INFLUENCE OF FAMILY HISTORY OF MORBID CARDIOVASCULAR EVENTS ON BLOOD PRESSURE LEVELS OF SCHOOL CHILDREN

A.K. Gupta

ABSTRACT

The influence of family history of hypertension, myocardial-infarction and/or stroke on the blood pressure levels of 3,194 children in the age group 5-15 years was studied. Compared to children of normotensive parents, subjects coming from families with history of uncomplicated hypertension, complicated hypertension (hypertension plus myocardial infarction or stroke) and myocardial infarction or stroke without history of hypertension tended to have significantly higher levels of both systolic and diastolic pressures ($p<0.001$) in both the sexes in all age groups studied. Further, 15 (4.83%) of the children coming from families with positive history of one of the aforesaid morbid cardiovascular events had persistent hypertension (BP> mean +2 SD for age and sex). On the contrary only one (0.03%) of the 2,884 children belonging to normal parents had persistent hypertension. All the 16 children with sustained hypertension had only mild hypertension and were asymptomatic. Ten (62.5%) of them were obese (weight/height^2 >2.26). Baseline investigations failed to detect underlying cause to account for raised blood pressures in 9 of the 16 cases that could be investigated. These findings suggest that children of people with hypertension or other morbid cardiovascular events are more likely to have persistently elevated blood pressures than children from families without such a history.

Key words: *Essential hypertension, Parental history, Blood pressure levels.*

The clustering of hypertension in families is a well known phenomenon(1,2). In addition, several hypertension screening projects in school children have confirmed that family history of essential hypertension is present in 44-75% of hypertensive children(3-6). The influence of parental history of morbid cardiovascular events (essential hypertension, coronary artery disease and stroke) on blood pressure levels of children, however, has not been extensively studied(7).

The present work was carried out to study the influence of parental history of morbid cardiovascular events on blood pressure levels of school children. This is based on high risk approach as suggested by the Task Force on Blood Pressure Control in children, American Academy of Pediatrics(8). According to their recommendation, "blood pressure is to be obtained in all first degree relatives, aged 3 or more, as family incorporation offers an optimal approach to the cost effective hypertension detection and entry of the individual into the health care system."

Material and Methods

This study was conducted between January, 1985 to April, 1986 and is based on full coverage of four local schools in which 3,861 school children in the age group 5-15 years were included. Schools were selected by stratified random sampling. The schools from Aligarh were divided into two categories. First group comprised schools where children belonged to

From the Department of Pediatrics, JN Medical College, Aligarh Muslim University, Aligarh.

Reprint requests: Dr. A.K. Gupta, 151, Shakti Vihar, Near Rani Bagh, New Delhi-110 034.

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affluent families (upper middle and higher classes). The second group comprised children whose parents belonged to lower or middle class. From both the groups, 2 schools each were selected by random sampling. Clinical examination was usually carried out between 11 am. to 1.00 pm. In order to allay the anxiety and fear of the children, the nature of procedure was explained in depth.

Every child in the class was given a precoded questionnaire which he was advised to bring the next day after getting it filled by his parents. This questionnaire was designed to obtain information with reference to history of hypertension, myocardial infarction and/or stroke in the parents. The following day, 10 children at a time were called to the room where physical examination was to be performed. The precoded proforma given on the previous day was collected and the names of defaulters noted. They were requested to bring it the following day. Blood pressure of both hypertensive and normal parents of the children was confirmed by direct recording in the school itself.

Age of the child was recorded in complete years. Every effort including interview with parents and evaluation of school records as well as inspection of other documents, if any, was made to determine an exact age of the child.

Socio-economic status was recorded based on three parameters: (*a*) Income, (*b*) Education, and (*c*) Occupation of the parents (Kuppuswamy classification, 1962)(9).

Height and weight was measured in every child employing standard technique.

A thorough general physical examination and examination of cardiovascular system was then carried out. During the perabdominal examination, both lumbar regions were palpated for the presence of any lump, bruit was looked for over the flanks, the presence of organomegaly, if any, was noted.

Blood pressure was recorded in both arms while sitting, whereas blood pressure in right lower limb was taken with the child in prone position using a standard mercury sphygmomanometer and appropriate sized cuff, the breadth of the cuff being about two-thirds of the length of the upper arm, and with bladder encompassing most of the circumference of the arm without overlapping. As recommended by American Heart Association(8) systolic and diastolic pressure were taken to correspond to the appearance and muffling of Korotkoff's sounds (Phase I and Phase IV), respectively. Three measurements were taken at intervals of five minutes for each child and the mean of the three readings was taken as the systolic and diastolic blood pressure, respectively. Same blood pressure instrument was used throughout the study and was checked periodically for any loss of mercury height or any leak in the tubing or the control valves. Normal control values of systolic and diastolic blood pressure in right upper limb have previously been stated(10).

