

Risk Factor of Elevated Blood Pressure Among Children in Tulikup Village, Bali

Christin Natalia Kalemang^{*}, Gusti Ayu Putu Nilawati, Bagus Ngurah Mahakrishna

Department of Child Health, Medical Faculty of Udayana University, Sanglah General Hospital, Denpasar, Indonesia

Email address:

christinkalemang@gmail.com (C. N. Kalemang), drnilaspa@gmail.com (G. A. P. Nilawati),

bagusngurahmahakrishna@gmail.com (B. N. Mahakrishna)

^{*}Corresponding author

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Abstract: Elevated blood pressure in children is a worldwide problem, constitute as major, often overlooked, public health problem in many countries. Normal blood pressure value in children varies based on age, sex and body height which available in standardized table. Measurement of blood pressure is crucial and needed to be done at least once a year in every child with risk factors. Risk factors for elevated blood pressure includes family history of hypertension, salt intake, physical activity, stress level and obesity. Therefore we aimed to determine risk factors for elevated blood pressure among children in Tulikup village Bali. This observational analytic study with cross-sectional design, was conducted in children age 1-18 years old whom visit child health community service program in Tulikup. We collected data from 81 children, age range from 1 to 13 years old, with median age was 4 years old. Data was collected by using questionnaire and physical examination. This study was dominated by female and elevated blood pressure (11.1%). On the other hand, nutritional status were both equal between well-nourished status and mild nutrition (44.4%). Multivariate analysis showed two factors associated with elevated blood pressure such as family history of hypertension with $p=0.045$ (OR 8.89; 95% CI 1.05-75.29) and excessive salt intake with $p=0.046$ (OR 5.24; 95% CI 1.02-26.77). Therefore risk factors such as family history of hypertension and excessive salt intake, significantly cause elevated blood pressure in children.

Keywords: Children, Blood Pressure, Elevated Blood Pressure, Hypertension

1. Introduction

Elevated blood pressure in children is a worldwide problem and constitute as major, often overlooked, public health problem in many countries. Annual blood pressure screening needs to be performed on every visit especially for those with risk factors [1].

Elevated blood pressure is defined as blood pressure of systolic and/or diastolic blood pressure $\geq 90^{\text{th}}$ percentile to $<95^{\text{th}}$ percentile or 120/80 mmHg to $<95^{\text{th}}$ percentile +12 mmHg (for children aged 1-13 years of age) and 120/ <80 mmHg (for children aged ≥ 13 years old) based on age, gender and body height. Children with elevated blood pressure may progress to hypertension during childhood, adolescence, or adulthood, which is confirmed through blood pressure monitoring. Ambulatory blood pressure monitoring should be performed to confirm elevated blood pressure [2]. About 2.5-

3.7% cases of elevated blood pressure develop into hypertension [2].

Hypertension is the most common form of blood pressure problem in clinical practice which frequently found in adolescents and adults rather than in young children. The pathogenesis of essential hypertension is affected by many factors such as obesity, insulin resistance, inappropriate activation of sympathetic nervous system, alterations in sodium hemostasis, renin angiotensin system, vascular smooth muscle structure and function, genetic factors and fetal programming. All those have implication in circulatory disorder [1, 2].

Hypertension in children has lower prevalence compared to adult. Children tend to have normotension and elevated blood pressure in the population [3, 4]. Some evidence suggests that essential hypertension in adults is a continuation of that in children [5]. AAP stated the

prevalence of hypertension in children was 3.5% in 2017, meanwhile the prevalence of elevated blood pressure was between 2.2% and 3.5% [6]. Moreover the survey from Indonesian Ministry of Health found that 8.4% children suffered hypertension in 2017 [7]. Another study from Wati et al. stated that the prevalence of children with elevated blood pressure was 233 children (18.5%), hypertension grade 1 was 279 children (22.2%) and hypertension grade 2 was 177 children (14.1%) [8].

History taking and physical examination are crucial to determine primary or secondary hypertension in child with elevated blood pressure [2]. Primary hypertension occurs when the cause of hypertension is unknown or unexplainable, usually related to family history of hypertension (heritability is about 50%), salt intake, physical activity, stress level and obesity [5, 9]. Secondary hypertension occurs when one suffers from other underlying diseases and is the most frequent type of hypertension in children [10-12]. Furthermore the elevated blood pressure in children can also cause complications, such as stroke, heart attack, heart failure and kidney disease [3, 4].

Therapeutic lifestyle changes such as weight loss if overweight or obese, healthy diet and regular exercise are crucial in children with elevated blood pressure. All those can lower blood pressure, reduce the development cardiovascular disease so does not become hypertension in the future [2].

