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Pediatric Blood Pressure Profile Based on NIH / NHLBI 2004 Guideline and Revised AAP Pediatric Hypertension Guideline 2017 in Pasangkayu General Hospital

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Abstract: ***Introduction: The guideline in diagnose and determining the degree of hypertension in children were using Guideline NIH/NHLBI 2004 or Fourth Report (FR) and American Academy of Pediatrics (AAP). Prevalence of hypertension in Pasangkayu from these two guidelines is unknown, where the difference between FR and AAP guidelines is a simpler table for measurement. Objective: This study aims to determine the prevalence of hypertension in children using the guidelines from the FR and AAP. Method: This study was conducted with a descriptive cross-sectional design, using data from medical record. Conducted at the pediatric's polyclinic of Pasangkayu General Hospital in West Sulawesi from March-May 2020 until the number of samples was met. Result: For 3 months, there were 147 children from the minimum required 122 samples. Blood pressure in the percentile ≥90 - <95 in the FR guidelines is known as prehypertension, with a prevalence of 14.3% and in the AAP guidelines as elevated blood pressure with a prevalence of 16.3%. The prevalence of hypertension with FR guidelines was 14.9% and with AAP guidelines was 12.8%. Conclusion: The applications of the new AAP guidelines are easier to use in diagnosing and determining the degree of hypertension in children. The prevalence of hypertension from the FR and AAP guidelines in this study was not significantly different.***

Keywords: hypertension, prevalence, children

1. Background

Hypertension is a chronic disease and a leading cause of worldwide premature death in adults. Primary hypertension arises from the complex relationship between genetic, environmental and lifestyle factors. The existence of hereditary factors is a consideration that primary hypertension can appear in children. Currently it has been established that hypertension can be detected in children and adolescents with a frequent number of cases. Changes in population due to lifestyle that affect health, including obesity in children, indicate a possible increase in the number of hypertension in children. Since 2004, "Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents" (NIH/NHLBI 2004) (FR) has become the main reference for normal blood pressure data in children and adolescents. In 2016, The European Society of Hypertension released a new guideline (ESHG 2016) which was revised again by the American Academy of Pediatrics by releasing a Clinical Practice Guideline in 2017 (AAP) there are 2 main changes, the lower limit of systolic blood pressure and diastolic blood pressure still determined by age, sex and height, but obtained from a population of normal weight children, thus excluding overweight and obese children, and collecting a blood pressure threshold of at least 130/80 mmHg in adolescents aged 13 years regardless of height, gender and sex, as well as in adults.

Interpretation of children's blood pressure using FR guidelines requires 2 steps, firstly is finding the percentile of height using a height curve based on age then entering it into the blood pressure table. In AAP, the results of height and blood pressure measurements can be directly entered into the blood pressure table for interpretation. The FR guidelines classify pediatric stage 1 hypertension (Percentile ≥95-<99th + 5 mmHg) andstage 2 hypertension (Percentile ≥99th + 5 mmHg), whereas the AAP is grouped by age 1-13 years (stage 1: Percentile ≥95-<95th + 12mmHg or 130/80-139/89 mmHg (lower); stage 2: Percentile ≥95th + 12 mmHg or ≥ 140/90 mmHg (lower) and≥13 years (stage 1: 130-139/80-89 mmHg; stage 2: ≥140/90 mmHg).

This new approach has the advantage that conclude only children with normal weight as a reference, that is provide an overview of the association between excess weight, obesity and blood pressure. In addition, the determination of a single blood pressure threshold in children aged more than 13 years provides a simplification in screening and diagnosing hypertension in adolescents.The exclusion of overweight and obese children resulted in a decrease in normative blood pressure about 2-3 mmHg across the percentile compared to the data in the Fourth Report. Adoption of a lower threshold is expected to get the better identification of children at risk so that interventions can be initiated earlier[1]

The prevalence of hypertension in children and adolescents is estimated between 1-3% .[4,5]Sinaiko et al, in their study of

14,686 children aged 10-15 years found 4.2% of children had hypertension.[6]Less than 5 % of children, with a greater proportion of adolescents, developed hypertension on one blood pressure measurement. In Indonesia, the prevalence of hypertension in children and adolescents varies from 3.11% to 4.6%.[7,8]Wati et al, in 2019 showed hypertension data for children in Bali from 1257 samples, 689 children (54.8%) with hypertension and increased blood pressure. Based on age group, children aged ≤13 years were 47.3% and age group >13 years 62.2%.[9] The prevalence of hypertension in confirmed children ranged from 2-4% based on the 2004 NIH / NHLBI guidelines, but the prevalence of hypertension in children is still unknown when using the new guidelines. Prevalence was compared in the same population based on sex, age, and nutritional status.[2]The aim of this study was todetermine the prevalence of hypertension in children using the guidelines from the FR and AAP.

