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Research Article

Prevalence of hypertension in urban school going adolescents of Bangalore, India

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ABSTRACT

Background: Systemic hypertension is an important condition in childhood, with estimated population prevalence of 1-2% in the developed countries. Nutritional surveys in USA shows a significant secular increase in systolic and diastolic blood pressures. The prevalence may be high in south India, because of increased genetic inheritance and also due to altered dietary habits and life style. Therefore, the present study was undertaken. The aim and objectives of the study was to study the prevalence of hypertension and associated risk factors in school going adolescents of urban Bangalore, India.
Methods: This is a school based cross sectional study carried out in three different schools of different socioeconomic status conducted over a period of 1 year. All boys and girls between the age group of 11 and 19 were included in the study.
Results: Total 748 students were included, family history of hypertension was present in 145 students (19.4%), family history of obesity seen in 76 students (10.2%), and 69.3% were non-vegetarians and 66.7% were taking junk food. Majority were in lower middle class (48.8%). Pre hypertension and stage I hypertension noted in 3.6% of students. It is significantly high in children with BMI>23. Family h/o hypertension and obesity were significant in children with pre hypertension and stage I hypertension ($p<0.001$).
Conclusions: Hypertension is a significant problem in urban adolescents of Bangalore city. Obesity, increased BMI and increased waist hip ratio are significant anthropometric risk factors. Family histories of hypertension and obesity have a strong correlation with occurrence of hypertension.

Keywords: Essential hypertension, Risk factors, Adolescents

INTRODUCTION

Systemic hypertension is an important condition in childhood, with estimated population prevalence of 1-2% in the developed countries.[1] Nutritional surveys in USA shows a significant secular increase in systolic and diastolic blood pressures.[1] The causes of increase in blood pressure are attributed to obesity, change in dietary habits, decreased physical activities and increasing stress.

In infants and young children, systemic hypertension is uncommon, with a prevalence of <1%, but when present it is usually indicative of underlying disease process (secondary hypertension). In contrast, adolescents may develop primary or essential hypertension (with no underlying cause). Children with blood pressure >90th percentile have a 2.4 fold greater risk of having hypertension as adults. Similarly, nearly half of hypertensive adults had a blood pressure >90th percentile as children. There is a correlation between early childhood hypertension and early atherosclerosis.[2]

Essential hypertension is a common disease worldwide and is associated with an increased risk of myocardial infarction, stroke and cardiovascular mortality in adults.[3] This essential hypertension is detectable in the young and may track into adulthood.[4-9] There is a proof that even asymptomatic adolescents with mild blood pressure elevation can have evidence of target organ damage.[10] However this hypertension goes unnoticed unless specifically looked for. Therefore according to the recommendation of the fourth report from the national high blood pressure education program working group- all children above 3 years of age, seen in medical care should have their blood pressure measured routinely.[10]

Various factors are known to influence the onset of this essential hypertension in childhood. Family history of hypertension and obesity in the child are well established risk factors.[5-7,11-15] This can be prevented by early detection of hypertension and modifying its risk factors.[16]

Hypertension is classified as essential (primary) or secondary to, e.g. a renal parenchyma, reno-vascular or an endocrine disorder. Most children with sustained, severe or symptomatic hypertension have an underlying etiology, and are at risk for acute and chronic complications. Screening studies suggest that essential hypertension is also important during late childhood and adolescence. There is increasing evidence that essential hypertension tracks into adulthood, resulting in considerable cardiovascular morbidity.[17]

Definition and staging of hypertension

Normal BP is defined as SBP and DBP that are <90th percentile for gender, age, and height measured on at least 3 separate occasions. Hypertension in children and adolescents continues to be defined as systolic hypertension and/or diastolic hypertension, that is, on repeated measurement, it should be ≥95th percentile. BP between the 90th and 95th percentile in childhood had been designated as "high normal". To be consistent with the Seventh Report of the joint national committee on the prevention, detection, evaluation, and treatment of high blood pressure (JNC 7), this level of BP will now be termed as Prehypertension and is an indication for lifestyle modifications.[18] Also, adolescents with BP levels ≥120/80mm of Hg should be considered Pre hypertensive.

Stage I hypertension: BP between 95th-99th centile plus 5mm oh Hg.

Stage II hypertension: BP more than 99th centile plus 5mm oh Hg.

Measurement of BP in children

1. Children >3 years old who are seen in a medical setting should have their BP measured.
2. The preferred method of BP measurement is auscultation.
3. Correct measurement requires a cuff that is appropriate to the size of the child's upper arm.
4. Elevated BP must be confirmed on repeated visits before characterizing a child as having hypertension.
5. Measures obtained by oscillometric devices that exceed the 90th percentile should be repeated by auscultation.
6. Children more than 3 years who are seen in medical care settings should have their BP measured at least once during every healthcare episode. Children <3 years old should have their BP measured in special circumstances.

