DISTRIBUTION OF BLOOD PRESSURE AND ITS ANTHROPOMETRIC CORRELATES AMONG SCHOOL CHILDREN OF RURAL PUDUCHERRY

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ABSTRACT

Background: *Hypertension is the tenth leading cause of death worldwide. Hypertension has its root in childhood itself. But blood pressure determination among school-going adolescents and acting upon it has traditionally not been given enough importance.*

Objectives: *To explore the distribution pattern of blood pressure and their correlation with anthropometric indices among secondary school children.*

Methodology: *Cross sectional study was conducted in schools of Seliamedu Puducherry, involving students of 11 to 15 years of age. Blood pressure and anthropometric indices were measured for data collection.*

Results: *Among the 405 subjects, the prevalence of high blood pressure was found to be 8.6%. The pattern of distribution of blood pressure increases as the age increases. Correlations between blood pressure and height, weight and BMI were positive with significance level of less than 0.01.*

Conclusion: *There is a high prevalence of hypertension among the school children which remained unnoticed. Hence tracking of blood pressure, awareness about obesity and hypertension can be prioritized as a part of educational curriculum.*

Key words: *Blood Pressure, Hypertension, school children, anthropometry*

INTRODUCTION

The cardiovascular diseases are the major public health concern and are projected to remain the single leading cause of death. It is estimated that almost 20 million people will die due to cardio vascular disease and stroke by 2015 [1]. Raised blood pressure (Hypertension) remains to be the leading risk factor for cardiovascular disease and leading cause of death accounting for 16.5% of global death. The increased blood pressure has its root from the childhood itself which often remains asymptomatic. Thus the asymptomatic hypertension continues to be silent for next two decades which turns to be the risk factor for other diseases also. Pediatric hypertension is also known to cause long-term cardiovascular morbidity and interferes with cognitive function during the developmental stages [2].The American Heart Association recommends yearly blood pressure measurements to all children from the age of 3 years for tracking the blood pressure from childhood till adulthood. But the measurement of blood pressure is not routinely done either in schools or by clinicians during their check up and also studies related to the blood pressure of school going Indian children are still inadequate.

There are few studies showing direct association between age and blood pressure. In addition to age and gender, anthropometric indices are also found to influence blood pressure levels in childhood[3]. The origin of adult obesity and its adverse health consequences often begins in childhood which remains unnoticed or goes with some misconception which in later age turns to be a seed for many risk factors like hypertension, hypercholesterolemia etc and for many disease like heart disease [4].Though many studies have been done to find the relation between BMI and blood pressure, this study is commenced which will scientifically contribute to identify the population at risk well in advance to implement necessary action. The aim of this study was to determine the blood pressure distribution in school children and to correlate with their anthropometric measurement.

METHODOLOGY

This is a cross sectional study done in the rural field practice area of Department of Community Medicine, Mahatma Gandhi Medical College & Research Institute (MGMCRI), Puducherry. The study was conducted among all the students studying in higher secondary schools (age limit from 11 to 15 years) of Seliamedu, Bahour. Written permission was obtained from the Directorate of school education, Government of Pondicherry. Prior to the start of the study, informed consent was obtained from the school head. The ethical clearance was also obtained from Institutional Human Ethical Committee. The importance of the study was explained to the staffs, students and teachers in their local language. In this study 405 school children in the age range of 11–15 years were enrolled from six schools in the first year between November 2013 and January 2014. These

children will be tracked for Blood Pressure and other determinants for next 4 years (till 2018).

Socio demographic data were recorded in computer based questionnaire sheet which have been made for this purpose in Epi-info version-7. The age was determined from the school registration record/ ID card. All the students who were present on the day of survey were clinically examined with special prominence on evaluation of cardiovascular disease. Those students absent for successive visits were excluded from the study. Anthropometric measurement like height, weight, hip circumference and waist circumference were recorded as per the standard recommendations [5]. The height of the students were measured using a portable height measuring device in standing position without their footwear, with heels together and their head positioned perpendicular to the body. A standard weighing machine was calibrated against known weights regularly. The zero error was checked for and removed before starting the examination every day. The weight and height were recorded to the nearest 0.1 kg by weighing scale and 0.5 cm by measuring scale respectively. BMI was calculated using the following formula: weight in kg/height in metre^2.

