Open Access Maced J Med Sci **electronic publication ahead of print,**
published on June 30, 2019 as https://doi.org/10.3889/oamjms.2019.466

ID Design Press, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences.
https://doi.org/10.3889/oamjms.2019.466
eISSN: 1857-9655
Clinical Science

Child Blood Pressure Profile in Bali, Indonesia

Dyah Kanya Wati[1*], Putu Cintya Denny Yuliyatni[2], I Made Krisna Dinata[3], Gusti Ayu Putu Nilawati[1], I Gede Raka Widiana[4], Ida Bagus Ramajaya Sutawan[1], I Gusti Ngurah Putu Mandela Agatha Sunantara

[1]Department of Child Health, School of Medicine Udayana University - Sanglah Denpasar Hospital, Denpasar, Indonesia; [2]Department of Public Health, School of Medicine Udayana University, Denpasar, Indonesia; [3]Department of Physiology, School of Medicine Udayana University, Denpasar, Indonesia; [4]Department of Internal Medicine, School of Medicine Udayana University - Sanglah Denpasar Hospital, Denpasar, Indonesia

Citation: Wati DK, Yuliyatni PCD, Dinata IMK, Nilawati GAP, Widiana IGR, Sutawan IBR, Sunantara IGNPMA. Child Blood Pressure Profile in Bali, Indonesia. Open Access Maced J Med Sci. https://doi.org/10.3889/oamjms.2019.466

Keywords: Child hypertension; Bali; Age; Nutrition; Family history

***Correspondence:** Dyah Kanya Wati. Department of Child Health, School of Medicine Udayana University - Sanglah Denpasar Hospital, Denpasar, Indonesia. E-mail: dyahkanyawati@unud.ac.id

Received: 04-Mar-2019; **Revised:** 01-May-2019; **Accepted:** 02-May-2019; **Online first:** 30-Jun-2019

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Mortality and morbidity in an adult will be reduced by controlling hypertension from an early age. Uncontrolled blood pressure since children can contribute to diseases such as heart disease, organ damage, and decreased quality of life. As changes in lifestyle, it is estimated that hypertension in children will continue to increase. Until now, data regarding the profile of blood pressure in children in Indonesia is still lacking.

AIM: The purpose of this study was to determine the prevalence of increased blood pressure and hypertension in children in Bali.

METHODS: This study was a cross-sectional study. The sampling technique in this study was multistage random sampling, that is, from 9 regencies in Bali, the selection of 3 regencies to be sampled according to socio-economic stratification based on regional economic growth and regional per capita income in Bali Province.

RESULTS: From 1257, samples examined the prevalence of increased blood pressure, and hypertension was 689 children (54.8%). From the age group, the prevalence of an increase in blood pressure and hypertension in the age group ≤ , 12 years was 47.3%, and in the age group > 12 years was 62.2%. Increased blood pressure in nutritional status including Obesity 51.4%, Nutrition More 52.9%, Good Nutrition 42.2%, Nutrition Less 43.9%, Malnutrition 50.0%. In families with a history of hypertension, the prevalence of increased blood pressure and hypertension in subjects was 60.3% and in families without a history of hypertension was 43.4%.

CONCLUSION: It can be concluded that there is still a prevalence of hypertension in children in Bali. Health efforts are needed so that they can minimise the further health impact that might occur. It should also be noted that various factors can influence the prevalence of increased blood pressure and hypertension in children.

Introduction

Hypertension still becomes the world's concern as this disease could occur at such a young age with its continuous risks until adult and contribute to heart disease, organs damage, and decreased quality of life [1], [2]. Early management of hypertension could decrease mortality and morbidity related to this disease. Its percentage in children varies one another. A study by Meng L et al. showed the increased blood pressure percentage in children aged 3 – 18 years as 3.1% [3]. Also reported that between 2011 to 2014, the prevalence of children hypertension aged 8 – 17 years old was 2.2% [2]. A study by Gupta et al. found the aetiology of hypertension itself, of which 423 children aged > 5 years who had hypertension were 275 children (65%) with essential hypertension of 43% and secondary by 57%. It was also found that the most age experienced hypertension ranged from 13 to 19 years old [4].

Blood pressure measurement in children is more complicated than the adults, because of children, blood pressure values need to be seen according to each normal percentile based on their age, sex, and height. Also, children are harder to cooperate in the measurements, often because they were scared to the examiner; therefore, it could bias the results [5], [6].

