OBESITY AND HYPERTENSION IN CHILDREN

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ABSTRACT

A study was conducted on two thousand five hundred and sixty school children to evaluate the prevalence of hypertension in apparently healthy school children of a prosperous, industrialized city of Punjab. The children belonged to 5-15 years age group of both sexes. The weight (kg) was taken by a standardized weighing machine while height was measured using a calibrated bar. For diagnosing obesity, the body mass index (DM1) was calculated by the formula:

$$\frac{\text{Weight (g)}}{\text{Height (cm}^2\text{)}}$$

A value of >2.26 was considered as obesity.

Blood pressure (BP) measurements were taken by a mercury sphygmomanometer as per the recommendations of American Heart Association. Hypertension was diagnosed if blood pressure was more than 95th percentile for the age. Family history of hypertension was enquired from the parents of children. The BP of the hypertensive children was reassessed after six and nine months.

The prevalence of hypertension was 2.8% at the first screening but decreased to 1.3% and 1.1% by 6 and 9 months, respectively. This fall was statistically significant ($p<0.01$). There was no significant difference in the prevalence of hypertension between the two sexes. At the final screening, only children of 11 years or above were hypertensive. A statistically significant correlation with positive family history of hypertension was noted; 85.7% of hypertensive children had positive family history. The prevalence of hypertension was much higher in obese as compared to non-obese children (13.7% vs 0.4%). The correlation between obesity and hypertension was statistically significant ($p<0.01$). It is concluded that obesity in childhood has a significant association with hypertension. Both together may be risk factors for later coronary disease. Modification of such a risk factor in childhood can have enormous potential pay-off.

Key words: *Obesity, Hypertension.*

Hypertension is the most common, most potent universal contributor to cardiovascular mortality. Elevated blood pressure, labile or fixed, systolic or diastolic, at any age, in either sex is **a** contributor to all forms of cardiovascular diseases(l). Studies on hypertension in childhood have the important advantage that they may help in the control and possibly prevention of high blood pressure before its harmful sequelae can occur.

The prevalence of hypertension in children is reported to range from a high of 16.2% to a low of less than l%(2-5). This diversity in prevalence of hypertension is due to the varying age groups taken for the study and different criteria adopted for defining hypertension, basic differences between racial sub-groups related to geographic, dietary and cultural factors.

The present study was conducted to evaluate the prevalence of hypertension in apparently'healthy school children in **a**

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prosperous, industrialized city of Punjab.

Material and Methods

Two thousand five hundred and sixty school children of both sexes in the age group of 5-15 years formed the study material. The age was recorded in completed years. The weight (kg) was taken by a standardized weighing machine while height was measured using a calibrated bar. For diagnosing obesity, the body mass index (BMI) was calculated by the following formula:

$$\frac{\text{Weight (g)}}{\text{Height (cm}^2\text{)}}$$

A value of >2.26 was considered as obesity(6). Family history of hypertension was enquired from the parents of children.

Blood pressure (BP) measurements were taken using a mercury sphygmomanometer as per the recommendations of American Heart Association(7). The measurements were taken in **a** quiet room in the sitting posture with the arm resting on the table. Efforts were made to eliminate the factors which may affect the blood pressure, *e.g.,* anxiety, crying, exercise, *etc.* The average of three consecutive readings was taken as the blood pressure of the child. Hypertension was diagnosed if the blood pressure was more than the 95th percentile for the age. The blood pressure of the hypertensive children was reassessed after six and nine months.

Results

At the first screening, 2.8% of the children had elevated blood pressure. Six months later it was reduced to 1.3% and after nine months only 1.1% were hypertensives *(Table I).* The fall in the prevalence rates from first screening to 6 months was statistically significant ($p < 0.05$).

There was no significant differnce in the prevalence of hypertension between the two sexes. On the initial screening, the age groups for hypertension ranged from 6-15 years but later on only children of 11 years or above were hypertensive. The prevalence rates were higher for the age group of 13-15 years *(Table II).* The range of systolic BP was 132-140 mm Hg and diastolic 82-90 mm of Hg. As seen in *Table HI,* out of 28 hypertensive children, 85.7% had positive family history of hypertension. This correlation was statistically significant ($p < 0.01$).

