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Epidemiological correlates of hypertension among adolescent girls

Deepika Anand and RK Anuradha

Abstract

Background: High blood pressure has become a serious public health challenge and further inclining the risk of atherosclerosis, ventricular hypertrophy and carotid intimal medial thickness. Hypertension during childhood and adolescence can be progressive into adulthood and is the strongest evocator of hypertension during adulthood.

Objectives: The objective of the study was to assess the prevalence of hypertension among adolescent girls and to study the correlation of hypertension with socio-economic status of the subjects.

Methods and Materials: In the present study, a total number of 1300 school going adolescent girls from the age group of 13-17 years were randomly selected for the study from Puttaparthi, Anantapur District, Andhra Pradesh. A pre-designed and pre-tested questionnaire was used to collect the data regarding anthropometric, socio-economic and blood pressure profile of the selected subjects. The data analysis was carried out using the Statistical Package for Social Sciences (SPSS) Software.

Results: In the present study, the overall prevalence rate of hypertension (SBP and DBP $\geq 95^{\text{th}}$ Percentile) was observed to be 7.2 per cent. Further the pooled prevalence of Systolic and Diastolic hypertension were found to be 4.3 and 4.1 per cent respectively. Adolescents belonging to illiterate parents' showed significantly ($p < 0.05$) higher prevalence of hypertension. Mild physical activity and increased junk/fast food consumption pattern were found to be other significant ($p < 0.01$) predictors of hypertension.

Conclusions: The findings of the present study can translate as adult hypertension in the near future and so an urgent necessity for improving their overall nutritional status by implementation of multi-sectorial community based programme such as nutrition education awareness.

Keywords: Hypertension, adolescent girls and socio-economic gradients, systolic and diastolic hypertension

1. Introduction

Hypertension is a global problem, affecting both developed and developing nations. Hypertension is the major cause of morbidity and mortality. It places a heavy burden on healthcare systems, families, and society as a whole. High blood pressure has become a serious public health challenge and further inclining the risk of atherosclerosis, ventricular hypertrophy and carotid intimal medial thickness (Dong *et al.*, 2019; Lande and Kupferman, 2019) [6, 13]. Hypertension during childhood and adolescence can be progressive into adulthood and is the strongest evocator of hypertension during adulthood (WHO, 2018) [21]. Despite evidence of an increasing prevalence of hypertension among adolescents, the consequences of early onset are poorly established and often overlooked. Hypertension is increasing at an alarming rate among adolescents, which further heightens the risk of various metabolic syndromes.

Hypertension remains a leading risk factor for cardiovascular diseases and a major cause of morbidity and mortality worldwide (Bell *et al.*, 2019) [2]. Several studies have provided evidence that adult hypertension had its root in childhood (Kumar *et al.*, 2017; Mahajan and Negi, 2015; Ujunwa *et al.*, 2013) [12, 14, 19]. The prevalence rate of hypertension was found to be 18.2 per cent among school going adolescents aged 11-17 years.

2. Material and Methods

A cross-sectional study was carried out in 10 different schools of Puttaparthi, Anantapur District, Andhra Pradesh. A total number of 1300 adolescent girls from the age group of 13-17

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years were randomly selected for the study. The participants and parents were informed about the study and written consent was obtained from the parents and guardians of the participants. A pre-designed and pre-tested questionnaire was used to collect the data regarding anthropometric, socio-economic and blood pressure profile.

Blood pressure level of the selected subjects was measured using electronic blood pressure monitor. Three consecutive readings were recorded and average of three was taken as the final reading. The systolic and diastolic readings were expressed in mmHg. The data analysis was carried out using

the Statistical Package for Social Sciences (SPSS) Software. The relationship between blood pressure profile (Hb) and socio-economic status was examined by calculating Pearson's Correlation Coefficient.

3. Results

In the present study, the mean systolic blood pressure of the subjects ranged from 112.7 for 13 years to 120.8 mm Hg for 17 years (table 1). A similar progressive trend was observed for the mean diastolic blood pressure of the subjects from 69.6 to 75.2 mm Hg for age 13 and 17 years.