Heretofore, there is still a little of profile data of children blood pressure in Indonesia. Moreover, there were only some studies related to children blood pressure as the lack of concern since the difficulty of the measurement and probably also due to small prevalence that could be such a lack in its urgency.

Therefore, the primary objective of this study was to find out the hypertension prevalence of children in Bali. Secondary, it aims to prove the relation of some factors such as age, nutrition status and family history to children blood pressure in Bali. The obtained profile data is expected, contributing to the improvement of screening and prevention management, which can earlier be done in hypertension of children.

Material and Methods

It was a descriptive, cross-sectional study using a questionnaire and direct examination of the samples. All of the children from elementary and junior high school in Bali Province were included in this study. The inclusion criteria included children aged 6 to 18 years when examination conducted, willing to participate in this study, students, of elementary or junior high school in Bali Province, and live with both biological parents. The exclusion criteria included children with corticosteroid history of > 2 weeks or other drugs impacted blood pressure, children were absent when examination conducted, and research questionnaires were not filled.

The sampling technique is using multistage random sampling, which is from 9 regencies/municipalities in Bali, it was chosen 3 regencies/municipalities to become sampling sites according to socio-economic stratification based on regional economic growth and regional per capita income. In each stratification area in Bali Province, 1 regency/ municipality was taken using the stratified random sampling method, 9 districts/municipalities were designated as sampling locations using cluster sampling method, distribution of 9 sub-districts was carried out proportionally based on proportions the number of elementary and junior high school students in each selected district/municipality. Then, from 9 selected sub-districts, 18 elementary or junior high schools are designated as sampling locations using the cluster sampling method. Determination of students/children selected as samples in each primary school is done by simple random sampling method.

Blood pressure was determined using a sphygmomanometer to get designated samples' blood pressure. The measurement was conducted according to Flynn TJ et al., algorithm both in procedure and hypertension determination [6], i.e.: (1) percentile < 90: normotension; (2) percentile ≥ 90 to < 95 or 120/80 mmHg to percentile < 95: prehypertension; (3) percentile ≥ 95: hypertension, as a nominal measurement scale. Age was defined as chronological age at the time the sample examined. Samples were chosen at the age group of 28 days to 18 years, as a numeric measurement scale. The familial factor was a factor of father or mother who has prior hypertension history. The familial factor was determined by interview and direct examination to the parents; then the results would be categorised into the group "yes" or "no", as a nominal measurement scale. Exclusive breastfeeding was defined as giving only breast milk to the babies without infant formula, or other food and drink for 6 months, the results were obtained from the interview to parent and would be categorised into the group "yes" or "no", as a nominal measurement scale.

Nutrition status was determined accrding anthropometry status, i.e. body weight (BW) to length or height (L/H). Samples aged ≤ 5 years used Z-Score BW/H based on WHO Anthro Chart with interpretation: (1) Z-score BW/H > 3 SD: obese; (2) Z-score BW/H > 2 SD: overweight; (3) Z-score BW/H > 1 SD: potential risk of overweight; (4) Z-score BW/H < -2 SD: wasted; (5) Z-score BW/H < -3 SD: severely wasted. While patients aged > 5 years, it used BW/H based on The Centers for Disease Control and Prevention (CDC) 2000 and then classified to Waterlow criteria (BW/ideal body weight) as following: (1) Obesity: > 120%; (2) More nutrition: > 110 – 120%; (3) Good nutrition: 90 – 110%; (4) Less nutrition: 70% to 90%; (5) Malnutrition: < 70%, as a nominal measurement scale.

The diagnosis was established through anamnesis, physical examination, work up, and a decision made by the physician. The diagnosis of essential hypertension was established if: (1) increased blood pressure ≥ 95 in 3 times measurements; (2) no other causes leading to secondary hypertension; and (3) no influence of drugs that potentially increase blood pressure. While secondary hypertension evaluated by a physician.

Calculation of the estimated sample size required, using the sample size formula [7] by setting the significance level at 1.96, mean of standard deviation in the previous references was 25.3% [8], as well as the degree of precision was set at 2.5%, the number of samples from each group needed was 1161 children.

The obtained then collected and processed into software, to be analysed using the program. Descriptive analysis to determine the prevalence of hypertension in children, childhood obesity, and parental history of hypertension. Bivariate test (chi-square test) and calculation of prevalence ratio (PR) used to assess the relationship between hypertension and related factors.