2. Method

This research was conducted by using descriptive research design, with a cross sectional design, by giving questionnaire and physical examination. All patients who came to the pediatric polyclinic were subjected to a history and physical examination by measuring height, weight, and blood pressure. This research was conducted at the Pediatric Polyclinic of Pasangkayu General Hospital, in March-May 2020. The inclusion criteria were children aged 6-18 years who came to the Pediatric Polyclinic of Pasangkayu General Hospital during the study period. Children with a history of using corticosteroids for >2 weeks or other drugs that affect blood pressure, have a history of kidney disease (chronic kidney infection, obstruction of urine flow, congenital urinary tract disorders) were excluded from the study. Research variables include: hypertension, age, sex, and nutritional status. Hypertension is a condition of systolic and/or diastolic blood pressure >P95 based on age, sex, and height on 3 consecutive measurements. Blood pressure grouping was carried out using 2 guidelines, namely Fourth Report and AAP CPG 2017. Nutritional status is determined by calculating body weight for age and height, then plotted based on the 2002 CDC curve. This study uses primary data by collecting data using a questionnaire and direct measurements at the time when the patient visits the pediatric clinic. Cases that close to the inclusion criteria will be included as the study sample by consecutive sampling. Data was collected by recording characteristic data and clinical data in the form of gender, age, body weight, height and nutritional status.

3. Results

During March-May 2020, there were 147 children out of 122 minimum samples. The sample characteristics data in table 1 shows that the proportion of sex is not much different between male 76 (51.70%) and female 71 (48.29%). Based on the age category, there was no difference in the number of children aged ≤13 years and> 13 years, 72 (48.97%) and 75 (51.02%). More than half of the sample had a good nutritional status 83 (56.46%) with 3 (2.04%) malnourished children and 14 (9.52%) obese children. A total of 3 (2.04) children had parents with a history of hypertension.

Table 1: Characteristics of the research sample

Variable	Frequency	Percentage
Age		
Median (IQR), year	12,1	
Min-Max	5,9-16,9	
Age category		
≤13year	72	48,97
>13year	75	51,02
Gender		
Men	76	51,70
Woman	71	48,29
Nutritional status		
Obesity	14	9,52
Overweight	20	13,60
Healthy weight	83	56,46
Underweight	27	18,36
Malnutrition	3	2,04
Parental history of hypertension		
Yes	3	2,04
No	144	97,95

All samples were tested for blood pressure and then classified using AAP and FR guidelines. The prevalence of hypertension in children using the FR guidelines was 14.9% and if blood pressure was classified using the guidelines from AAP, the prevalence of hypertension decreased to 12.8%. There is a reduction in the prevalence of childhood hypertension if the AAP guidelines are applied. In contrast, at elevated blood pressure, the AAP guideline yields a prevalence of 16.3% which is higher than the FR guideline with a prevalence of 14.3% (Figure 1).Table 2 shows the number of samples after being classified based on their blood pressure status, there were 2 samples that were reclassified from FR to AAP where there were 1 sample classified as normal by FR and 1 sample classified as elevated and 1 sample to stage 1 hypertension. Blood pressure reclassification was mostly found in hypertension. Stage 1 based on FR, 1 sample becomes normal blood pressure, 4 samples become elevated and 1 sample becomes stage 2 using AAP's guidelines.Changes in the prevalence of blood pressure occurred in the elevated group and stage 1 hypertension. There was an increase in prevalence in the elevated group and a decrease in the prevalence of stage 1 hypertension when using AAP's guidelines compared to FR as shown in Figure 1.

When grouped based on patient characteristics, children aged ≤13 years had more hypertension than children> 13 years. Men have a higher prevalence of hypertension than woman. Based on their nutritional status, obese children tend to suffer from hypertension than children with other nutritional status. There were 4 (4.81%) children with good nutrition who suffered from hypertension. All children with a parental history of hypertension also had hypertension (Table 3).

