BLOOD PRESSURE PROFILE IN SCHOOL CHILDREN IN RURAL AND URBAN AREA IN AND AROUND KARAD

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Abstract: A cross sectional study among 1000 school going children of age group 6 – 16 years was conducted to study the relation of Blood Pressure with variables Like Body Mass Index, Socio Economic Status, Family History of Hypertension, Age and Sex at our tertiary care hospital Krishna Institute of Medical Sciences Deemed University, Karad. 1.The study group had 100 (10%) children of 13, 14, 15 and 16 years, 90 (9%) children of 6, 8, 9 and 12 years and 80 (8%) children of 7, 10 and 11 years. 12.Systolic hypertension was observed in 13.3% of overweight and 6.7% of obese children. Systolic prehypertension was observed in 11.7% of overweight and 13.3% of obese children. BMI was significantly associated with pre hypertension and hypertension (SBP) in children (p<0.001). Diastolic hypertension was observed in 16.7% of overweight and 6.7% of obese children. Diastolic prehypertension was observed in 18.3% of overweight and 20% of obese children. Only 1.7% and 0.9% of prehypertension and hypertensive children had normal BMI.

Keywords: School children, Blood pressure, Cardiac output, Hypertension

1. INTRODUCTION

The measurement of blood pressure is firmly established as an important component of routine paediatric physical examination [1]. Norms for blood pressure and definition of hypertension were revised and strengthened by "the fourth report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents; April 29, 2004" [2]. Juvenile blood pressure was found to be one of the several predictors of adult blood pressure [3,4]. Studies have concluded that both systolic and diastolic blood pressure have a direct correlation with weight and with height (independent of age) [5-11]. There are number of studies conducted in different parts of the world regarding paediatric blood pressure profiles and its correlation with weight, height and body mass index, but there is paucity of studies in Indian context. The local reference data is essential to evaluate any observed blood pressure values. Hence the present study was done at our tertiary care centre to study the Relation of Blood Pressure with Variables Like Body Mass Index, Socioeconomic Status, Family History of Hypertension, Age and Sex in School Going Children of Age Group 6- 16 Years.

2. AIMS AND OBJECTIVES

To study the relation of blood pressure with variables like body mass index, socioeconomic status, family history of hypertension, age and sex in school going children of age group 6-16 years. To assess norms for normal blood pressure in school going children of 6-16 yrs. To find out prevalence of hypertension in the school going population of 6-16 years. To find out the probable etiological factors for hypertension in school going children of age group 6-16 years.

3. REVIEW OF LITERATURE

In 1940's, two physicians, in US Andre Cournand and Dickinson Richards developed special small catheter for use in the heart. They passed the catheter into the right ventricle and pulmonary artery to record the pressure and measure the cardiac output. For this, Frossman, Cournand and Richards received Noble Prize in 1956 [12].

Oscillometric method technique was first demonstrated by Marey in 1876,[13] and it was subsequently shown that when the oscillations of pressure in a sphygmomanometer cuff are recorded during gradual deflation, the point of maximal oscillation corresponds to the mean intra-arterial pressure. The oscillations begin at approximately systolic pressure and continue below diastolic, so that systolic and diastolic pressure can only be estimated indirectly according to some empirically derived algorithm. This method is advantageous in that no transducer need be placed over the brachial artery, and it is less susceptible to external noise (but not to low-frequency mechanical vibration). The main disadvantage is that such recorders do not work well during physical activity when there may be considerable movement artifact.

The increasing use of electronic monitors for both self- and ambulatory monitoring has necessitated the development of standard protocols for testing them. The two most widely used protocols have been developed by the British Hypertension Society (BHS)[14] and the Association for the Advancement of Medical Instrumentation (AAMI) in the United States [15]. One of the limitations of the validation procedures is that they analyze the data on a population basis and pay no attention to individual factors. Thus, it is possible that a monitor will pass the validation criteria and still be consistently in error in a substantial number of individuals.