All parents/guardians who will be included in this study have obtained and approved oral and written explanation regarding the purpose and procedure of the study. This research has received approval from the Ethics Committee of Medicine Faculty of Udayana University-Sanglah Denpasar Hospital.

Results

This study has been running for 6 months, and the sample was 1257 children from 1161 planned samples. Stratified random sampling used had resulted in three selected districts, namely: Denpasar, Karangasem and Singaraja. In those cities, the selection of elementary and junior high schools was obtained based on cluster sampling 1 and 2 with the distribution of the number of students whose number of students was quite balanced from the entire study sample. This study included an exclusive breastfeeding history and a parental history of hypertension. All canteens studied in the school were categorised as "Red" category (not in the table), which meant that almost all food sold in the canteen in this school is unhealthy or has given no effect on the health of the subject. Certain foods became the risk factors for the incidence of hypertension in children.

Table 1 showed the distribution of sample characteristics. The sex proportion in this research was not much different. In the age category, the age of children included this study was at balanced composition for ages ≤ 12 years and ages > 12 years. The highest proportion of students used as research subjects was 7th-grade students, in the amount of 22.9% while the lowest was 3rd-grade students, which 4.7%. While students from Bali are 96.8% of all students studied.

Table 1: Distribution of sample chracteristics

No	Characteristic	Frequency	Pecentage
1	Sex		
	Male	633	50.4%
	Female	624	49.6%
2	Age		
	Median (IQR), years	12.03 (3.40)	
	Minimum-Maximum	5.80 – 17.37	
	Age category		
	≤ 12 years old	620	49.3%
	> 12 years old	637	50.7%
3	Grade of school		
	1	71	5.6%
	2	78	6.2%
	3	59	4.7%
	4	138	11.0%
	5	123	9.8%
	6	131	10.4%
	7	288	22.9%
	8	133	10.6%
	9	236	18.8%
4	Level		
	Elementary	600	47.7%
	Junior High School	657	52.3%
5	District of School		
	Denpasar	418	33.3%
	Singaraja	440	35.0%
	Karangasem	399	31.7%
6	Origin		
	Bali	1217	96.8%
	Outside Bali	40	3.2%
	Total	1257	100%

Table 2 is a distribution of subject based on their clinical conditions. The median of waist circumference obtained was 65 cm. Nutritional status of good nutrition was 38.8%, more nutrition was 12.6%, and obesity was 30.2%. Samples who experienced hypertension grade 1 were 22.2%, and grade 2 was 14.1% while samples who began to experience increased blood pressure were elevated in the amount of 18.5%.

Table 2: Distribution of samples based on the clinical condition

No	Clinical condition (n = 1257)	Median (IQR)	Min-Max
1	Weight (kg)	40.0 (21.0)	15.0 – 105.0
2	Height (cm)	146.0 (21.5)	104.0 – 245.0
3	Waist circumference (cm)	65.0 (17.0)	40.0 – 118.0
4	Body mass index (kg/m2)	18.6 (6.3)	10.5 –36.8
5	Sistole (mmHg)	120.0 (10.0)	70.0 – 180.0
6	Diastole (mmHg)	70.0 (10.0)	40.0 – 130.0)
7	Nutritional status	Frequency	Percentage
	Obesity	379	30.2%
	More nutrition	159	12.6%
	Good nutrition	488	38.8%
	Less nutrition	221	17.6%
	Malnutrition	10	0.8%
8	Blood pressure		
	Normal	568	45.2%
	Elevated	233	18.5%
	Hypertension grade 1	279	22.2%
	Hypertension grade 2	177	14.1%
9	Exclusive breastfeeding (n = 528)		
	Yes	379	71.8%
	No	149	28.2%
10	Parental history of hypertension (n = 528)		
	Yes	46	8.7%
	No	482	91.3%
11	Hospitalization history (n = 528)		
	Yes	60	11.4%
	No	468	88.6%

Historical data of exclusive breastfeeding, parental history of hypertension and hospitalisation history were not obtained 100% of the data because most parents did not remember.

