value (p-value) below 0.05. The problems of malnutrition were overweight and obesity, which were experienced by many adolescent girls and had a pre-hypertensive condition. Likewise, with UAC, adolescent girls who had CED also experienced pre-hypertension. Meanwhile, age, Hb level, and anemia level were not associated with the incidence of hypertension in adolescent girls (table 8).

DISCUSSION

The findings in our research, the incidence of hypertension among adolescent girls in Jembrana Regency, Bali Indonesia was moderately high as many as 13%, consisting of pre-hypertension (12%0 and Hypertension I and II (1%). The prevalence rate is still relatively low in comparison to the results of previous research. The research on basic health in 2013 showed a higher rate, which was 17.4% of adolescent girls aged 15-19 years old experienced hypertensive problems. (Ministry of Health Republic of Indonesia 2013) The prevalence of hypertension in our research was also relatively small when compared to the findings of the research of Kurnianto et al., (2020), among adolescent girls in Palembang, Indonesia, 17% experienced pre-hypertension and hypertension.(Kurnianto et al. 2020) Similarly, research in Tahrin-Iran, Rafraf et al., (2013) found the prevalence of pre-hypertension was 13.9%, and hypertension was higher at 19.4%.(Rafraf et al. 2013) However, research in the United States was lower; the prevalence of hypertension in 2011-1012 was 1.6% in adolescents aged 8-17 years old.(Hardy and Urbina 2021) This proves that hypertension is a health problem for adults in the world, but also in Indonesia.

Hypertension in children and adolescents often goes undetected due to non-specific symptoms and wide variation in blood pressure in children. Many children and adolescents aged 10-18 years old were also admitted to Sanglah Hospital in Denpasar, Bali, Indonesia, with a diagnosis of hypertension (Arga, Suarta, and Nilawati 2020). Based on gender, hypertension in adolescent boys was higher than in adolescent girls. However, the prevalence of hypertension in adolescent girls cannot be ignored. Hypertension in children and adolescent girls requires special attention, not only because of the increase in prevalence but also because hypertension in adulthood can occur during childhood or adolescence. The previous pathophysiologic and epidemiologic evidence showed that hypertension in children was related to essential hypertension and cardiovascular disease incidence in adulthood (Zhao, Mo, and Pang 2021). Almost half of the adult population with hypertension experienced elevated blood pressure during childhood or adolescence. Previous research also showed that blood pressure elevation in children was correlated to carotid intima-media thickness, atherosclerosis, left ventricular hypertrophy, and renal failure in adulthood (Mardianti et al. 2020).

Monitoring blood pressure since childhood up to adulthood is very important to do for early detection and prevention efforts. In addition to blood pressure monitoring and measurement, tracking the risk factors of hypertension in adolescents must also be conducted. The lifestyle of adolescents in this decade has changed, which includes diet and rest. These changes will certainly affect the overall health of adolescents in general and the increase in blood pressure in adolescents in particular. In this research, the risk factors data were gathered that had a relationship with the incidence of hypertension in adolescent girls which were BMI and upper arm circumference.

Nutritional status is a measure of a person's physiological condition as a result of food consumption, absorption, and utilization of nutrients. Nutritional status can be assessed from the Body Mass Index (BMI). In this research, it was found that the nutritional status, either overweight or obese had a proportion of 5.36% and 8.89% and less than the normal nutritional status of 61.19%. Thus, it can be assessed that the nutrition of adolescent girls in Jembrana, Bali, Indonesia is normal. However, the incidence of overweight and obesity must also be considered because overweight and obesity in adolescents will persist into adulthood, and they are at risk of cardiovascular disease (Wójcik et al. 2023). The obesity rate obtained in this research is higher or can be said to have increased from the condition found in Riskesdas Indonesia Ministry of Health, (2019) which was 7.68% of adolescents in the province of Bali, Indonesia, were obese.(Ministry of Health of Republik Indonesia 2019) This was because in adolescence, there was rapid physical growth where adolescent boys wanted to have huge body builds that sometimes could be uncontrollably huge, while adolescent girls became large

because of hormonal influences. Besides that, the increase in the number of obese adolescents was also due to the Covid-19 pandemic, where adolescents tended to consume food high in fats, had a low consumption of vegetables and fruits, and lacked physical activities (Suprayogi et al. 2023). BMI is the most suitable indicator to predict dyslipidemia and high blood pressure in children and adolescents.