BP is an important indicator of appropriate circulation which is a composite of cardiac function and peripheral circulation as determined by cardiac output (CO) and systemic vascular resistance (SVR), respectively. Since this thesis copes with the measurement of blood pressure in children, the understanding of the underlying physiology is of uttermost importance. In particular, the anatomy and functioning of the blood pressure supporting system, i.e. the Cardio Vascular System (CVS), are to be comprehended.

A sketched description of the CVS, including the most relevant organs and anatomical structures participating in the control of BP. The Pulmonary circulation is in charge of transporting blood from the Right Ventricle (RV) through the lungs in order to perform a gas exchange at the alveolar level (release of carbon dioxide, and capture of oxygen). Oxygenated blood is recalled by the Left Atrium, LA. The Systemic circulation distributes then the oxygenated blood through all the body (starting at the left ventricle, LV) and recalls the deoxygenated blood at the right auricle, RA. The flow of blood through pulmonary and systemic circulation is orchestrated by a cardiac cycle. Cardiac output (CO) is a function of stroke volume (SV) and heart rate (HR). The preload of cardiac myocytes determines SV, and HR is regulated by the sympathetic nervous system (SNS), as well as by the cardiac autonomic pacemaker. The SNS receives homeostatic feedback from baroreceptor /chemoreceptor reflexes and regulates the distribution of cardiac output over short-term. Increased SNS activity is most likely responsible for the mild tachycardia seen in many patients with primary hypertension. Cardiac Index (CI) is a function of CO and body surface area (BSA). Young patients with mild hypertension have significantly higher CO, CI, and sympathetic nerve burst frequency than age-matched controls [16]. In nearly all forms of established Hypertension, SVR is increased and CO is reduced. Moreover, in progressive hypertension, a further increase in SVR occurs and CO continues to fall, indicating reduced vascular compliance.[17]

As the cross-sectional area of a vessel decreases, resistance to flow increases. This makes systemic vascular resistance mainly a function of small, peripheral arterioles, whose medial layer characteristically increases in response to sustained hypertension. In larger vessels, the content of elastin and collagen in the media increases and the number of smooth muscle cells decreases (via medial atrophy, necrosis, or apoptosis), leading to a loss of elasticity and the development of increased vessel 'stiffness.'[18] Altered vascular structure in hypertension is also accompanied by functional changes in the cellular components of the vessel wall, specifically decreased relaxation and increased contraction. These functional alterations act in concert with the structural changes discussed above to perpetuate hypertension, emphasizing the importance of the vasculature in the pathogenesis of hypertension [19].

A crucial element of the blood pressure regulation is determined by Autonomic Nervous System (ANS). Actuating via two opposite branches (the Sympathetic and Para-sympathetic systems) the ANS is capable of either achieving fast increases of BP (innervation of cardiac muscle contractibility, innervation of resistance vessel tone, and innervation of venous tone) or performing very fast decreases of BP (innervation of the sinus node, and thus, lowering of the heart rate). The amount of ANS nerve electrical activity is controlled by the cerebral cortex: by comparing the balance of pressor and depressor reflexes to a central set-point, electrical commands are continuously delivered to the CVS via the different ANS pathways.

The Kidneys play a crucial role in maintaining a homeostatic blood pressure as well as many other important functions such as filtering the blood. The kidney is comprised of an outer section called the renal medulla and an inner section called the renal cortex. The renal pelvis is connected to the ureter, which ultimately leads to the bladder. The functional unit of the kidney is the nephron and is located within the medulla and cortex.