Table 3: Distribution of blood pressure based on sample characteristic

No	Characteristic	Blood Pressure				
		Normal	Elevated	Hyper-tension 1	Hyper-tension 2	Total
1	Sex					
	Male	280 (44.2%)	111 (17.5%)	140 (22.1%)	402 (16.1%)	633 (100%)
	Female	288 (46.2%)	122 (19.6%)	139 (22.3%)	75 (12.0%)	624 (100%)
2	Age					
	Frequency	568	233	279	177	1257
	Median (IQR)	11.41 (3.43)	13.61 (2.37)	12.17 (2.58)	11.37 (2.95)	12.03 (3.40)
	Mean Rank	560.45	847.01	651.19	527.03	
	Age group					
	≤ 12 years old	327 (52.7%)	57 (9.2%)	127 (20.5%)	109 (17.6%)	620 (100%)
	> 12 years old	241 (37.8%)	176 (27.6%)	152 (23.9%)	68 (10.7%)	637 (100%)
3	Level					
	Elementary	322 (53.7%)	55 (9.2%)	119 (19.8%)	104 (17.3%)	600 (100%)
	Junior High School	246 (37.4%)	178 (27.1%)	160 (24.4%)	73 (11.1%)	657 (100%)
4	Schools					
	Denpasar	275 (65.8%)	74 (17.7%)	60 (14.4%)	9 (2.2%)	418 (100%)
	Singaraja	108 (24.5%)	49 (11.1%)	145 (33.0%)	138 (31.4%)	440 (100%)
	Karangasem	185 (46.4%)	110 (27.6%)	74 (18.5%)	30 (7.5%)	399 (100%)
5	Origin					
	Bali	543 (44.6%)	228 (18.7%)	274 (22.5%)	172 (14.1%)	1217 (100%)
	Outside Bali	25 (62.5%)	5 (12.5%)	5 (12.5%)	5 (12.5%)	40 (100%)
6	Nutritional status					
	Obesity	163 (43.0%)	63 (16.6%)	87 (23.0%)	66 (17.4%)	379 (100%)
	More nutrition	50 (31.4%)	52 (32.7%)	41 (25.8%)	16 (10.1%)	159 (100%)
	Good nutrition	239 (49.0%)	88 (18.0%)	102 (20.9%)	59 (12.1%)	488 (100%)
	Less nutrition	110 (49.8%)	29 (13.1%)	48 (21.7%)	34 (15.4%)	221 (100%)
	Malnutrition	6 (60.0%)	1 (10.0%)	1 (10.0%)	2 (20.0%)	10 (100%)
7	Exclusive breastfeeding					
	Yes	201 (53.0%)	99 (26.1%)	59 (15.6%)	20 (5.3%)	379 (100%)
	No	86 (57.7%)	31 (20.8%)	25 (16.8%)	7 (4.7%)	149 (100%)
8	Parental history of hypertension					
	Yes	18 (39.1%)	15 (32.6%)	8 (17.4%)	5 (10.9%)	46 (100%)
	No	269 (55.8%)	115 (23.9%)	76 (15.8%)	22 (4.6%)	482 (100%)
9	History of hospitalised					
	Yes	30 (50.0%)	18 (30.0%)	12 (20.0%)	0 (0%)	60 (100%)
	No	257 (54.9%)	112 (23.9%)	72 (15.4%)	27 (5.8%)	468 (100%)

The distribution of blood pressure based on sample characteristics can be seen in Table 4. Differences in the composition of subjects experiencing hypertension were found in the subject's composition in blood pressure with hypertension grade 2, which was 16.1% in male compared to 12% in female.

Table 4: Data Distribution of Sistole and Diastole based on age and sex

Percentile	Sistole							Diastole						
	5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
Sex														
Male	90	100	110	120	125	130	140	60	60	70	80	80	90	90
Female	90	100	110	120	120	130	140	60	60	70	70	80	90	90
Age														
6	90	98	110	120	120	130	136	54	68	70	70	80	90	90
7	93,5	100	110	120	130	133	140	60	60	70	80	80	90	96
8	100	100	110	120	120	140	140	60	60	70	70	80	90	100
9	100	100	110	120	120	130	130	60	60	70	70	80	90	90
10	100	100	110	110	130	130	140	60	70	70	70	80	90	90
11	90	90	100	110	120	130	140	50	60	60	70	80	90	90
12	90	100	100	110	120	130	130	50	60	60	70	80	80	90
>=13	100	100	110	120	130	130	140	60	60	70	80	80	90	90