The significance of the relationship between adolescent girls' BMI and blood pressure was clearly illustrated in this research. In line with the research from Rajinikanth B et al., (2023) it was found that there were individuals who were obese in their research populations, eight of whom (8.8%) suffered from hypertension, while 83 people (91.2%) did not suffer from hypertension, with a p-value <0,0001, indicating a significant relationship between hypertension and obesity. Research conducted by Wieniawski and Werner (2021) also showed similar results, which was a significant difference (p <0,05) in systolic and diastolic blood pressure values, depending on the weight category, as determined by BMI. Obesity can directly cause an increase in cardiac output. This is due to the greater the body mass, the greater the amount of circulating blood, and it can cause an increase in cardiac output. The results of research conducted by Zaen et al., (2023) stated that the respondents with obesity compared to normal had a 2.44 times higher risk of hypertension. (Zaen et al. 2023) During COVID-19, BMI significantly influences blood pressure in children and adolescents aged 7-17 years old (Mao et al. 2024).

The second assessment of nutritional status, which is related to the incidence of hypertension in adolescent girls, is upper arm circumference. The upper arm circumference shows the representation of the amount of body fat built up. In this research, we found a significant correlation between upper arm circumference and hypertension incidence in adolescent girls. In line with the research results of Stankute et al., (2024), which showed the significant relationship between MUAC and SBP and DBP.(Stankute et al. 2024) Mphahlele et al., (2020) Found a potential relationship between poor nutrition and the risk of developing hypertension.(Mphahlele et al. 2020) Therefore, simple anthropometric measurements such as MUAC, BH, BW, and nutritional assessment are important tools to identify young subjects at risk of developing HPN. Nutritional status is a controllable factor. These findings underline the importance of addressing nutritional issues early on to prevent the development of cardiovascular disease in adulthood.

The association of age with the prevalence of hypertension in adolescent girls was not found in our research. Age and gender factors contribute to the incidence of hypertension, but hypertension generally occurs in the elderly, although it can also be found at a young age. Hypertension can occur in anyone and at any age. In our research, the prevalence of pre-hypertension spread across the ages of 15-19 years old. This was also found in Falkner's research (2010), which found that hypertension was found in children over 15 years old.(Falkner 2010) Thus, it is stated that there was no association between adolescence and hypertension incidences. Nest risk factors that had no relationship with adolescent girls' hypertension were anemia and hemoglobin level. Anemia is a decrease in blood hemoglobin levels below normal.(Ghosh, Rehman, and Ahamed 2021) Hemoglobin is a component of blood that functions to carry or bind oxygen to be circulated throughout the body. Anemia can be caused by several things, such as rapid destruction of red blood cells, excessive blood volume loss, and low production.(Triatmaja 2019) High and low blood pressure was not related to anemia and hemoglobin levels in the blood. Nevertheless, adolescent girls should take care of their health, especially their reproductive health, and delay the age of marriage until the age of ≥ 20 years old. This is because mothers or prospective mothers who have a history of anemia and hypertension are at risk of giving birth to babies with low birth weight, resulting in stunting.(Ediriweera et al. 2017; Majni 2022).

CONCLUSION

Most respondents had a good nutritional status with normal BMI and UAC. Most respondents had normal hemoglobin levels, but some experienced anemia, which was categorized as mild and moderate anemia. Most respondents had normal blood pressure. A small number of adolescents experienced pre-HT, HT-1, and HT-2. Nutritional status (BMI and MUAC) had a relationship with the incidence of hypertension in respondents. Routine monitoring of blood pressure in adolescent girls and efforts to overcome nutritional problems early on can prevent further cardiovascular disease and prepare future mothers to give birth to a superior and healthy generation.

This research had limitations, so future researchers are advised to examine other factors that affect adolescent hypertension, such as family history, salt consumption, and activity patterns.

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CONFLICTS OF INTEREST

All contributing authors declare no conflicts of interest.

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