Children whose blood pressure exceeded +2SD of the mean for age and sex were evaluated by six repeat measurements taken during six different visits before labelling them as hypertensive. Those found to have persistently elevated blood pressures were subjected to following investigations: Urine, routine, microscopic, specific gravity and VMA estimation; blood urea; serum creatinine; serum electrolytes; serum-cholestrol; *X*-ray chest PA view; plain *X*-ray abdomen; intravenous pyelography; ECG and fundus examination.

Statistical methods included calculation

of age and sex specific mean and SD for systolic and diastolic BP, and Student 't' test to find out if there was any significant difference in the measurements between the two groups. A p value <0.05 was considered significant.

Results

Of the 3,861 children aged 5 to 15 years studying in Kindergarten to Class IX of four local schools of Aligarh, only 3,194 (82.7%) returned the precoded questionnaire after getting duly filled by their parents.

Family history have been divided into three categories: uncomplicated hypertension; complicated hypertension (hypertension plus myocardial infarction or stroke); and myocardial infarction or stroke without history of hypertension.

Family history of uncomplicated high blood pressure was available in 200 students whereas 2,884 gave no history of any morbid cardiovascular events in either of the parents. On the other hand family history of high blood pressure complicated by myocardial infarction or stroke was seen in 70 children. Remaining 40 students had history of myocardial infarction or stroke without hypertension in their parents. These results are based on the direct recording of blood pressure of all the parents in the school itself. Thus three hundred and ten (9.7%) of the total number of children examined had a positive history of one of the morbid cardiovascular events in either or both of the parents. It included 182 boys and 128 girls. For statistical evaluation subjects with family history of myocardial infarction or stroke with or without associated hypertension were included in the same category since the number was small (*Tables I & II*). As evident from the data both boys as well as girls coming from families with history of one of the morbid cardiovascular events had significantly higher levels of both systolic and diastolic pressures in all age groups studied ($p < 0.001$).

Further, 210 (6.6%) of the 3,194 school children screened had elevated blood pressure (BP > mean +2 SD) on the first contact. It included 146 boys and 64 girls. Both systolic and diastolic readings were in excess of 2 SD, in 171 (5.3%) instances while 20 (0.6%) children had only raised systolic pressures. Diastolic hypertension alone was seen in the remaining 19 (0.6%) children.

Children with elevated blood pressure levels on first contact were re-evaluated at monthly interval for next six months. It was observed that only 52 of the 210 children had raised blood pressures at end of one month follow-up and the number dropped down to only 16 during the subsequent two examinations done at monthly interval. Blood pressure recordings of these 16 children at end of six months follow-up revealed consistently elevated blood pressures. Thus only 16 (0.5%) of 3,194 school children had sustained hypertension while those whose blood pressures had returned to normal during second and third follow-up examinations continued to be normotensive during the follow-up.

Some of the characteristics of the 16 children who had persistent hypertension on follow up is presented in *Table III*. It included 9 males and 7 females. Of these 50% (8/16) were more than 11 years of the age while 25% (4/16) were only 5 years old. Further, 14 of 16 students came from socio-economic class I. Also 10 (62.5%) of them were obese (weight/height^2 >2.26) (18) while the prevalence of obesity in the non-hypertensive students (n=3, 178) was

TABLE I—*Effect of Family History of Morbid Cardiovascular Events on Blood Pressure Levels in Children (Boys aged 5-15 years)*