Age	Male		Female	
	Sistole (Mean ± SD)	Diastole (Mean ± SD)	Sistole (Mean ± SD)	Diastole (Mean ± SD)
6	116,6 ± 12,9	76,0 ± 7,4	106,4 ± 18,6	67,9 ± 8,9
7	118,7 ± 15,1	77,3 ± 11,8	104,4 ± 16,7	68,1 ± 15,7
8	115,2 ± 11,5	74,5 ± 8,5	107,5 ± 16,9	67,1 ± 12,7
9	115,2 ± 13,0	72,7 ± 10,9	112,8 ± 16,4	71,2 ± 11,4
10	117,7 ± 15,2	77,1 ± 11,9	109,7 ± 14,4	70,4 ± 12,5
11	112,6 ± 17,8	71,6 ± 14,1	114,8 ± 13,2	72,7 ± 11,0
12	113,9 ± 12,0	72,8 ± 10,5	120,4 ± 12,0	78,3 ± 10,9
>=13	117,6 ± 14,0	75,2 ± 11,1	118,4 ± 10,0	76,1 ± 8,2

The subject's distribution with hypertension grade 1 was the largest distribution (28.4%) of children who experienced increased blood pressure. Whereas the highest region experiencing increased blood pressure was Singaraja (75.5%). In obese children, 57% of children experienced increased blood pressure and 17.4% with grade 2 hypertension. While in children with more nutrition, 68.6% experienced increased blood pressure, with 10.1% with grade 2 hypertension.

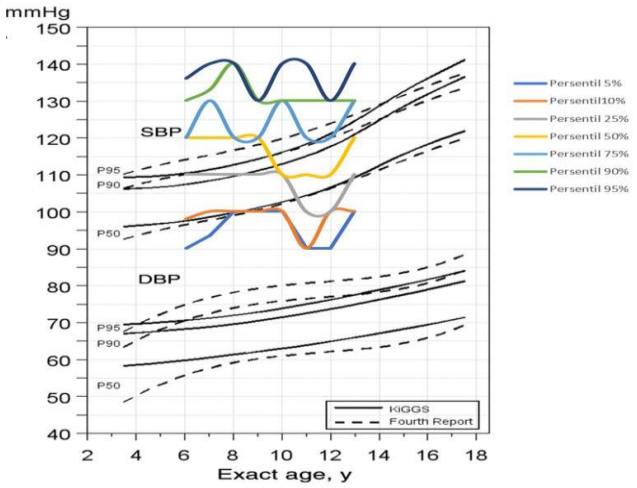

Figure 1: Study result curve to KIGGS and Fourth Report curve based on systolic blood pressure

Table 4 shows the data distribution of systole and diastole based on age and sex. The increase in age has a higher profile of mean systole and diastole. The male children have a higher profile of systole and diastole.

Figures 1 and 2 show study result curve to KIGGS and Fourth Report curve based on systolic and diastolic blood pressure, both curves show that this study has a different result than KIGGS and Fourth Report.

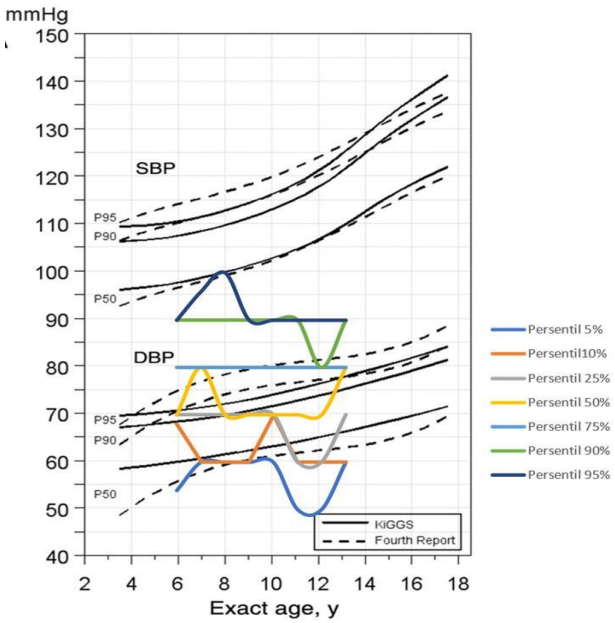

Figure 2: Study result curve to KIGGS and Fourth Report curve based on diastolic blood pressure