The BP tables are based on auscultatory measurements; therefore the preferred method of measurement is auscultation.

There is a wide variation in the prevalence of hypertension.[7,19,20] The prevalence may be high in south India, because of increased genetic inheritance secondary to more number of consanguineous marriages in south India, and also due to altered dietary habits and life style. Therefore, the present study was undertaken. The aim and objectives were (1) To study the prevalence of hypertension in urban school going adolescents of different socio economic status; (2) To study the risk factors for hypertension.

METHODS

This s a school based cross sectional study carried out in three different schools of different socio economic status conducted from October 2008 - September 2009.

Inclusion criteria

All adolescent boys and girls between the age group of 11 and 19 years were included.

Exclusion criteria

Adolescents with chronic diseases and on stimulant drugs were excluded from the study.

Method

Written, valid and informed consent was taken from parents or care takers of the subjects included in the study.

A systematically structured study proforma was sent to the parents, who included birth weight, history of health related complaints of the child, history of drug intake in the child, and family history of chronic illnesses, diet history of child, physical activity of the child and socio economic status. The study subjects underwent a detailed clinical examination including BMI, waist hip ratio and serial BP measurements and were charted on standard charts.[21] Detailed systemic examination was done in all

cases. Relevant investigations were done in children with abnormal BP.

Blood pressure has been recorded by the same doctor to avoid inter observer variations. Appropriate sized cuff was selected with the bladder width about 40% of the arm circumference at a point mid-way between olecrenon and acromion and the bladder length covering at least 80-100% circumference of the arm. The first (k1) and fifth (k5) phases of korotkoff sounds were taken as indicative of the systolic and diastolic blood pressures respectively. Three measurements were taken at intervals of 5 minutes each and systolic blood pressure and diastolic blood pressure were categorized by the higher value. The percentile charts based on gender, age and height provided by NHBPEP were used for classification of blood pressure.[10]

Statistical methods

Descriptive statistical analysis and ANOVA has been used as statistical methods in this study. SPSS 15.0 STAT 8.0 Med calc 9.01.1 Systat 11.0 were used for the analysis of the data.

RESULTS

Total 748 students were enrolled in the study, most of them in the mid adolescence i.e., between 14-15 years of age [490 students (65.5%)]. Boys comprised 62.4% (467) and maximum number of adolescents was with birth weight between 2.5 and 3kg (53.9%).

Table 1: Prevalence of hypertension according to basic characteristics.

Characteristics	Total	Normal		Pre-Hypertension		Stage I hypertension		p value (Stage I)
		No	%	No	%	No	%	
Age in years								
12	19	16	84.2	0	0.0	3	15.8	0.012
13	140	131	93.7	6	4.3	3	2.1	0.534
14	286	268	92.2	7	2.4	11	3.8	0.272
15	204	188	91.8	10	4.9	6	2.9	0.437
16	99	91		4	4.1	4	4.0	0.939
Gender								
Male	467	437	93.6	15	3.2	15	3.2	0.556
Female	281	257	91.5	12	4.3	12	4.3	0.556
Birth weight								
1.5-2.0	76	75	98.7	1	1.3	0	0.0	0.100
2.01-2.5	152	141	92.8	5	3.3	6	3.9	0.944
2.51-3.0	403	377	93.5	17	4.2	9	2.2	0.063
3.01-3.5	87	72	82.8	3	3.4	12	13.8	**<0.001**
3.51-4.0	26	25	96.2	1	3.8	0	0.0	0.604
>4.00	4	4	100	0	00	0	0.0	0.855
Diet								
Vegetarian	230	216	93.8	7	3.1	7	3.1	0.278
Non vegetarian	518	478	92.2	20	3.9	20	3.9	0.278
Religion								
Hindu	515	475	92.2	22	4.3	18	3.5	0.346
Muslim	161	152	94.4	4	2.5	5	3.1	0.630
Christian	72	67	93.1	1	1.4	4	5.6	0.382
Social economic status								
Class I	15	15	100	0	0.0	0	0.0	0.551
Class II	198	161	81.3	22	11.1	15	7.6	<0.001
Class III	365	355	97.3	3	0.8	7	1.9	<0.001
Class IV	170	163	95.9	2	1.2	5	2.9	0.128
BMI								
18	385	379	98.4	2	1.5	4	1.1	<0.001
18.1-23	320	287	89.7	21	6.6	12	3.8	0.001
>23	43	28	65.1	4	9.3	11	25.6	<0.001
Total	748	694	92.8	27	3.6	27	3.6	-

Table 2: Abnormal blood pressure across three screenings.