Table 1: Age specific distribution of SBP, DBP, MAP and PP among the subjects

Measurements (mm Hg)	Age (Years)					F-value	P value
	13 (N=271)	14 (N=263)	15 (N=251)	16 (N=255)	17 (N=260)		
SBP	112.7 ±3.2	116.2 ±4.9	118.4 ± 7.2	119.7 ±9.8	120.8 ± 6.5	29.7	0.000*
DBP	69.6 ± 4.7	70.3 ±2.9	71.5 ±5.1	73.6 ± 6.7	75.2 ± 8.2	41.2	0.000*
MAP	81.6 ±3.8	83.9 ±5.4	86.2 ± 9.2	88.2 ± 7.9	90.1 ±9.5	59.2	0.000*
PP	42.7 ± 4.1	44.9 ± 3.8	45.2 ± 8.1	45.3 ±9.7	45.1 ±7.2	38.6	0.000*

SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure, MAP-Mean Arterial Pressure, PP-Pulse Pressure
Values are mean ± SD of number of subjects under each group.

*Significant at $p < 0.01$ level.

A progressive increment for the mean arterial pressure of the subjects ranged from 81.6 to 90.1 mmHg was observed for 13 and 17 years. The mean pulse pressure of the subjects ranged from 42.7 for age 13 years to 45.2 mm Hg for age 15 years. Congruent values of pulse pressure (45.2, 45.3 and 45.1 mmHg) were observed among the subjects of age 15, 16 and 17, respectively. The overall prevalence of hypertension among the subjects was shown in Table 2. The findings from present study revealed that about 7.2 per cent of the subjects suffered from hypertension. Systolic and diastolic hypertension among the subjects were found to be 4.3 and 4.1 percent respectively.

Table 3 and Fig. 1 showed age specific prevalence of hypertension among subjects. The prevalence rate of 15 per cent was found to be highest among 17 years followed by 14.5 per cent for 16 years, 4.4 per cent for 15 years, 1.5 per cent for 14 years and least by 0.7 per cent for 13 years. Further, the systolic and diastolic hypertension were found to be 9.2 and 8.5 per cent among 17 years of the subjects. A slight decrease i.e., 9.0 and 7.0 per cent was observed in the systolic and diastolic hypertension among 16 years age group.

Among 13 years age group, the systolic hypertension (0.7%) and diastolic hypertension (1.1%) were found to be lowest when compared with other age groups.

Table 2: Overall prevalence rate of hypertension among the subjects

Variable	N	%
Systolic Hypertension (SBP ≥ 95 th percentile)	56	4.3
Diastolic Hypertension (DBP ≥ 95 th percentile)	54	4.1
Hypertension (average SBP and/or DBP ≥ 95 th percentile)	93	7.2

Table 3: Age specific distribution of prevalence of hypertension

Age (Years)	Systolic Hypertension (SBP ≥ 95 th percentile)		Diastolic Hypertension (DBP ≥ 95 th percentile)		Hypertension (SBP and/or DBP ≥ 95 th percentile)	
	N	%	N	%	N	%
13	2	0.7	3	1.1	2	0.7
14	2	0.8	4	1.5	4	1.5
15	5	2.0	7	2.8	11	4.4
16	23	9.0	18	7.0	37	14.5
17	24	9.2	22	8.5	39	15.0