Discussion

In this study, the prevalence of hypertension was 36.3%, in which hypertension grade 1 was 22.2%, and grade 2 was 14.1%. This prevalence resembled results obtained by Fuiano *et al.,* [9] in 2006 in Foggia-Italy, which found 35.1% of boys and 40.2% in girls aged 3 to 16 years. This result was higher than the prevalence of 24.2% in children aged 7 to 11 years obtained by Mohkam *et al.,* [10] in 2011 in Tehran-Iran, and also the prevalence of 20.6% in children aged 8 to 13 years obtained by Urrutia-Rojas, *et al.,* [11] in Fort Worth Texas-USA in 2006. This prevalence was also higher than study in Khartoum-Sudan in 2010 by Salman, *et al.,* [12] which found of 4.9% in children aged 6 to 12 years, prevalence in Sabinas Hidalgo-Mexico in 2009 by Aregullin-Eligio and Alcorta-Garza [13] of 4.9% in children aged 6 to with 12 years, and prevalence of 13.8% in children aged 5 to 17 years by Moore, *et al.,* [14] in Oklahoma-USA in 2009.

The differences in the prevalence of hypertension from various studies could be caused by several factors including the differences in the

definition of hypertension in each country, the difference of race or ethnicity, culture, lifestyle, type of food, the prevalence of obesity, and genetic factors of each. Other factors that affect the prevalence of hypertension were the differences in study design, methods of examination of blood pressure, age range, and the number of samples [15].

The prevalence of hypertension in this study was high, reaching 36,3%, this result was similar to the prevalence of hypertension in the adult population in Indonesia in 2007 by 31.7% [16] and much higher than expected by Falkner, *et al.,* [17] of 3 to 5% in children. The high prevalence of hypertension in this study was probably caused by the high prevalence of obesity in the population. This study found obesity was 30.2% and including the rural and urban area. This condition probably caused by all the school of the subject have red canteen category, there for the pattern of food habit at school is not healthy and the student stays at school 6-8 hours-per-day. Quality and quantity persuasive education are needed in the future to make correction of food habits on children at school.

Obesity in children continues to be on the rise, with a predicted increase of 40% in the next decade [18]. The National Health and Nutrition Examination Survey data showed that since 1976–1980, obesity has doubled among preschool children 2-5 years of age and tripled among children and adolescents 6-19 years of age [19], [20]. The most recent National Health and Nutrition Examination Survey data from 2007 to 2008 showed 10% of infants and toddlers < 2 years of age had a weight-for-height ≥ 95th percentile, and 17% of children aged 2 – 19 years had a weight-for-height ≥ 95th percentile [21], [22], [23]. In the USA, the prevalence of obesity was 17% from 2011 to 2014 in the pediatric population [24]. In Europe, an estimated prevalence of 20% of children and adolescents are overweight, with one-third of these being considered as obese [25]. Obesity, or increased BMI, can now be considered as a risk factor not just for cardiovascular disease and diabetes, but also for CKD [18], [19], [20], [21], [22], [23], [24], [25], [26]. The increase in CKD in those who are obese is thought to be in part due to increased metabolic demands which, in turn, lead to a compensatory glomerular hyperfiltration injury in the kidney [18], [19], [20], [21], [22], [23], [24], [25], [26], [27]. This is now termed obesity-related glomerulopathy, and it has been speculated that a decrease in the number of functional nephrons might also be implicated in the pathogenesis [27], [28]. Obesity can also lead to RAAS activation along with many other metabolic pathways leading to HTN and the metabolic syndrome [29], [30]**.**

Metabolic syndrome is defined by three metabolic abnormalities such as obesity, elevated BP, low high-density lipoprotein cholesterol, hypertriglyceridemia, and hyperglycemia. 68 The prevalence of metabolic syndrome in adolescents was 4.5% from 1994 to 2004, as reported in the US National Health and Nutrition Survey data. It is estimated from the CKiD study that 13% of children with CKD had metabolic syndrome [30], [31]. The strong relationship between metabolic syndrome and CKD has become increasingly identified [32], [33], [34]

The high prevalence of hypertension in primary school children required the attention to prevent in the short- and long-term complications of this disease. This result proved that the government needed to do early detection and intervention for hypertension in children in Bali. Also, the school could work together with the government health centre to perform blood pressure checks routinely for the students and provide education to parents. These results could also be basic data for a general practitioner or paediatrician to perform blood pressure checks routinely in pediatric patients.

This study also found a high prevalence of obesity in primary and junior high school children in Bali; the prevalence was 30.2%. Based on this study result and the results of previous studies, blood pressure checks should be done periodically in children with obesity to detect hypertension. Also, the more important thing was how the government, in this case, the health department, the school, and parents play a role to control obesity in children. Early detection Program of obesity in children, education about obesity and lifestyle risk for a parent, and parent awareness of the dangers of obesity would play a role in efforts to control the disease.