Age (yrs)	Total No. of children	(A) Control cases (No F/H)			(B) Cases with F/H of uncomplicated hypertension			(C) F/H of heart attack &/or stroke with or without hypertension		
		(n)	Systolic Mean ± SD	Diastolic Mean ± SD	(n)	Systolic Mean ± SD	Diastolic Mean ± SD	(n)	Systolic Mean ± SD	Diastolic Mean ± SD
≥5-7	269	241	97.3 ± 8.4	62.3 ± 7.0	21	106.2 ± 4.2	70.0 ± 4.0	7	106.6 ± 5.1	66.9 ± 2.8
≥7-9	474	440	98.2 ± 8.1	62.7 ± 6.5	30	104.4 ± 3.5	68.1 ± 3.1	4	104.5 ± 3.4	65.5 ± 2.8
≥9-11	349	318	101.7 ± 9.2	65.8 ± 7.8	27	107.1 ± 3.9	68.7 ± 2.2	10	109.6 ± 7.1	71.0 ± 6.7
≥11-13	325	288	105.5 ± 8.0	70.7 ± 6.4	25	111.7 ± 3.3	75.8 ± 3.4	12	114.0 ± 4.3	80.0 ± 3.1
≥13-15	515	463	112.4 ± 8.4	74.1 ± 7.8	33	119.0 ± 2.4	79.8 ± 2.8	19	122.5 ± 3.4	80.6 ± 2.5
Total	1932	1750	103.7 ± 9.4	67.5 ± 7.3	130	110.2 ± 8.9	73.0 ± 6.9	52	114.5 ± 10.0	75.7 ± 7.1

	Systolic	Diastolic	
(A)-(B)	***	***	*$p > 0.05$
(A)-(C)	***	***	**$p < 0.01$
			***$p < 0.001$

TABLE II—*Effect of Family History of Hypertension on Blood Pressure Levels in Children (Girls aged 5-15 years)*

Age (yrs)	Total No. of children	(A) Control cases (No F/H hypertension)			(B) Cases with F/H of uncomplicated hypertension			(C) Cases with F/H of heart attack &/or stroke/hypertension		
		(n)	Systolic Mean ± SD	Diastolic Mean ± SD	(n)	Systolic Mean ± SD	Diastolic Mean ± SD	(n)	Systolic Mean ± SD	Diastolic Mean ± SD
≥5-7	220	209	97.1 ± 7.9	61.8 ± 6.9	9	104.2 ± 4.8	68.7 ± 2.5	2	102.0 ± 2.8	67.0 ± 1.4
≥7-9	268	239	99.1 ± 8.2	62.5 ± 7.1	25	106.4 ± 6.5	69.4 ± 5.7	4	107.0 ± 1.5	69.0 ± 1.5
≥9-11	280	252	102.3 ± 9.1	63.7 ± 7.0	18	108.2 ± 1.8	70.7 ± 2.5	10	111.7 ± 10.6	72.2 ± 1.7
≥11-13	243	208	107.2 ± 8.9	70.2 ± 7.2	29	113.1 ± 3.8	77.5 ± 2.8	6	113.3 ± 2.8	81.0 ± 4.9
≥13-15	251	226	115.3 ± 8.0	75.1 ± 4.4	17	124.8 ± 6.6	80.1 ± 4.8	8	122.6 ± 5.9	81.0 ± 6.9
Total	1262	1134	104.1 ± 8.7	66.6 ± 8.1	98	111.7 ± 10.2	73.8 ± 7.2	30	113.6 ± 9.8	75.5 ± 7.3

	Systolic	Diastolic
(A)-(B)	***	***
(A)-(C)	***	***

*p > 0.05

**p < 0.01

***p < 0.001

TABLE III—*Characteristics of Hypertensive Children (n = 16)*

Case No.	Age (yrs)	Sex	Social class	Weight (kg)	F/H	Systolic BP	Diastolic BP	Systolic Mean +2 SD (Norms)**	Diastolic Mean +2 SD (Norms)**
1.	5.0	M	I	21.0	A	120.0	76.0	112.4	75.3
2.	5.5	M	I	18.0	C	110.0	86.0	112.4	75.3
3.	5.0	F	I	34.5*	A	110.0	90.0	116.4	80.5
4.	5.7	F	I	17.0	B	130.0	92.0	113.7	78.2
5.	6.0	M	I	40.0*	B	112.0	80.0	115.0	76.9
6.	8.0	F	I	43.0*	A	128.0	90.0	116.1	78.2
7.	8.2	F	I	48.0*	A	122.0	80.0	116.1	78.2
8.	10.0	M	I	32.5	B	124.0	84.0	120.4	81.4
9.	11.5	M	I	62.0*	B	128.0	94.0	120.3	84.5
10.	11.0	F	I	44.5	D	128.0	88.0	121.7	86.5
11.	11.0	M	I	71.0*	A	130.0	90.0	120.3	84.5
12.	12.0	F	I	55.0	A	110.0	88.0	123.2	87.0
13.	14.0	M	I	58.0*	A	130.0	90.0	136.2	91.2
14.	14.0	M	I	70.0*	A	130.0	90.0	136.2	91.2
15.	14.0	F	I	68.0*	C	126.0	96.0	136.6	88.6
16.	15.0	M	I	77.0*	A	138.0	94.0	139.7	91.1

F/H Family History Category

A—Uncomplicated hypertension; B—Hypertension + MI or/Stroke; C—Stroke and/or MI without hypertension; D—Negative.