Blood pressure (n=748)	Initial Screening	Second screening	Third screening
Systolic (>90th percentile)	128 (17.1%)	78 (10.42%)	37 (4.9%)
Diastolic (>90th percentile)	91(12.2%)	47 (6.3%)	38 (5.08%)

Table 3: Incidence of hypertension.

Incidence of hypertension	Number (n=748)	Percentage
Normal	694	92.8
Pre hypertension	27	3.6
Stage I	27	3.6
Stage II	-	-

Table 4: Prevalence of hypertension in different studies.

Study	Place of study	Year	Prevalence hypertension
Verma et al[15]	Ludhiana, Punjab	1994	1.1%
Anand NK, Tondon L[23]	Amritsar, Punjab	1996	0.46%
Chadha SL, Tandon R et al[7]	New Delhi	1999	11.65%
Jaber et al[35]	Israel	2000	2.18%
Sorof JM et al[13]	Texas, Houston	2004	4.5%
Mohan B et al[20]	Ludhiana, Punjab	2004	6.69%
Savitha MR et al[22]	Mysore, Karnataka	Jun 2006-Aug 2006	6.1%
Present study	Bangalore urban schools, Karnataka	2008-09	7.2%

Family history of hypertension was present in 145 students (19.4%), family history of obesity in 76 students (10.2%) and 518 students (69.3%) had non-vegetarian diet, 499(66.7%) students had junk foods daily, 5.7% of students had BMI>23 and waist hip ratio was >0.85 in 13.1% of students. Majority were belonging to lower middle socio economic status as per updated Kuppuswamy scale.

Prehypertension and stage I hypertension noted in 3.6% each of the study group, and is significant in birth weight of 2.5-3.0kg (p value=0.063) and in birth weight between 3.0 and 3.5kg (p value<0.001). 44% of stage I hypertension was noted in the same range (12 adolescents out of 27).

Table 5: Prevalence of hypertension in obese children in various studies.

Study	Place of study	Year	Prevalence hypertension in obesity
Gupta AK et al	India	1990	0.34%
Verma M et al[15]	Punjab, India	1994	13.7%
Anand NK et al[23]	Amritsar, India	1996	0.23%
Macedo ME et al[37]	North Portugal	1996	5.2%
Sorof J et al[36]	Texas, Houston	2002	19.4%
Present study	Bangalore urban schools, Karnataka	2008-09	25.6% (stage I) 9.3% (Prehypertension)

Prehypertension and stage I hypertension was significantly high in upper middle class (p<0.001), in children with BMI >23(P<0.001). Family history of hypertension was significantly associated with hypertension in prehypertension in adolescents (p<0.001).

Family history of obesity was significant in adolescents with stage I hypertension. 14 of 76 students (18.4%) had hypertension (p<0.001)

There was no statistically significant difference in incidence of hypertension in gender, diet pattern including non-vegetarian and junk intake.

Hypertension was associated with increasing birth weight i.e., prehypertension (2.85±0.45) and hypertension (3.04±0.45) p=0.016. Significant increase in hypertension with increasing weight (p=<0.001) and with increasing height (p=0.038). Prehypertension noted with adolescents with BMI 20.50±2.41 and hypertension noted with BMI 22.75± 4.89 (p value=0.007).

There was no significant difference according to physical activity, sleep disturbances and intake of junk food.

The distribution of hypertension across three screenings, showed drastic reduction in prevalence of systolic hypertension from 17.1% to 4.9% and, diastolic hypertension from 12.2% to 5.08%.

DISCUSSION

A total of 788 students were included for the study, of which 748 students returned the filled up questionnaire

and fulfilled the inclusion criteria. Mean age was 14.3±1.01. Boys were 467 (62.4%) and girls were 281 (37.6%) (Table 1).

The distribution of systolic and diastolic hypertension across three screenings is shown in Table 2. At the end of third screening a total of 54 cases (7.2%) had abnormal blood pressure. Of these 16 cases had systolic hypertension only and 17 cases had diastolic hypertension only and 21 cases had both.

Table 6: Mean distribution of anthropometric parameters according to status of hypertension.