Nitric oxide (NO) is an endothelium-derived gas, synthesized from the amino acid L arginine by the endothelial isoform of nitric oxide synthase (NOS). NO is extremely labile, with a half-life of <4 s in biological solutions. It is rapidly oxidized to nitrite and then nitrate by oxygenated hemoglobin before being excreted by the kidneys. Synthesized nitric oxide diffuses across the endothelial cell membrane and enters vascular smooth muscle cells, activating guanylate cyclase, leading to production of the second messenger cyclic guanosine-3,5-monophosphate (cGMP) [20]. CGMP in turn mediates control of vascular tone and platelet function. Nitric oxide is a vasodilator, and the balance between nitric oxide and various endothelium-derived vasoconstrictors and the sympathetic nervous system maintains physiologic blood vessel tone [21]. Thyroid hormone plays an important role in the regulation of blood pressure. Administration of exogenous thyroid hormone results in a decrease in systemic vascular resistance, which in turn results in renin release, activation of the angiotensin–aldosterone axis, increase in renal sodium reabsorption, increase in intravascular volume, cardiac output and cardiac contractility [22]. Genetic predisposition is one of the most important risks for essential hypertension. Which is been proved beyond doubt. One of the most promising recent development has been the discovery of candidate‟s genes for hypertension that highlight the role of the rennin angiotensin system. The genetic basis seems to polygenic and therefore does not follow simple mendelian patterns of inheritance. Several other genetic aspects of hypertension have been investigated and include lithium counter transport mechanisms; the association with insulin resistance, sodium sensitivity and gene influenced body mass index [5]. Other factors which influence the blood pressure are dietary sodium, potassium and calcium. Although in adults with established hypertension, decrease in dietary sodium intake may lower blood pressure; but in studies of infants and adolescents, this effect is less clear. Studies have proved that sodium sensitivity in the young seems to be linked to race; family history and obesity and that although little effect is seen with reduced sodium intake over a few weeks, a sustained reduction in sodium intake over years may have an effect on blood pressure [5,23].

4. MATERIALS AND METHODS

A cross sectional study among 1000 school going children of age group 6 – 16 years was conducted to study the relation of Blood Pressure with variables Like Body Mass Index, Socio Economic Status, Family History of Hypertension, Age and Sex at our tertiary care hospital Krishna Institute of Medical Sciences Deemed University, Karad. The present study was conducted on randomly selected attending school children of age group 6 – 16 years. one school managed by Nagar parishad and other school managed by private trust. Within the selected school, children will be selected by systematic sampling technique, proportionate to the total number of children in that school. A total of 1000 children of age group 6 to 16 years with apparently good health of both the sex are included in the study. This study was carried out in an rural tertiary care centre in Karad. The study sample consisted of 1000 (455 boys and 545 girls) apparently healthy children studying at school managed by Nagar parishad and other school managed by private trust in the age group of 6 -16 years, between December 2015 to November 2017.

5. OBSERVATIONS AND RESULTS

A cross sectional study among 1000 school going children of age group 6 – 16 years was conducted to study the relation of Blood Pressure with variables Like Body Mass Index, Socio Economic Status, Family History of Hypertension, Age and Sex at our tertiary care hospital Krishna Institute of Medical Sciences Deemed University, Karad.

Table 1: Distribution of children according to Age

Age (years)	N	%
6	90	9%
7	80	8%
8	90	9%
9	90	9%
10	80	8%
11	80	8%
12	90	9%
13	100	10%
14	100	10%
15	100	10%
16	100	10%

Total	1000	100%

As seen in table no. 1, the study group had 100 (10%) children of 13, 14, 15 and 16 years, 90 (9%) children of 6, 8, 9 and 12 years and 80 (8%) children of 7, 10 and 11 years.

Table 2: Distribution of children according to BMI

BMI	N	%
Normal	925	92.5%
Overweight	60	6%
Obese	15	1.5%
Total	1000	100%

As seen in table no. 2, 925 (92.5%) children were in the Normal range while 60 (6%) and 15 (1.5%) children were overweight and obese respectively.

Table 3: Distribution of children according to Diet

Diet	Male		Female		Total
	N	%	N	%	
Vegetarian	385	38.5%	470	44%	855
Non-Vegetarian	70	7%	75	7.5%	145
Total	455	49.5%	545	50.5	1000

As seen in table no. 3, majority of the children (85.5%) were vegetarian of which 385 (38.5%) and 470 (47%) were male and female children respectively.