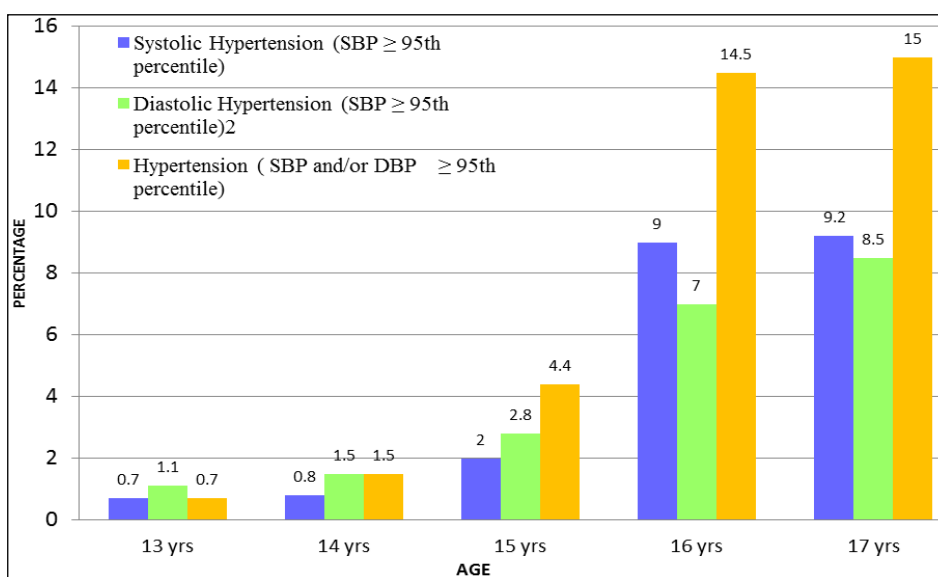


Fig 1: Prevalence of hypertension among the subjects

3.1 Prevalence of hypertension as per socioeconomic determinants

Table 4 depicts the prevalence of hypertension as per different socio-economic gradients. The prevalence rate of hypertension was found to be significantly ($p < 0.05$) higher among the subjects (11.3%) belonging to higher income group when compared with other income groups. Among the low income group, the prevalence of hypertension was 5.7 per cent, and in middle income group it was 7.4 per cent respectively.

Adolescents (44.6%) belonging to illiterate fathers showed significantly ($p < 0.05$) higher prevalence of hypertension. However, least per cent (2) to get affected by hypertension belonged to graduate fathers. With respect to mothers' educational status, less per cent of subjects suffered from hypertension with maximum per cent of 11 belonging to illiterate mothers. Overall, with better educational status a decline in hypertension trend was noticed.

A higher proportion of the subjects (12.7%) who slept for less than 7 hours were affected from hypertension. With better sleeping pattern, the prevalence rate of hypertension tend to

decline. But this trend was not found to be significant. About 5.6 per cent of subjects who slept for 7 to 8 hours were also found to have hypertension. The prevalence rate of hypertension decreased up to 2.8 per cent among the subjects sleeping for more than 8 hours.

The prevalence of hypertension was significantly ($p < 0.01$) higher among the subjects (18.5 per cent) performing mild physical activity in comparison with subjects performing moderate and heavy physical activity. With an increment in the physical activity hypertension trend was observed to be declined. However, about 2.5 and 2.8 per cent of the subjects who were involved in heavy and moderate activities were also found to suffer from hypertension. Adolescents who were consuming junk and fast foods showed significantly ($p < 0.05$) higher prevalence of hypertension in comparison with the subjects who never consumed junk and fast foods. The prevalence rate of hypertension was found to be significantly ($p < 0.05$) higher among obese (42.9%) and overweight subjects (36.3%) when compared with normal weight subjects.

Table 4: Nutritional status of adolescents as per Socio-economic determinants

S. No.	Variables	No. of Subjects (%)					Total N	Chi square, P-value
		Severe Thinness	Thinness	Normal	Overweight	Obesity		
1.	Type of Family							
	Nuclear Family	68 (7)	225 (23.2)	518 (53.5)	128 (13)	30 (3.1)	969	$\chi^2 = 19.74$ $p = 0.073$
	Joint Family	8 (2.4)	67 (20.2)	222 (67.1)	29 (8.8)	5 (1.5)	331	
	Total	76	292	740	157	35	1300	
2.	Family Income							
	< 2500 (Economically Weaker Section)	20 (20.1)	27 (27.6)	47 (48)	4 (4.08)	-	98	$\chi^2 = 28.93$ $p = 0.016^{**}$
	2501-5500 (Low Income Group)	16 (6.1)	68 (25.9)	147 (55.9)	32 (12.2)	-	263	
	5501-10,000 (Middle Income Group)	40 (5.1)	167 (21.4)	450 (57.7)	96 (12.3)	27 (3.5)	780	
	>10,001 (High Income Group)	-	30 (18.9)	96 (60.4)	25 (15.7)	8 (5)	159	
	Total	76	292	740	157	35	1300	
3.	Fathers Education							
	Illiterate	9 (13.9)	17 (26)	25 (38.5)	10 (15.4)	4 (6.2)	65	$\chi^2 = 42.18$ $p = 0.002^*$
	Upto primary	8 (9)	22 (25)	42 (47.7)	13 (14.8)	3 (3.4)	88	
	Upto secondary	38 (5.8)	153 (24)	356 (54.8)	87 (13.4)	16 (2.5)	650	
	Higher secondary	15 (5)	66 (22)	179 (60.1)	30 (10.1)	8 (2.7)	298	
	Graduation & above	6 (3)	34 (17)	138 (69.3)	17 (8.54)	4 (2)	199	
	Total	76	292	740	157	35	1300	
4.	Mothers Education							
	Illiterate	28 (7.2)	99 (25.4)	199 (51)	52 (13)	12 (3.1)	390	$\chi^2 = 23.26$ $p = 0.0275^{**}$
	Upto primary	40 (5.7)	153 (21.8)	401 (57.2)	86 (12)	21 (3)	701	
	Upto secondary	7 (4.4)	29 (18.2)	104 (65.4)	17 (11)	2 (1.3)	159	
	Higher secondary	1 (2.9)	9 (25.7)	23 (65.7)	2 (5.7)	-	35	
	Graduation & above	-	1 (6.67)	14 (93.3)	-	-	15	
	Total	76	292	740	157	35	1300	
5.	Physical Activity							
	Mild Physical Activity	22 (3)	137 (18.7)	404 (55.2)	140 (19)	29 (4)	732	$\chi^2 = 157.7$ $p = 0.0001^*$
	Moderate Physical Activity	32 (7.8)	110 (26.7)	248 (60.2)	16 (3.9)	6 (1.5)	412	
	Heavy Physical Activity	22 (14.1)	45 (28.8)	88 (56.4)	1 (0.6)	-	156	
	Total	76	292	740	157	35	1300	