Obesity was correlated with hypertension. *Table TV* shows that prevalence of hypertension was much higher in obese children as compared to non-obese, (13.7% *vs* 0.4%) and a highly significant correlation was noted ($p < 0.01$). This difference was statistically significant.

Discussion

The incidence of hypertension depends on its definition. The prevalence rates have been reported to have a wide range. In the present study, taking the 95th percentile for the age as the upper limit of normal, the incidence of hypertension was 2.8% at the first screening. After rescreening, the incidence had decreased to 1.1% at 9 months. Other studies from India have reported

TABLE I—*Prevalence of Hypertension*

Screening	Male	Female	Total	(%)
I	38	34	72*	(2.8)
II	20	14	34*	(1.3)
III	15	13	28	(1.1)

*p <0.05 (significant).
Figures in parentheses are percentages.

TABLE II-*Prevalence of Hypertension at Different Ages*

Age	1st screening		2nd screening (after 6 mo)		3rd screening (after 9 mo)	
(yrs)	Number	Percentage	Number	Percentage	Number	percentage
5	-	-	-	-	-	-
6	2	0.84	-	-	-	-
7	4	1.99	-	-	-	-
8	4	1.56	-	-		-
9	4	1.54			-	-
10	5	2.13		-	-	
11	6	2.34	1	0.39	-	-
12	14	6.28	4	1.79	2	0.90
13	12	5.29	8	3.52	7	3.08
14	11	5:26	11	5.26	10	4.78
15	10	5.38	10	5.38	9	4.84
	72	2.8	34	1.3	28	1.1

TABLE III-*Correlation of Positive Family History with Hypertension*

Family history of hypertension	Number	Percentage
Present	24	85.7*
Not present	4	14.3*
Total hypertension	28	100.0

*p <0.01 (significant)

TABLE IV-*Prevalence of Hypertension in Obese and Non-Obese Children*

Obesity	Total	Hypertension	Percentage
Yes	131	18	13.7*
No	2429	10	0.41*
Total	2560	28	1.1

*p <0.01 (significant)

higher prevalence while a lower prevalence has also been reported(4,5,8,9). A fall in prevalence on repeated evaluations has also been noticed by Gupta and Ahmed(4). Other authors also agree to the fact that serial determinations of blood pressure are necessary in order to document persistent elevations(3,10). The phenomenon of maintaining the rank for a measurement within their age-sex group is referred to as tracking. The tracking of BP among children and adolescents has been investigated in different surveys with varying results. Leumann *et al.* reported that tracking of BP is detectable even after 4-5 years and is strongest in those with highest values(ll). Palti *et al.* observed that children maintaining their percentile rank for weight or BMI showed a

higher correlation for tracking(12). A number of reports concluding low degree of tracking for BP in children have decried the futility of large scale screening programmes(13,16). Hofman *et al.* noted moderate degree of tracking but stated that it is impossible to detect future hypertensives early in life(14). The tracking correlates were found to be zero by Ibsen(16). Burke *et al.* have recommended serial measurements to reduce the effect of regression to mean and increase the predictive value(17).

The hypertensive children in the .present study were adolescents of 11-15 years age group. The elevation of BP at adolescence has been noted by others also although the exact reasons for the same are not yet clear. Various postulates put forward include biological maturation, increase in body mass and hormonal changes(18).

It is well known that some families are more frequently hit by elevated blood pressure, cerebral hemorrhage and athero-sclerotic heart disease than other families. A statistically significant correlation between hypertension in children and positive family history was noted in this study. Gupta and Ahmad have also made similar observations(4). Hansen *et al.* have concluded that familial tendency to elevated BP is detectable relatively early in life(19). The reason for familial aggregation may be genetic or environmental or both.

As in adults, the relationship between hypertension and obesity in childhood has been noted though less extensively evaluated. We found that the prevalence of hypertension was 34 times in obese children as compared to non-obese and the correlation was statistically significant. Gupta and Ahmad have also reported that prevalence of sustained hypertension in obese children was 20 times more as compared to controls(4). Andriska *et al.* found that 41% of their hypertensive children were obese(20). Court *et al.* have concluded that hypertension has significant correlation with severe childhood obesity(21). Schachter *et al.* evaluated the blood pressure during first five years of life and found only modest association between body size and blood pressure(22). Schall *et al.* studied black adolescents and reported that high BP among females was associated with greater fatness while in males highest BP correlated with increased muscle mass and decreased fatness(23).