Table 4: Prevalence of diastolic prehypertension and hypertension (DBP) in children according to BMI

BMI	Total	Normal	Pre HTN	HTN	p Value
Normal	925	900 (97.4%)	16 (1.7%)	9 (0.9%)	**<0.001**
Overweight	60	39 (65%)	11 (18.3%)	10 (16.7%)	
Obese	15	11 (73.3%)	3 (20%)	1 (6.7%)	
Total	1000	950 (95%)	30 (3%)	20 (2%)	

As seen in table no. 4, diastolic hypertension was observed in 16.7% of overweight and 6.7% of obese children. Diastolic prehypertension was observed in 18.3% of overweight and 20% of obese children. Only 1.7% and 0.9% of prehypertensive and hypertensive children had normal BMI. BMI was significantly associated with pre hypertension and hypertension (DBP) in children (p<0.001).

6. DISCUSSION

A cross sectional study among 1000 school going children of age group 6-16 years was conducted to study prevalence of blood pressure and its probable etiology in school going children in rural and urban area in and around Karad. In the present study, the study group had 100 (10%) children of 13, 14, 15 and 16 years, 90 (9%) children of 6, 8, 9 and 12 years and 80 (8%) children of 7, 10 and 11 years. 54.5% children were female while male children constituted 45.5% of the study group.

Madhusudhan K et al [24] in an observational study reported according to weight, students were arranged into 6 groups with a difference of 10 kg between each group, independent of age and height. It is observed that with increase of weight, there is a linear increase of mean systolic and diastolic blood pressures in both boys and girls. It is observed that as the height of the group increased, there is a linear increase of mean systolic and diastolic blood pressures of the group with a steep rise in >170 cm height group. BMI of subjects, students were categorized into four groups (those with BMI < 5th percentile, between 5th and <85 percentile, 85th and <95 percentile and those ≥ 95 percentile). The mean SBP and DBP of the overweight group (BMI 85th to 95th percentile) and obese group (BMI ≥95th percentile) was higher than other BMI groups. In our study, 297 (29.7%) children had a family history of hypertension while 703 (70.3%) children had no family history of hypertension. 60 (6%) children were from upper class, 240 (24%) and 560 (56%) children were from upper middle class and lower middle class respectively. 110 (11%) and 30 (3%) children were from upper lower class and lower class respectively. Majority of the children (85.5%) in our study were vegetarian of which 385 (38.5%) and 470 (47%) were male and female children respectively. Prevalence of overweight was 7.5% in males compared to 4.8% in females with overall prevalence of 6%. Prevalence of obesity was 2.4% in males compared to 0.7% in females with overall prevalence of 1.5%.

7. CONCLUSION

Hypertension is not an uncommon problem in children; its morbidity should be prevented by identifying children in pre hypertension stage and adopting life style modification.Therefore blood pressure measurement should be made mandatory in school health programs and in routine clinical practice. High BMI should be taken as risk factor for hypertension and it should also be taken into consideration for labeling a particular child as hypertensive based on blood pressure nomograms. There was no significant difference of blood pressure (systolic as well as diastolic) between males and females.With increase of age, weight and height there was a linear increase of mean systolic and diastolic blood pressure. The mean values of systolic and diagnostic blood Pressure in overweight and obese group is significantly higher with p value <0.001. For a given age, blood pressure levels were higher in taller and obese children.Children with family history of hypertension and those belonging to higher socio economic status (class I) had increased systolic and diastolic blood pressure. Higher body weight may be used as a predictor of high blood pressure. Overweight and obesity in children should be considered as pre disease state which may lead to development of hypertension and related cardiovascular complications in later life.