Table 2: Classification of blood pressure based on AAP and FR

Classification		FR				Total
AAP		Normal	Pre/elevated	Stage 1	Stage 2	
	Normal	102	1	1	0	104
	Pre/elevated	1	19	4	0	24
	Stage 1	1	1	13	1	16
	Stage 2	0	0	1	2	3
	Total	104	21	19	3	147

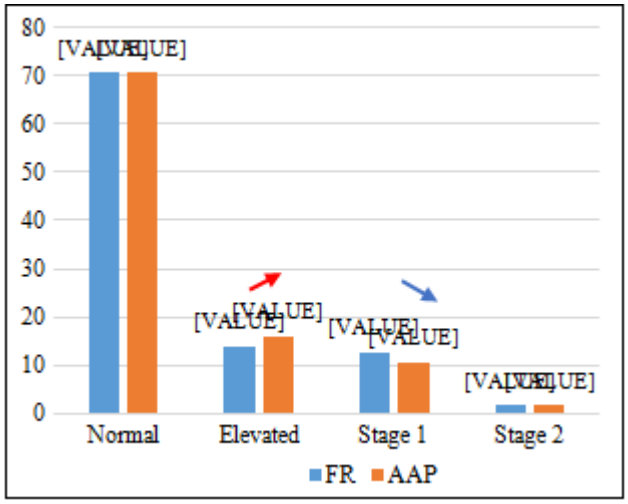

Figure 1: Prevalence of hypertension. AAP: American Academy of Pediatrics; and FR: The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents.

4. Discussion

The AAP's guidelines bring some changes to the normative threshold depending on the age of the child. When compared with FR, the exclusion of obese children led to a decrease in the threshold for most of the younger children. This decrease in the blood pressure threshold causes blood pressure to be classified as high in younger children. As the blood pressure threshold for elevated blood pressure and hypertension decreases, the prevalence of both increases. There are 3 potential ways the AAP's guidelines change prevalence estimates by lowering the blood pressure threshold for children aged <13 years, applying a static threshold for children ≥13 years of age and specifying the number of blood pressure measurements to diagnose abnormal blood pressure. First, younger children are more likely to have hypertension when using the AAP guidelines than the FR.

Comparing blood pressure in the 95th percentile of AAP and FR among men aged 10-13 years may explain this phenomenon. At the 5th percentile of height, the AAP threshold is 3 mmHg lower than that of FR, leading to an increased prevalence of hypertension in men with low height. However, looking at the 95th percentile of height, there is a difference in the threshold between a 2 mmHg lower AAP to a 1 mmHg higher than the FR, which means taller men will be diagnosed with hypertension less frequently using AAP's guidelines. Based on this, it is inappropriate to consider the lower AAP guideline threshold than the FR due to not including obese children as normative data.

Some men ages 10-13 years who are taller have blood pressure thresholds that are also higher on the AAP's guidelines. Second, the application of 130/80 mmHg as a static threshold in older children eg children aged> 13 years with short stature will suffer from hypertension less frequently. Third, the AAP's guidelines specify the number of blood pressure measurements for blood pressure grouping. Normal blood pressure can be determined by one first measurement, while elevated blood pressure and hypertension use an average of 2-3 measurements. This is based on a previous study by Negroni et al. In 2016 which stated that blood pressure tends to fall on repeated blood pressure measurements where the highest is the first measurement and the lowest is the fourth measurement.

In this study, the prevalence of high blood pressure based on AAP's guidelines was 12.92%, stage 1 hypertension was 10.88%, and stage 2 hypertension was 2.04%. This result is similar to a study conducted by Moore *et al* which found a prevalence of hypertension of 13.8% in children aged 5-17 years in Oklahoma, United States in 2009.[10]This result is higher than the study conducted by Salman et al (2010) in Khartoum, Sudan, which found a prevalence of hypertension of 4.9% in children aged 6-12 years.[11]

A higher result was shown by a study by Fuianoet al (2006) in Foggia, Italy, which found a prevalence of hypertension in men of 35.1% and 40.2% in woman aged 3-16 years.[12] Another study which also shows a higher prevalence is a study by Mohkam et al (2011) in Tehran, Iran which found the prevalence of hypertension in children aged 7-11 years was 24.2% .[13] This difference in prevalence can be caused by several factors such as differences in the definition of hypertension in each country, differences in race or ethnicity, culture, lifestyle, type of food, obesity prevalence and genetic factors. The limitation of this study is the small number of samples, and only using samples in the hospital in a Covid-19 pandemic situation. This study still uses the height according to age curve from the CDC which uses data based on measurements on Americans where the population of children there has a higher height than Indonesian children, so that it can affect the results of blood pressure interpretation.

5. Conclusion

The applications of the new AAP guidelines is easier to use in diagnosing and determining the degree of hypertension in children. The prevalence of hypertension from the FR and AAP guidelines in this study was not significantly different.Further research is needed with a larger sample, multi ethnicity and considering other factors such as food recall.