Anthropometric parameters	Normal	Pre-hypertension	Stage hypertension	P value (stage I)
Birth weight	2.78±0.48	2.85±0.45	3.04±0.45	0.016
Age in years	14.30±0.99	14.44±1.01	14.19±1.18	0.632
Weight	43.65±8.31	50.67±9.87	58.48±13.35	<0.001***
Height	155.73±9.31	156.76±11.58	160.35±7.53	0.038
BMI	18.17±8.41	20.50±2.41	22.75±4.89	0.007**
Waist-hip ratio	0.79±0.05	0.82±0.06	0.84±0.05	<0.001***

Table 7: Prevalence of hypertension according to family history.

Family history	Total	Normal		Pre-hypertension		Stage I hypertension		P value (stage I)
		No	%	No	%	No	%	
Hypertension	145	120	82.8	7	4.8	18	12.4	<0.001***
DM	65	59	90.8	2	3.1	4	6.2	0.206
Obesity	76	60	78.9	2	2.6	14	18.4	<0.001***
CVD	9	8	88.9	1	11.1	0	0.0	-
Total	748	694	92.8	27	3.6	27	3.6	-

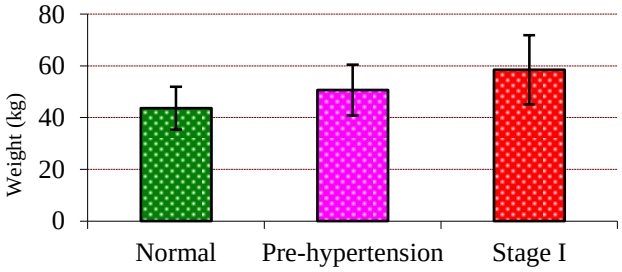

Figure 1: Mean distribution of weight according to status of hypertension.

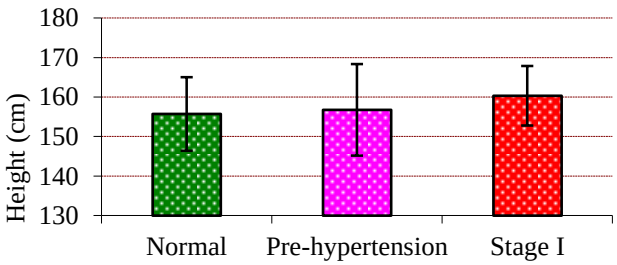

Figure 2: Mean distribution of waist hip ratio according to status of hypertension.

The different grades of hypertension noted in the group are shown in Table 3. The prevalence of hypertension and prehypertension in our study was 7.2% total and 3.6% each.

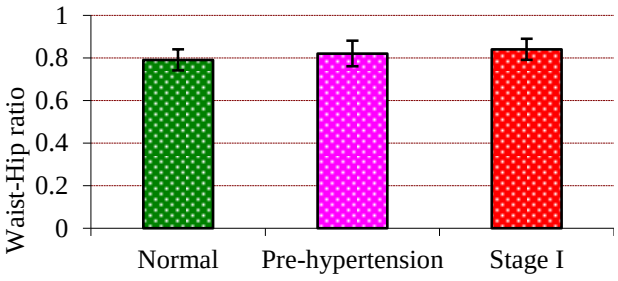

Figure 3: Mean distribution of height according to status of hypertension.

The prevalence in various other studies ranged from 0.46% to 11% as shown in Table 4. This wide difference could be due to different standards used for the diagnosis of hypertension and also, due to variations in the regions. Also, there is higher prevalence of hypertension in southern India probably because of influencing factors like genetic inheritance, dietary habits and lifestyle factors.

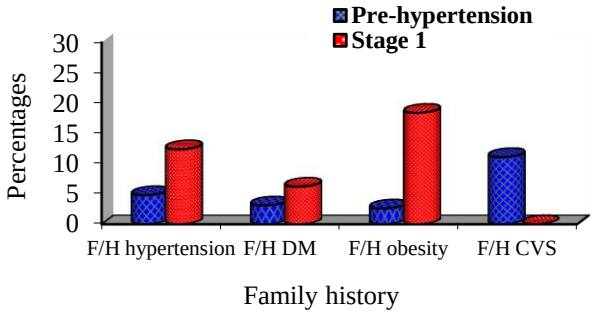

Figure 4: Status of hypertension according family history.

According to NHBPEP abnormal blood pressure is prehypertension if BP is between 90th & 95th percentile. Stage I hypertension is BP from 95th percentile to <99th percentile plus 5mm of Hg. Stage II hypertension is BP more than 99th percentile plus 5mm of Hg. Prehypertension and stage I hypertension need only weight and dietary management. Stage II hypertension needs pharmacological therapy in addition to weight and diet management. Our cases were managed accordingly.