References

1. Essouma M, Noubiap JJN, Bigna JJR, Nansseu JRN, Jinggi AM, Aminde LN, et al. Hypertension prevalence, incidence and risk factors among children and adolescents in Africa: a systematic review and metaanalysis protocol. BMJ Open. 2015; 5. https://doi.org/10.1136/bmjopen-2015-008472 PMid:26373403 PMCid:PMC4577976

2. Lewis MN, Shatat IF, Philips SM. Screening for hypertension in children and adolescents: methodology and current practice recommendations. Front. Pediatr. 2017; 5:51. https://doi.org/10.3389/fped.2017.00051 PMid:28361048 PMCid:PMC5350116

3. Meng L, Liang Y, Liu J, Hu Y, Yan Y, Mi J. Prevalence and risk factors of hypertension based on repeated measurements in Chinese children and adolescents. Blood Pressure. 2013; 22:57-64. https://doi.org/10.3109/08037051.2012.701790 PMid:22853559

4. Gupta-Malhotra M, Banker A, Shete S, Hashmi SS, Tyson JE, Barrat MS, et al. Essential hypertension vs. secondary hypertension among children. American Journal of Hypertension. 2015; 28(1). https://doi.org/10.1093/ajh/hpu083 PMid:24842390 PMCid:PMC4318949

5. 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. USA: U.S. Department of Health and Human Service; 2005.

6. Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Carroll AE, Daniels SR, et al. Clinical practice guideline for screening and

management of high blood pressure in children and adolescents. Pediatrics. 2017; 140(3). https://doi.org/10.1542/peds.2017-3035 PMid:29192011

7. Sastroasmoro S. Pemilihan Subyek Penelitian. Dalam: Sastroasmoro, S., Ismael, S., ed. Dasar-dasar metodologi penelitian klinis. 2008.

8. Sutawan IBR. Prevalensi dan hubungan hipertensi dengan obesitas anak dan riwayat hipertensi orang tua pada anak sekolah dasar di Bali. Thesis. 2015.

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

10. 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.

11. Urrutia-Rojas X, Egbuchunam CU, Bae S, Menchaca J, Bayona M, Rivers PA, et al. High blood pressure in school children: prevalence and risk factors. BMC Pediatrics. 2006; 6. https://doi.org/10.1186/1471-2431-6-32 PMid:17109750 PMCid:PMC1657006

12. Salman Z, Kirk GD, DeBoer MD. High rate of obesity-associated hypertension among primary schoolchildren in Sudan. International Journal of Hypertension. 2010; 11: 1-5. https://doi.org/10.4061/2011/629492 PMid:21234364 PMCid:PMC3014717

13. Aregullin-Eligio EO, Alcorta-Garza MC. Prevalencia y factores de riesgo de hipertensión arterial en escolares Mexicanos. Salud Pública De México. 2009; 51: 14-18. https://doi.org/10.1590/S0036-36342009000100005 PMid:19180308

14. 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. https://doi.org/10.1038/ajh.2009.13 PMid:19214168

15. Subhi MD. Blood pressure profiles and hypertension in iraqi primary school children. Saudi Med J. 2006; 27: 482-486.

16. Ministry of Health Republic of Indonesia. The 2007 Report of National Basic Health Survey. Jakarta: Research and Development Board Ministry of Health Republic of Indonesia; 2008.

17. Falkner B, Lurbe E, Schaefer F. High blood pressure in children: clinical and health policy implications. The Journal of Clinical Hypertension. 2010; 12:261-276. https://doi.org/10.1111/j.1751-7176.2009.00245.x PMid:20433547

18. Tkaczyk M, Nowicki M, BałaszChmielewska I, et al. Hypertension in dialysed children: the prevalence and therapeutic approach in Poland-a nationwide survey. Nephrol Dial Transplant. 2006; 21:736-742. https://doi.org/10.1093/ndt/gfi280 PMid:16303782

19. Kramer AM, van Stralen KJ, Jager KJ, et al. Demographics of blood pressure and hypertension in children on renal replacement therapy in Europe. Kidney Int. 2011; 80:1092-1098. https://doi.org/10.1038/ki.2011.232 PMid:21814180

20. Halbach SM, Martz K, Mattoo T, Flynn J. Predictors of blood pressure and its control in pediatric patients receiving dialysis. J Pediatr. 2012; 160:621- 625. https://doi.org/10.1016/j.jpeds.2011.09.046 PMid:22056352 PMCid:PMC3409690

21. Kaelber DC. IBM explorys cohort discovery tool, 2019. Available at: www.ibm. com/watson/health/explorys. Accessed March 3, 2019.