Thus it is evident that obesity in children is a risk factor for later coronary diseases. In order to prevent or decrease the target organ damage, it is necessary to modify the risk factors in childhood. The potential pay-off of prevention of later cardiovascular disease is enormous and allows the provision of more comprehensive care to a pediatric population.

REFERENCES

1. Kannel WB. Role of blood pressure in cardiovascular disease—The Framingham Study. Angiology 1975, 26: 1-14.
2. Hahn L. The relation of blood pressure to weight, height and body surface area in school boys aged 11-1 years. Arch Dis Child 1952, 27: 43-53.
3. Rames LK, Clarke WR, Cornor WE, Reiter MA, RM. Normal blood pressure and the evaluation of sustained blood pressure elevation in childhood-the Muscatine study. Pediatrics 1978, 61: 245-257.
4. Gupta AK, Ahmad AJ. Normal blood pressure and the evaluation of sustained blood pressure elevation in childhood. Indian Pediatr 1990, 27: 33-42.
5. Sachdev Y. Normal blood pressure and hypertension in Indian Children. Indian Pediatr 1984, 21: 41-48.

6. Whyte HM. Behind the adipose curtain. Am J Cardiol 1965, 15: 66-80.

7. Kirkendall WM, Feinleib M, Freis ED, Mark AL. American Heart Association. Recommendations for human blood pressure determination by sphygmomanometer. Hypertension 1981, 3: 509-519.

8. Laroia D, Sharma M, Diwedi V, Belapurkar KM, Mathur PS. Profile of blood pressure in normal school children. Indian Pediatr 1989, 26: 531-536.

9. Aggarwal VK, Sharon R, Srivastava AK, Kumar P, Panday CM. Blood pressure profile in children of age 3-15 years. Indian Pediatr 1983, 20: 921-925

10. Kilcoyne MM. Natural history of hypertension in adolescence. Pediatr Clin North Am 1978, 25: 47-53.

11. Leumann EP. Physiologic increase and tracking of blood pressure in school children. Clin Exper Theory Practice 1986, A8: 557-562.

12. Palti H, Gopin R, Alder B, Graplein O, Belmaker F. Tracking of blood pressure over an eight year period in Jerusalem school children. J Clin Epidemiol 1985, 41: 731-735.

13. Fixler DE, Lair PL. Validity of mass blood pressure screening in children. Pediatrics 1983, 72: 459-463.

14. Hofman A, Valkenburg HA, Maas J, Groustra FN. The natural history of blood pressure in childhood. Int J Epidemiol 1985, 14: 91-96.

15. Andre JL, Deschamps JP, Petic JC. Change of blood pressure over five years in childhood and adolescence. Clin Exper-Theory Practice 1986, A8: 539-545.

16. Ibsen KK. Tracking of blood pressures. Scand J Clin Lab Invest 1989, 49: 59-61.

17. Burke GL, Cresanta JL, Shear CL Miner MH, Berenson GS. Cardiovascular risk factors and their modification in children. Cardiol Clin 1986, 4: 33-46.

18. Szklo M. Epidcmiologic patterns of blood pressure in children. Epid Rev 1979, 1: 143-169.

19. Hansen HS, Hyldebrandt H, Nielsen JK. Familiar aggregation of blood pressure in childhood. Scand J Clin Lab Invest 1989, 49: 55-57.

20. Andriska J, Gombik M, Breyer H, Tarr A. Hypertension in children and adolescents: Results of a long term follow up study. Clin Exper Theory Practice 1986, A8: 567-579.

21. Court JM, Hill GJ, Dunlop M, Boulton TJC. Hypertension in childhood obesity. Aust Pediatr J 1974, 10: 296-300.

22. Schachter J, Kuller LH, Perjetti C. Blood pressure during the first five years of life: Relation tcetflhic group (Black or white) and to parental hypertension. Am J Epidemiol 1984, 119:541-553.

23. Scholl JI, Hediger ML, Katz SH, Zemel BS, Valleroy LA. Pulse rate, blood and body composition in black adolescents: The Philadelphia blood pressure project. J Chronic Dis 1985, 38: 241-251.