Socio demographic risk factors

There was no age and sex predilection in our study which was similar to Savitha MR et al, Anand NK and Tondon L and Sharma et al.[22-24] A significantly greater number of girls had diastolic hypertension in a study by Horacio E. Androgue HE and Sinaiko AR et al and a study by Genovesi S et al, which they attribute to hormonal changes around puberty.[12,25] They have shown higher Tanner scores in girls at this age and were heavier and had greater BMI.

Anthropometric risk factors

Significant increase in hypertension with increasing weight, Prehypertension (50.67±9.87) and Stage I hypertension (58.48±13.35). 'p'= <0.001** (Figure 1). Significant increase in hypertension with increasing height, Prehypertension (156.76±11.58) and Stage I hypertension (160.35±7.53). 'p'= 0.038* (Figure 2). Prehypertension noted with BMI 20.50±2.41 and hypertension noted with BMI 22.75±4.89. 'p' value=0.007** (Figure 3).

Body mass index and increased weight & height had a significant association with hypertension in our study (p=<0.001), similar results were obtained in Savitha MR study, and Chadha SL, Tondon R study.[7,23] The results also showed that lower the BMI lessen the chances of hypertension.

Obesity in childhood is a well-established risk factor for hypertension. In our study, prevalence of HTN in obese children is 25.6% which is statistically significant. Sorof JM et al, Verma M et al have shown that 19.4% and 13.7% of obese children had hypertension respectively (Table V).[13,15] Hypertension in obese children could be due to increased cardiac output, increased blood volume, excessive sodium intake, increased steroid production and alteration in receptors for various pressor substances.[21]

There is also a significant association between waist hip ratio and hypertension in our study, the average waist hip ratio was 0.82±0.06 in children with prehypertension and 0.84±0.05 in stage I which is statistically significant (p<0.001) (Table VI). Porto PI et al and Guizar JM et al also found significant correlation between the two.[26,27] Few studies have shown no correlation between the two.[7,28]

Birth weight did not have any influence on BP, similar results were obtained in Savitha MR et al though some studies have shown an increased association with low birth weight which can be explained by Barker's hypothesis.[22,29] Zao MF in their study have shown birth weight is inversely proportional to early onset hypertension.[30]

Familial risk factors

Family history of hypertension and obesity, had a strong correlation adolescent hypertension in our study, the reason may be genetic, environmental or both. Verma et al obtained similar results, and Berke et al showed 16.5% cases with family history of hypertension.[15,31] Similarly Maria C et al noted significant association with family history of hypertension and obesity.[32] They also observed a positive association between hypertension in adolescence and having both mother and father with high blood pressure (OR=8.6; 95% CI 3.51-20.59) was higher than one hypertensive parent (OR=2.17; 95% CI 1.18-3.99).

There is an increased familial association of other cardiovascular events like myocardial infarction and stroke in Gupta et al study.[5] In the present study 1 out of 9 with CVD had hypertension which is not significant. This probably could be due to small sample of hypertensives in our study. Though there were many subjects with family history of DM in our study (Six out of 65 subjects), there was no statistically significant correlation (p=0.206) (Figure 4).

Diet and lifestyle risk factors

Both hypertensives and non hypertensives consumed more of junk food and oily food, and non-vegetarian diet, and less of fruits and vegetables with no significant correlation. It is generally accepted that hypertensive individuals benefit from a dietary increase in fresh vegetables, fresh fruits, fiber and reduction of sodium. Lower BP has been associated in children and adolescents with an increased intake of potassium, magnesium, folic acid which are rich in vegetables and fruits.[10]

Regular physical activity and occurrence of hypertension had no statistically significant correlation in our study. The present study doesn't show any association between hypertension and sleep disturbances.

Limitations

The sample size in the present study was small and there are no standard charts available for the local population from which the sample has been taken. Blood pressure is also influenced by various other factors such as ambience, fasting vs. non fasting state, psychological stress, which could not be controlled in our study.

Recommendations

Regular blood pressure monitoring at least once in a year on an outpatient basis or in routine school health check-up should be incorporated in early life. Appropriate cuffs recommended should be strictly followed while measuring the BP.

Serial blood pressure measurements are required to diagnose hypertension than single reading and children with significant clinical history should be screened at the earliest.

Studies involving a larger population are required to prepare standard centile charts for the local population.

CONCLUSION

Hypertension is a significant problem in the urban school going adolescents of the Bangalore city, India.

The results were falsely high in the initial readings, which reduced drastically on further screening, stressing on the need for repeated BP recording in children.

Obesity, waist hip ratio, and increased body mass index are significant anthropometric risk factors for hypertension.

Family histories of hypertension and obesity have a strong correlation with the occurrence of hypertension that could be multifactorial involving genetic and environmental causes.

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