Blood Pressure was measured using standard method with appropriate size cuff, covering two-thirds of the arm. After five minutes rest in sitting position with the arm at the level of the heart, the blood pressure was measured. The cuff was inflated to a level at which the distal arterial pulse was not palpable. Then both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were determined. Hypertension is defined as "SBP or DBP exceeding the 95th percentile for age, gender and blood pressure >120/80 mm Hg". If the SBP was higher than 120 mm Hg and the DBP higher than 80 mm Hg, two additional readings were obtained and cross checked. The lowest of the three readings was recorded [6]. All the readings were made by the same observer to avoid inter-observer variation.

Statistical analysis was done using epi info 6.6 version. Mean blood pressure at 5th, 10th, 25th, 50th, 75th, 90th, 95th percentile for both systolic and diastolic blood pressure were calculated. Mean, Percentage, standard deviation and increment were used for the analysis of the data. Pearson correlation Coefficient and chi square test were applied to assess the relationship between Blood Pressure and anthropometric variables. A value of $P < 0.01$ was considered as statistically significant.

RESULTS

Totally 405 children were examined among which 193(47.7%) were boys and 212(52.3%) were girls. Distribution of blood pressure in accordance with their age, sex and anthropometric indices (height, weight and body mass index) were studied.

The age wise distribution of both systolic and diastolic blood pressure (11-15 years of age) and their mean blood pressure is shown in Table-1. The mean Systolic Blood Pressure was observed to be105.53 mm of Hg, and Diastolic Blood Pressure was 73.37. It has been found that both systolic and diastolic blood pressure increases as the age increases. Every unit increase in age of the students there is 10% increment of Systolic Blood Pressure and 2% for Diastolic Blood pressure with significant *p* value. Minimum increment among the students was at 14 years (0.98 mm of Hg) and maximum at 15 years of age (2.9 mm of Hg) for Systolic blood Pressure. For Diastolic Blood pressure, the minimum increment was observed at 15 years (0.33mm of Hg) and maximum at 12 years of age (3.03 mm of Hg)

The overall Prevalence of hypertension was 8.64% among the study population is shown in Table-2. The Prevalence of hypertension was found to be high among boys at 12 years of age (14.29%) and among girls at 15 years of age (25%) and significant difference was observed between the sex. Among the study population girls were found to have 2.5 times higher prevalence of hypertension than that of the boys.

Association between age and hypertension is shown in Table-3. Among the students in 12 years of age the odds of being hypertensive is seven times more when compared to those students in 11 years of age. Frequency distribution of mean systolic blood pressure and diastolic blood pressure for the anthropometric variables like height, weight and BMI is shown in Table 4. As the BMI increases both systolic and diastolic Blood Pressure increases. Positive correlation was seen among all anthropometric variables for Systolic Blood Pressure and Diastolic Blood Pressure of which weight has maximum correlation. For every unit of increase in weight Systolic Blood Pressure increases by 36% and Diastolic Blood Pressure increases by 29%. All correlation was found to significant at the level of 0.01.