Table 3: Classification of blood pressure based on characteristics

Characteristics	Blood pressure								Total
	Normal		Elevated		Hypertensionst 1		Hypertensionst 2		
	N	(%)	N	(%)	N	(%)	N	(%)	
Age category									
≤13 year	42	(58,33)	17	(23,61)	11	(15,27)	2	(2,77)	72
>13 year	62	(82,66)	7	-9,333	5	(6,66)	1	(1,33)	75
Gender									

Men	55	(72,36)	10	(13,15)	9	(11,84)	2	(2,63)	76
Woman	49	(69,01)	14	(19,71)	7	(9,85)	1	(1,40)	71
Nutritional status									
Obesity	2	(14,28)	3	(21,42)	7	-50	2	(14,28)	14
Over weight	8	-40	6	-30	5	-25	1	-5	20
Healthy weight	69	(83,13)	10	(12,04)	4	(4,81)	0	0	83
Under weight	22	(81,48)	5	(18,51)	0	0	0	0	27
Malnutrition	3	-100	0	0	0	0	0	0	3
Parental history of hypertension									
Yes	0	0	0	0	2	(66,66)	1	(33,33)	3
No	104	(72,22)	24	(16,66)	14	-9,722	2	(1,38)	144

References

[1] Di Bonito P, Valerio G, Pacifico L, Chiesa C, Invitti C, Morandi A, et al. Impact of the 2017 Blood Pressure Guidelines by the American Academy of Pediatrics in overweight/obese youth. *Journal of Hypertension*. 2019; 37(4):732–738.

[2] Bell CS, Samuels J, Samuel JP. Prevalence of Hypertension in Children: Applying the New American Academy of Pediatrics Clinical Practice Guideline. *Hypertension*. 2019;73(1):148-152.

[3] Falkner B, Flynn JT, Gidding S, Green LA, Ingelfinger JR, Lauer RM, et al. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescent. *U.S. Department of Health and Human Service*. 2005.

[4] Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Caroll AE, Daniels SR, et al. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *American Academy of Pediatrics*. 2017; 140(3):1-74.

[5] Norwood VF. Hypertension. *Pediatrics in Review*. 2002; 23:197-209.

[6] Alatas H. Masalahdanpenanggulanganhipertensipadaanak. *Sari Pediatri*. 1994; 1:88–94.

[7] Sinaiko AR, Gomez-Maurin O, Prineas RJ. Prevalence of "significant" hypertension in junior high school-aged children: The Children and Adolescent Blood Pressure Program. *J Pediatr*. 1989; 8:664-9.

[8] WilaWirya IGN, Alatas H, Tambunan T, Harmanses S, Windiastuti. Studies of blood pressure and prevalence of hypertension in schoolchildren in Jakarta. *PediatrIndones*. 1988; 28:183-91.

[9] Thaib TM, Alam HM, Agusnadi, Lubis M, Ramayati R, Rusdidjas. Blood pressure values in school age children in Medan. *PediatrIndones*. 1994; 34:154-63.

[10] WatiDK, Yuliatni CD, Dinata MK, Nilawati GAP, Widiana GR, Sutawan IBR, et al. Child Blood Pressure Profile in Bali, Indonesia. *Maced J Med Sci*. 2019 Jun 30; 7(12):1962-1967.

[11] Moore WE, Eichner JE, Cohn EM, Thompson DM, Kobza CE, Abbott KE. Blood pressure screening of school children in a multiracial school district: the healthy kids project. *American Journal of Hypertension*. 2009; 22: 351-356.

[12] Salman Z, Kirk GD, DeBoer MD. High rate of obesityassociated hypertension among primary schoolchildren in Sudan. *International Journal of Hypertension*. 2010;11:1-5.

[13] Fuiano N, Luciano A, Pilotto L, Pietrobelli A. Overweight and hypertension: longitudinal study in school-aged children. *Minerva Pediatrica*. 2006; 58: 451-459.

[14] Mohkam M, Karimi A, Khatami NEA, Fallah F, Maham S, Gorji FJFA. Blood pressure screening in school-aged children in Tehran. *Iranian Journal of Kidney Diseases*. 2011; 5: 229-233.

Attachment 1

Category	Fourth Report	AAP CPG	
		children 1-13 year	children ≥ 13 year
Normal	Percentile <90th	Percentile <90th	<120/<80 mmHg
Elevated Blood Pressure)	Percentile ≥90-<95thor ≥120/80 in adolescents	Percentile ≥90-<95th or 120/80mmHg – Percentile<95th (lower)	120-129/<80 mmHg
Stage 1 hypertension	Percentile ≥95-<99th + 5 mmHg	Percentile ≥95-<95th + 12mmHg Atau 130/80-139/89 mmHg (lower)	130-139/80-89 mmHg
Stage 2 hypertension	Persentil ≥99th + 5 mmHg	Percentile ≥95th + 12 mmHg or ≥140/90 mmHg (lower)	≥140/90 mmHg