8. REFERENCES

[1] Sinaiko AR. Hypertension in children. N Engl J Med 1996;335:168- 197.
[2] The Fourth Report on the Diagnosis, Evaluation and Treatment of High blood pressure in children and Adolescents". Pediatrics 2004; 114(2) S: 555-576.
[3] Shears CS, Barke GL, Freedman DS, Berenson GS. Value of childhood blood pressure

measurement and family history in predicting future blood pressure status : Results from 8 years of followup in Bogalus heart study. Pediatrics 1986;77:862-9.
[4] Nelson J, Regland DR. Longitudinal prediction of adult blood pressure from juvenile blood pressure levels. Am. J Epidemiol 1992;136(6):633-645.
[5] Sharon MB, Andrao JA. Childhood hypertension. An update on etiology diagnosis and treatment. Pediatric Clin North Am 1999;46(2):235-52.
[6] Fiscles De, Laura P. Validity of mass blood pressure screening in children. Pediatrics 1983;72(4):459-463.
[7] Sinaiko AR, Gomez O. Prevalence of significant hypertension in junior high school aged children ; The children and adolescent blood pressure programme. J Pediatric 1989;114:664-669.
[8] Mathew WG, Nancy RC. Identifying children at high risk for the development of essential hypertension. J Pediatric 1993;122(6):837-45.
[9] Agarwal VK, Sharan R. Blood pressure profile it in children of age 3-15 years. Indian Pediatr 1983;20:921-21.
[10] Rosner B, Princar RJ. Blood pressure normograms for children and adolescents by heights, sex and age in the United States. J Pediatric 1993; 123(6):871-86.
[11] Muntner P, HeJ, Cutler JA. Trends in blood pressure among children in adolescents. JAMA 2004;291:2107-13.
[12] Best and Taylor‟s. Physiological basis of medical practice. 12th Edn, John B West (Ed) 1990.
[13] Marey EJ. Pression et vitesse du sang. In: Masson G, editor. Physiologie experimentale, vol. 2. Paris; 1876. p. 307.
[14] O‟Brien E, Petrie J, Littler W, et al. The British Hypertension Society protocol for the evaluation of automated and semi-automated blood pressure measuring devices with special reference to ambulatory systems. J Hypertens 1990;8:607.
[15] Association for the Advancement of Medical Instrumentation. Electronic of automated sphygmomanometer. Arlington (VA): American National Standard; 1992.
[16] Floras JS, Hara K. Sympathoneural and haemodynamic characteristics of young subjects with mild essential hypertension. J Hypertens 1993;11:647– 655.
[17] Julius S. Changing role of the autonomic nervous system in human hypertension. J Hypertens Suppl 1990;8:S59–S65.
[18] Owens GK, Schwartz SM. Alterations in vascular smooth muscle mass in the spontaneously hypertensive rat. Role of cellular hypertrophy, hyperploidy, and hyperplasia. Circ Res 1982;51:280– 289.
[19] Folkow B. Structure and function of the arteries in hypertension. Am Heart J 1987;114:938–948.
[20] Moncada S, Higgs A. The L-arginine-nitric oxide pathway. N Engl J Med 1993;329:2002–2012.
[21] Vallance P, Collier J, Moncada S. Effects of endothelium-derived nitric oxide on peripheral arteriolar tone in man. Lancet 1989;2:997– 1000.
[22] Klein I, Levey GS. The cardiovascular system in thyrotoxicosis. In Werner and Ingbar‟s The Thyroid: A Fundamental and Clinical Text, 8th edn. Braverman LE, Utiger RD (eds.). Philadelphia, PA, Lippincott, Williams & Wilkins, 2000, pp. 596 604.
[23] Simons MD, Husberger S. Vanhorn L. et al., Nutrient intake and blood pressure in the dietary intervention study in children. Hypertension 1997;77: 862-7.
[24] Madhusudhan K, Betham R, Jampana VR. Study of blood pressure profile and correlation of hypertension with age, sex, anthropometric measurements (weight, height, body mass index), socio economic status and hereditary factors in school going children. Int J Contemp Pediatr 2017;4:19-27.