*Obesity

** Mean + 2 SD for age and sex (norms)

only 6.3%. The difference was significant ($p < 0.001$).

None of the 16 children with persistently raised blood pressures had any symptoms attributable to raised systemic pressure and all had only mild hypertension (*Table III*). Further, 9 (56.3%) subjects had family history of uncomplicated hypertension whereas family history of complicated hypertension (hypertension plus myocardial infarction or stroke) was seen in 4 (25%). Remaining 2 (12.5%) children had positive family history of myocardial infarction or stroke without hypertension in their parents. Thus 13 of the 16 children with persistently elevated blood pressures had positive history of hypertension or its associated complications in either or both of the parents. Ten (76.9%) of these 13 hypertensive students had history of two parent hypertension. On the contrary only one (0.03%) of the 2,884 children belonging to normal parents had persistent hypertension. Thus 15 (93.7%)

of the 16 subjects with sustained hypertension had family history of one of the morbid cardiovascular events in either or both of the parents.

Discussion

Hypertension which occurs in approximately 3-6% of the adult population, places affected individuals at increased risk of cerebrovascular accidents, ischemic heart disease and renal failure, which may lead to premature death(11,12). That these complications of hypertension can be prevented by early detection and effective control of blood pressure is also well documented(12). It is being realized more and more that about 1-5% of child population is hypertensive(13). Further, the long, slow and steady course of hypertension in adults also suggests that it perhaps has its footsteps early in childhood but probably goes undetected during this period of life only to manifest during adulthood(14). Several studies on hypertension screening in school children have observed that family history of essential hypertension is present in 44-75% of hypertensive children(3-6). Taking note of these findings, the Task Force on Blood Pressure Control suggested that the family history of hypertension (essential). history of myocardial infarction, cerebral stroke and other cardiovascular diseases should be taken into consideration while evaluating children with elevated blood pressure levels(8). The present study was carried out to see the effect of these risk factors on blood pressure levels of children.

The results of the present study clearly indicates that compared to the children of normotensive parents, subjects coming from families with history of the aforesaid morbid cardiovascular events tended to have significantly higher ($p<0.001$) levels of systolic and diastolic pressure in both sexes. That children with a family history of essential hypertension may have a higher mean systolic blood pressure than children without such a family history has also been substantiated by Munger *et al.*(7) in a recent study. There is hardly any other report in pediatric literature on this aspect. However, two reports on adults are in agreement with our observations(15,16). Thus Sigurdsson *et al.*(15) reported that the group with a positive history of hypertension in 1st degree relatives had a mean systolic pressure that was 6-8 mm Hg higher and diastolic hypertension (>105 mm Hg) on a single measurement twice as frequent as that in the negative group. Further, the mean systolic blood pressure in the group with a positive family history of stroke was 8-10 mm Hg higher than in the negative group. Similarly, Friman *et al.*(16) reported that individuals more than 33 years of age with a family history of hypertension had significantly high blood pressure readings as compared to those without a positive family history.

In the present study, 16 of the 3,194 children had blood pressure levels exceeding +2 SD on seven different visits at monthly interval. Fifteen of these belonged to families with positive history of one of the morbid cardiovascular events (*Table III*). All had only mild hypertension. Further, 10 of these were obese and 6 had hypercholesterolemia. However, none of the 9 children investigated had any evidence of target organ involvement. Further, baseline investigations also failed to demonstrate an underlying cause for high blood pressure in these asymptomatic school children. Similar findings have also been reported earlier(5,6,17,18). This clearly suggests that mild hypertension in

asymptomatic school children detected on routine physical examination is likely to be essential which is not as un-common in pediatric age group as it was once thought to be. The association between a positive family history of hypertension in the family and essential hypertension in adolescents and young adults is well established. That this association holds true for children as well, is reported by others(5,6), and is borne out by our data as well.

The results of the present study, therefore suggests that children of parents with hypertension or other morbid cardiovascular events are more likely to have persistently elevated blood pressures than children without such a family history. A positive family history of hypertension, myocardial infarction, or stroke among parents thus seems to be a worthy indication for blood pressure measurements in children from such families.

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