Table 1: Distribution of SBP (mmHg) and DBP (mmHg) by age

	Age	**N**	**Mean (mmHg)**	**Increment**	**S.D**	**Minimum (mm Hg)**	**Maximum (mm Hg)**	**Percentiles**						
								5	**10**	**25**	**50**	**75**	**90**	**95**
SBP	11	45	100.67		14.495	71	131	78.3	82.6	90.5	98	111.5	122	127.6
	12	71	102.76	2.09	16.578	74	158	80	86.2	96	105	116	130	140
	13	119	104.82	2.06	12.581	81	155	86	90	97	102	111	120	130
	14	112	105.8	0.98	12.807	71	137	90	92.3	98.25	102	113.7	126.5	130.7
	15	58	108.71	2.91	15.403	80	138	86.9	90	94	110	120	130.5	137
Total		405	105.53		14.135	71	158							
DBP	11	45	69.27		10.215	48	102	54.3	57.6	62	69	75	82.4	86
	12	71	72.3	3.03	12.262	46	106	51.2	57.4	63	71	80	90	94
	13	119	72.82	0.52	9.208	54	104	60	61	68	70	79	86	88
	14	112	75.19	2.37	11.712	50	104	58.3	60	68.25	75	83	89	98.8
	15	58	75.52	0.33	11.737	56	105	58.95	60	67	75	84.5	92	93.6
Total		405	73.37		11.093	46	106							

Pearson correlation 0.10918(SBP) 0.166677509(DBP); Sig (2 tailed) 0.02801(SBP) 0.0007584(DBP)

Table 2: Age wise prevalence of hypertension among study population

Age (Years)	Sex						p-value
	Boys			Girls			
	Total	Hypertension	Prevalence	Total	Hypertension	Prevalence	
11	16	0	0.00	29	1	3.45	0.4525
12	28	4	14.29	43	6	13.95	0.9686
13	56	2	3.57	63	4	6.35	0.4913
14	59	1	1.69	53	8	15.09	0.0092
15	34	3	8.82	24	6	25.00	0.0938
Total	193	10	5.18	212	25	11.79	0.0183

Chi square=10.599 p=0.0315

Table 3: Association between age and hypertension among study population

Age (Years)	Hypertensive	Normotensive	OR	95% CI		p-value
				LL	UL	
11	1	44	1			
12	10	61	7.213115	0.890476	58.42834	0.0336
13	6	113	2.336283	0.273367	19.96662	0.4254
14	9	103	3.84466	0.472709	31.26958	0.1774
15	9	49	8.081633	0.983981	66.37609	0.0238

Table 4: Frequency distribution of mean SBP, DBP (mm of Hg) for study population in anthropometric range

Anthropometric variables	Ranges	N	SBP		DBP	
			Mean	SD	Mean	SD
Height(cm)	<131	10	101.2	20.719	71.2	17.517
	131-140	56	99.96	13.563	68.84	9.796
	141-150	131	103.41	12.584	72.71	10.777
	151-160	154	108.61	14.761	74.94	11.641
	161-170	51	108.8	12.476	75.92	8.325
	>170	3	102.33	15.503	70.33	13.796
Weight(kg)	21-28.99	52	98.04	13.381	68.46	12.234
	29-36.99	129	102.35	12.815	70.87	9.049
	37-44.99	121	105.14	12.163	73.44	10.799
	45-52.99	64	113.58	15.508	79.05	12.171
	53-60.99	27	113.44	12.537	79.07	9.825
	≥ 61	12	115.33	14.587	77.83	6.887
BMI(kg/m^2)	<18.5	310	103.28	13.066	71.51	10.197
	18.5-22.99	71	112	15.359	79.34	12.723
	23-27.5	20	113.35	14.217	79.5	9.231
	>27.5	4	126	7.348	81	4

Pearson Correlation	SBP	DBP
Height	0.2375	0.2072
Weight	0.3601	0.2958
BMI	0.3390	0.2725

All correlations are significant at the 0.01 level

DISCUSSION

Early identification decodes into early interventions and prevention of later morbidity and mortality [7]. In the studied school children, 8.6% had hypertension. This reflects an alarming situation, because Hypertension is a major risk factor for cardiovascular and cerebrovascular diseases which is first and second leading cause of death as discussed earlier. Many literature supports that BP increases with age [8] and also many epidemiological studies show that primary Hypertension is far more common among apparently healthy children. Although the prevalence of Hypertension is less in children than in adults, there are evidences to suggest that the root background of essential Hypertension starts from childhood itself [9]. In the present study it was found that the trend of both systolic and diastolic blood pressure increases as the age increases which was similar to that of a study conducted by M D Reddy et al among the school going children in Maharashtra [10] and also to a study conducted at Amristar [11].