Hypertension in children is multifactorial and cannot be ascertained as single cause. Blood pressure testing in children is usually not routinely perform in health center. Tulikup Village is located at southeast border of Gianyar regency. In addition social service program is carried out with the aim of planning appropriate programs and interventions for the people of Tulikup Village, especially for general health. We aimed to determine the blood pressure among children in Tulikup Village which is related to child health community service program.

2. Method

We conduct an observational analytic study with cross-sectional design using questionnaire and physical examination including measurement of body height, body weight and blood pressure in Tulikup Village on December 15th, 2019. The subject of this study were all children who visited public health center for the child health community service program. We used total sampling technique and data variable include gender, age, nutritional status, family history of hypertension, salt intake and physical activity were recorded.

Data were analyzed using computer program, bivariate analysis used prevalence ratio by chi square and multivariate analysis used odds ratio by logistic regression with 95% confident interval (CI) and statistically significant if p-value <0.05. The study has been approved by Ethics Committee of Medical Faculty of Medicine / Sanglah Hospital with ethical clearance 2483/UN 14.2.2. VII. 14/LT/2020.

3. Result

Total sample in this study was 81 children whom participated in the child health community service program on December 15th, 2019. Characteristic of samples was shown in *Table 1* their median age was 4 years old (1-13 years), most of them were female 44 (54.3%). Nutritional status was equally both of well-nourished 36 (44.4%) and mild malnutrition 36 (44.4%). Children with family history of hypertension and suffered elevated blood pressure 9 (11.1%).

Table 1. Characteristic of subjects.

Characteristic of subjects	n=81
Age, median (range), years old	4 (1-13)
Gender, n (%)	
Male	37 (45.7)
Female	44 (54.3)
Nutritional Status, n (%)	
Obesity	2 (2.5)
Overweight	7 (8.6)
Well nourished	36 (44.4)
Mild malnutrition	36 (44.4)
Family history of hypertension, n (%)	
Yes	9 (11.1)
No	72 (88.9)
Excessive salt intake, n (%)	
Yes	29 (35.8)
No	52 (64.2)
Physical activity (hour/days), n (%)	
Inadequate	13 (16)
Adequate	68 (84)
Elevated blood pressure, n (%)	
Non elevated	72 (88.9)
Elevated	9 (11.1)
Hypertension grade I	0
Hypertension grade II	0

Bivariate analysis, showed family history of hypertension and excessive salt intake were associated with elevated blood pressure. Furthermore, those risk factors were independently associated with elevated blood pressure by multivariate analysis, as shown in *Table 2* and *Table 3*.

Table 2. Blood pressure classification based on the characteristic of the subjects.

Variables	Blood Pressure		PR	95% CI	p-value
	Elevated n=9	Normal n=72			
Gender, n (%)					
Male	3 (8.1)	34 (91.9)	0.6	(0.16-2.21)	0.498
Female	6 (13.6)	38 (86.4)			
Nutritional Status, n (%)					
Overweight-obesity	2 (22.2)	7 (77.8)	2.3	(0.56-9.37)	0.261

Variables	Blood Pressure		PR	95% CI	p-value
	Elevated n=9	Normal n=72			
Mild malnutrition-well nourished	7 (9.7)	65 (90.3)			
Family history of hypertension, n (%)					
Yes	3 (33.3)	6 (66.7)	4	(1.20-13.28)	0.024
No	6 (8.3)	66 (91.7)			
Excessive salt intake, n (%)					
Yes	6 (20.7)	23 (79.3)	3.58	(0.96-13.28)	0.041
No	3 (5.8)	49 (94.2)			
Physical Activity, n (%)					
Inadequate	2 (15.4)	11 (84.6)	1.49	(0.35 -6.40)	0.593
Adequate	7 (10.3)	61 (89.7)			

Table 3. Multivariate analysis based on risk factors for hypertension.

Variables	OR	95% CI	p-value
Female	0.49	0.08-3.01	0.442
Overweight-obesity	2.61	0.28-24.36	0.400
Family history of hypertension	8.89	1.05-75.29	0.045
Excessive salt intake	5.24	1.02-26.77	0.046
Inadequate Physical Activity	0.26	0.02-3.01	0.282

4. Discussion

Elevated blood pressure in children may progress to hypertension during childhood, adolescence, or adulthood. A study by Fuiano *et al.* in France found that elevated blood pressure more frequent in female (35.1%) rather than males (41%) [13]. In addition Genovesi *et al.* also found that the prevalence of elevated blood pressure was significantly higher in females (5.4%) than males (3.1%).

Song *et al.* found that the prevalence of elevated blood pressure among children at 6 to 19 years of age varied from 75% to 79% before the onset of puberty and during puberty, reach to peak level at the end of puberty and steadily decrease until the beginning of adulthood [15]. Liang *et al.* found elevated blood pressure was significant higher in children of the age group 6 compared with those in the middle age group [16]. A study by Noubiap *et al.* found prevalence elevated blood pressure 2 to 5 years of age was 10.7% [4]. In this study found that elevated blood pressure prevalence in 4 years of age (5%).