22. Barker DJ. The fetal and infant origins of adult disease. BMJ. 1990;301:1111. https://doi.org/10.1136/bmj.301.6761.1111 PMid:2252919 PMCid:PMC1664286

23. Edvardsson VO, Steinthorsdottir SD, Eliasdottir SB, Indridason OS, Palsson R. Birth weight and childhood blood pressure. Curr Hypertens Rep. 2012; 14:596-602. https://doi.org/10.1007/s11906-012-0311-6 PMid:23054892

24. Mhanna MJ, Iqbal AM, Kaelber DC. Weight gain and hypertension at three years of age and older in extremely low birth weight infants. J Neonatal Perinatal Med. 2015; 8:363-369. https://doi.org/10.3233/NPM-15814080 PMid:26836822

25. Di Salvo G, Castaldi B, Baldini L, et al. Masked hypertension in young patients after successful aortic coarctation repair: impact on left ventricular geometry and function. J Hum Hypertens. 2011; 25:739-745. https://doi.org/10.1038/jhh.2010.118 PMid:21228825

26. Falkner B, Gidding SS, Portman R, Rosner B. Blood pressure variability and classification of prehypertension and hypertension in adolescence. Pediatrics. 2008; 122:238-242. https://doi.org/10.1542/peds.2007-2776 PMid:18676538

27. Tracy RE, Newman WP III, Wattigney WA, Srinivasan SR, Strong JP, Berenson GS. Histologic features of atherosclerosis and hypertension from autopsies of young individuals in a defined geographic population: the Bogalusa Heart Study. Atherosclerosis. 1995; 116:163-179. https://doi.org/10.1016/0021-9150(95)05525-2

28. Urbina EM, Khoury PR, McCoy C, Daniels SR, Kimball TR, Dolan LM. Cardiac and vascular consequences of prehypertension in youth. J Clin Hypertens (Greenwich). 2011; 13:332-342. https://doi.org/10.1111/j.1751-7176.2011.00471.x PMid:21545394 PMCid:PMC3092159

29. de Simone G, Devereux RB, Daniels SR, Koren MJ, Meyer RA, Laragh JH. Effect of growth on variability of left ventricular mass: assessment of allometric signals in adults and children and their capacity to predict cardiovascular risk. J Am Coll Cardiol. 1995; 25:1056-1062. https://doi.org/10.1016/0735-1097(94)00540-7

30. O'Leary DH, Polak JF, Kronmal RA, Manolio TA, Burke GL, Wolfson SK Jr; Cardiovascular Health Study Collaborative Research Group. Carotidartery intima and media thickness as a risk factor for myocardial infarction and stroke in older adults. N Engl J Med. 1999; 340:14-22. https://doi.org/10.1056/NEJM199901073400103 PMid:9878640

31. Mitchell GF, Hwang SJ, Vasan RS, et al. Arterial stiffness and cardiovascular events: the Framingham Heart Study. Circulation. 2010; 121:505-511. https://doi.org/10.1161/CIRCULATIONAHA.109.886655 PMid:20083680 PMCid:PMC2836717

32. Lloyd-Jones DM, Hong Y, Labarthe D, et al; American Heart Association Strategic Planning Task Force and Statistics Committee. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic impact goal through 2020 and beyond. Circulation. 2010; 121:586-613. https://doi.org/10.1161/CIRCULATIONAHA.109.192703 PMid:20089546

33. Ning H, Labarthe DR, Shay CM, et al. Status of cardiovascular health in US children up to 11 years of age: the National Health and Nutrition Examination Surveys 2003-2010. Circ Cardiovasc Qual Outcomes. 2015; 8:164-171. https://doi.org/10.1161/CIRCOUTCOMES.114.001274 PMid:25782775

34. Steinberger J, Daniels SR, Hagberg N, et al; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Epidemiology and Prevention; Council on Functional Genomics and Translational Biology; Stroke Council. Cardiovascular health promotion in children: challenges and opportunities for 2020 and beyond: a scientific statement from the American Heart Association. Circulation. 2016; 134:e236-e255.