It was found from this study, there was increase in both systolic and diastolic blood pressure at the age of 12 years which was similar to a study done by Chirag et al [12] and again there was a decline in blood pressure at and after 13 years of age. Reason for the peak of both systolic and diastolic blood pressure at the age of 12 years may be due to the hormonal influence during the transition to adolescence [13]. Blood pressure was found to be high at the age of 9-10 years among other country children [14] where they included all children from 3 to 15years. In the present study there is an average annual increase in both Systolic Blood Pressure and Diastolic Blood Pressure between 10-15 years which is statistically significant. As per World Health Organization technical report series on blood pressure in children, the average annual increase in systolic blood pressure from birth until age of 20 is about 2 mm Hg in boys and about 1mm Hg in girls. Between ages 10-14 however the average rise is greater for both diastolic and systolic blood pressure, however there is no major difference between boys and girls [15].

Prevalence of Hypertension is found to be higher in the present study when compared to other studies which were 4.4%[10] and 0.38% [16].This could be probably due to the anxiety among the school children or due to white coat hypertension (WCH) which is unavoidable. Studies have shown that the prevalence of Hypertension among children shows variation from 0.41% to 11.7%. In our study, Prevalence of Hypertension was highest among girls compared boys; this was similar to that of a study done by Raj et al [13] whereas other study shows higher blood pressure among boys compared to girls and no difference among boys and girls [12]. Increased systolic and diastolic Blood Pressure is associated with onset of sexual maturation which is different for boys and girls, where girls attain sexual maturation relatively earlier than boys. This difference could contribute to the differences in blood pressure between boys and girls during adolescence [17].

The present study showed that systolic and diastolic blood pressure had significant and positive correlation with height, weight and BMI [12]. Similar findings were found in another study conducted by shivprakash et al [18] whereas Sarin et al [19] reported a significant correlation between BP and weight only. And Voors et al [20], reported that BP correlates more closely to height and body mass than age. Rosner *et al* published a study that examined the role of height in progression of BP during childhood [21]. The independent role of weight and height in influencing BP was explored in a recent study by Ma *et al* from china [22].

As the BMI increases both systolic and diastolic pressure increases which was similar to a study done by Schiel R et al and Nanaware et al [4]. The reason for increased BP with increase in fat deposition (obesity) in children and adolescents is due to the increased sympathetic activity, renin-angiotensin-aldosterone system activation, and compression of kidneys due to increases abdominal pressure.

Researchers have observed the prevalence of obesity among children is increasing in developing countries, which in turn increases the prevalence of childhood hypertension. The reason for increased prevalence of obesity among children [4] were misconception of parents that an obese child is a healthy child and high burden of school work, academic competitiveness, spending more time in television and computers leading to decreased physical activity.

LIMITATIONS

The study included children from the age group of 11 to 15 years only but the magnitude of the diseases starts even earlier who were not included in this study. The study focuses only anthropometric indices (height, weight, BMI) however there are other factors influencing blood pressure which is not considered during the study. The study was restricted to a single village which may not be the representative of the entire rural Puducherry.

CONCLUSIONS

Increased prevalence of hypertension among school going children gives an alarming sign for an emerging public health problem which is remaining undermined. Hence recording of blood pressure during school heath programme can be made mandatory and proper documentation of the measurement for further follow up. This could enable

us for early detection and prompt treatment. In addition to hypertensive children, pre-hypertensive (between 90th and 95th percentile) children can also be identified and advice on lifestyle modifications can also be given in order to avoid further progression of blood pressure. There are other factors which also associated with childhood hypertension like physical activity, dietary pattern, mental stress need to be addressed in forth coming year of the study.

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