Risk factors related to elevated blood pressure include family history of hypertension, salt intake, physical activity, stress level and obesity [5, 9]. Children obesity has become a major global health concern in recent decades with increasing prevalence in developing countries [17]. Children obesity is associated with many cardiovascular risk factors such as elevated blood pressure, dyslipidemia, abnormalities of endothelial function and hyperinsulinemia [18]. Although primary hypertension is closely associated with obesity, some patients who are obese are not considered to be hypertensive. A study by Dulskine *et al.* showed significant association between overweight and obesity and high blood pressure with (overweight: OR=2.62; 95% CI 3.02-4.19; obesity: OR=6.64; 95% CI 4.65-9.49) [18]. Another study by Parker *et al.* found that obese child age 3 to 11 had significantly higher risk of developing hypertension (HR=2.02; 95% CI 1.28-7.04) and the risk in obese adolescent was similar high

(HR=2.02; 95% CI 1.24-3.91) compared with lean child [19]. In this study found no significant difference was found between overweight and obesity as risk factor to hypertension from univariate analysis (OR=2.61; 95% CI 0.280-24.36, and $p=0.40$).

Family history is a consistent and independent risk factor for many common chronic diseases. The presence of genetic factor in the family can cause the risk of hypertension 80% indicating huge contribution of genetic for phenotype manifestation at this early age. A study conducted by Bilal *et al.* found that children with family history of hypertension 1.43 times more likely to develop hypertension ($p=0.04$, OR=1.43; 95% CI 1.88-3.31) and 1.32 times more likely to have elevated blood pressure ($p=0.02$, OR=1.32; 95% CI 1.32-4.43) compared to children with normal BMI aged between 8 and 12 years [20]. Gomes *et al.* found that family history of hypertension was also independently associated with primary hypertension in childhood. The presence of family history of hypertension can increase a three-fold in the risk of primary hypertension (OR=3.03; 95% CI 1.04-8.79) [21]. In this study, family history of hypertension plays significant role in determining the risk of hypertension in children ($p=0.04$, OR=8.89; 95% CI 1.05-75.29).

Sodium as the most abundant extracellular cation, plays important role in determining fluid balance. In early life, a positive sodium balance is needed for growth since newborns and preterm infants tend to lose sodium via their kidneys. Meanwhile among older children and adults, excessive salt intake leads to volume expansion and arterial hypertension [14, 22]. Similar with study by Genovesi *et al.* reported salt intake > 2.5 gram/day increased the prevalence of hypertension to 15-20% [14]. Leyvraz *et al.* showed that children with the higher intake of sodium had higher risk of having elevated blood pressure than children with lower sodium intakes (OR 2.00, 95% CI 1.38-2.62) [23]. He *et al.* found significant association between salt intake and systolic blood pressure. Increment 1 gram/day of salt intake related to increment of systolic blood pressure 0.4 mmHg and 0.6

mmHg in pulse pressure with $p < 0.001$ [24]. In this study we found excessive salt intake statistically significant associated with hypertension ($p = 0.04$, $OR = 5.24$; 95% CI 1.02-26.77).

The underlying mechanisms of physical activity in reducing blood pressure and prevent the development of hypertension remain unclear. This is due to the fact that the etiology of hypertension is multifactorial in nature and the interaction of these factors in contributing to the development of hypertension unclear. Meanwhile animal studies suggest aerobic exercise may prevent hypertension through alterations of insulin sensitivity and autonomic nervous system function, while resistance training may prevent increases of blood pressure through alterations in vasoconstriction regulation [24]. Kelley et al. found physical activity decrease blood pressure but not statistically significant with length of the study ranged from 36 weeks and training duration from 10-75 minutes. However, both regular physical activity and decrease of sedentary activity (such as watching television and playing video games) are important components of childhood obesity treatment and prevention [25]. Bilal et al. found limited physical activity does not significantly contribute to developing hypertension with ($p = 0.38$, $OR = 0.54$; 95% CI 0.32-1.67) [20]. This study found that physical activity was not a significant risk factor for hypertension ($p = 0.28$, $OR = 0.26$; 95% CI 0.02-3.01).

Limitations of the study consist of: (1) The duration of this study was relatively short to provide education for parents and participants about elevated blood pressure and hypertension; (2) Further prospective study is needed to determine the risk factor for elevated blood pressure in children; (3) This study did not analyze the type of diet like food recall in obese/overweight and did not analyze type of physical activity.

5. Conclusion

This study showed elevated blood pressure is particularly high in children at the age of four and we found an association between family history of hypertension and excessive salt intake as risk factor for essential hypertension in children. Therefore, preventing elevated blood pressure can be performed by maintaining healthy diet and lifestyle.

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