*Significant at $p < 0.01$ level.

**Significant at $p < 0.05$ level.

Table 5: Prevalence of hypertension as per Socio-economic determinants

S. No.	Variables	N	Hypertension	χ^2 P value
			N (%)	
1.	Family Income			$\chi^2 = 36.29$ $p = 0.035^{**}$
	< 2500 (Economically Weaker Section)	98	2 (2.0)	
	2501-5500 (Low Income Group)	263	15 (5.7)	
	5501-10,000 (Middle Income Group)	780	58 (7.4)	
	>10,001 (High Income Group)	159	18 (11.3)	
2.	Fathers Education			$\chi^2 = 21.06$ $p = 0.0272^{**}$
	Illiterate	65	29 (44.6)	

	Upto primary	88	25 (28.4)	
	Upto secondary	650	25 (3.8)	
	Higher secondary	298	10 (3.4)	
	Graduation & above	199	4 (2.0)	
3.	Mothers Education			$\chi^2=39.41$ $p = 0.0001^*$
	Illiterate	390	35 (9.0)	
	Upto primary	701	45 (6.4)	
	Upto secondary	159	10 (6.3)	
	Higher secondary	35	2 (5.7)	
	Graduation & above	15	1 (6.6)	
4.	Sleep Duration			$\chi^2=59.57$ $p = 0.064$
	< 7 hrs per day	355	45 (12.7)	
	7-8 hrs per day	772	43 (5.6)	
	>8 hrs per day	173	5 (2.8)	
5.	Physical Activity			$\chi^2=12.09$ $p = 0.004^*$
	Mild Physical Activity	363	67 (18.5)	
	Moderate Physical Activity	778	22 (2.8)	
	Heavy Physical Activity	159	4 (2.5)	
6.	Junk & Fast Food Consumption			$\chi^2=62.21$ $p = 0.0001^*$
	Yes	878	79 (9.0)	
	No	422	14 (2.1)	
7.	Body Mass Index			$\chi^2=47.09$ $p = 0.036^{**}$
	Normal weight	740	21 (2.8)	
	Overweight	157	57 (36.3)	
	Obesity	35	15 (42.9)	

*Significant at $p < 0.01$ level.

**Significant at $p < 0.05$ level.

Table 5 depicts the prevalence and adjusted odds ratios and 95% CI of hypertension according to socio-economic and life style determinants. Logistic regression analysis showed that the magnitude of being hypertensive was 1.125 fold (95% CI: 0.735-1.723) among the subjects when mothers were illiterate. Adolescent girls' performing mild physical activity showed 1.021 times (95% CI: 0.741-1.406) association towards hypertension when compared with subjects performing heavy physical activity. Increased junk and fast food consumption pattern further raised hypertensive children with 2.7 fold (95% CI: 2.009-3.591) when compared with subjects who were never consuming junk and fast foods. Obese adolescents were 2.6 times (95% CI: 1.763-3.015) at risk in developing hypertension when compared with normal weight subjects.

4. Discussion

High blood pressure has become a serious public health challenge and further inclining the risk of atherosclerosis, ventricular hypertrophy, carotid intimal medial thickness, congestive heart failure, arrhythmia, pericardial effusion, bleeding of lungs, stroke and sudden death (Weatherald *et al.*, 2018; Egan, 2017) [20, 7]. In the present study, the overall prevalence rate of hypertension (SBP and DBP $\geq 95^{\text{th}}$ Percentile) was observed to be 7.2 per cent. Further the pooled prevalence of systolic and diastolic hypertension was found to be 4.3 and 4.1 per cent respectively.

Consistent associations have been shown between hypertension in childhood and cardiovascular dysfunction in adulthood. Various studies have revealed that higher parental education and family income reduces elevated blood pressure levels (Zhang *et al.*, 2019; McNaughton *et al.*, 2014) [22, 15]. In the present study, adolescents belonging to illiterate parents showed higher prevalence of hypertension. Overall, with an increasing trend of parents' education status, the prevalence of hypertension was found to be declining. In contrary, the prevalence rate of hypertension was found to be significantly ($p < 0.05$) higher among the subjects belonging to higher income group when compared with low income group.

The global burden of hypertension is inclining and accounts for substantial non-communicable diseases. Lifestyle factors such as physical inactivity and poor dietary habits contribute to this burden, highlighting the need to implement preventing strategies to curb this public health epidemic (Egan, 2017; Hegde and Solomon, 2015; Diaz and Shimbo, 2013) [7, 11, 5]. The prevalence of hypertension was higher among the subjects performing mild physical activity in comparison with subjects performing moderate and heavy physical activity. With an increment in the physical activity hypertension trend was observed to be declined.

Increasing consumption of calorie and sodium rich junk and fast foods was associated with overweight, obesity and hypertension among children and adolescents (Gupta *et al.*, 2018; Payab *et al.*, 2015) [10, 17]. In the present study, adolescents who were consuming junk and fast foods showed higher prevalence of hypertension in comparison with the subjects who never consumed junk and fast foods.

Consistent associations have been shown between BMI and hypertension in children and adolescents (Weatherald *et al.*, 2018) [20]. Inclining rate of hypertension with increased BMI among overweight and obese children and adolescents was reported in various studies (Min and Cho, 2018; Aronow, 2017; Danasekaran and Vinoth, 2015; Sundar *et al.*, 2013) [16, 1, 4, 18]. In the present study, the prevalence rate of hypertension was found to be higher among obese and overweight subjects when compared with normal weight subjects.

Logistic regression analysis showed that the magnitude of being hypertensive is 1.125 fold (95% CI: 0.735-1.723) among the subjects when mothers were illiterate. Adolescent girls' performing mild physical activity showed 1.021 times (95% CI: 0.741-1.406) association towards hypertension when compared with subjects performing heavy physical activity. Increased junk and fast food consumption pattern further raised hypertensive children with 2.7 fold (95% CI: 2.009-3.591) when compared with subjects who never consuming junk and fast foods. Obese adolescents were 2.6

times (95% CI: 1.763-3.015) at risk in developing hypertension when compared with normal weight subjects. Higher nutritional knowledge is associated with better diet quality and lower blood pressure with adjustment in health status, lifestyle behaviours and socio-demographic characteristics (Geaney *et al.*, 2015)^[9]. Dietary Approaches to Stop Hypertension (DASH) dietary pattern constituting low intake of fats, sodium and processed foods with high intake of fruits and vegetables revealed potential association for reducing blood pressure (Fung *et al.*, 2008)^[8]. It is possible to reduce the prevalence of hypertension and cardiovascular diseases by improving individuals' diet quality (Bonaccio *et al.*, 2013)^[3].

5. Conclusion

Dietary inadequacies, meagre body mass index, parental education, family income, physical inactivity were the predominant risk factors for burgeoning prevalence of hypertension among the subjects. Besides this, the present study apostle the need to implement interventional measures for preventing obesity and hypertension among adolescent girls.

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