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Original Research Article

The influence of family history of cardiovascular disease on blood pressure, waist hip ratio and body mass index in adolescents

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ABSTRACT

Background: Cardiovascular Diseases (CVDs) are the major cause of mortality in the world. Reducing the incidence of CVDs has been a challenge due to the multifactorial risk profile of their origin. Among the non-modifiable risk factor for CVDs family history holds a lot of importance. Objective of the study was to study blood pressure, waist hip ratio and body mass index among adolescents and verify the possible the relation with a family history of cardiovascular disease.
Methods: This is a cross-sectional study, which was conducted in 286 school children aged 10 to 19 years, of either sex, from Barabanki. After getting consent from school authorities, children and their parents, a detailed history was taken with a pre-designed proforma. Anthropometric and blood pressure measurements were taken.
Results: In the presence of any risk factor of CVDs, 33.9% of the adolescents were overweight/obese, 45.8% had abdominal obesity, 26.3% had elevated systolic BP and 35.6% had elevated diastolic BP. The group with family history of CVDs had significantly higher number of adolescents with obesity and/or hypertension.
Conclusions: The present studied showed an important association between family history of CVDs and blood pressure, waist hip ratio and body mass index in adolescents.

Keywords: Blood pressure, Body Mass Index, Cardiovascular disease, Waist hip ratio

INTRODUCTION

Cardiovascular Diseases (CVDs) are the major cause of mortality in the world.[1,2] Reducing the incidence of CVDs has been a challenge due to the multifactorial risk profile of their origin.[3,4] There has been an upsurge of CVDs, during the recent years in the developing countries as they do not have properly implemented preventive programs like the developed world.[5-8] Thus interventions and strategies need to be developed for early diagnosis and control of cardiovascular risk factors.

Among the non-modifiable risk factor for CVDs family history holds a lot of importance. Various studies have established the hereditary nature of CVDs.[9,10] Parents not only have genetic influence on their offspring but parental behavior influences children's lifestyles, and this has been associated with cardiovascular risk factors. It has been demonstrated that sedentary lifestyle and uncontrolled consumption of high calorie diet can lead to development of obesity and cardiovascular disease at a younger age.[11] Environmental factors such as diet, smoking and physical activity have an influence on hypertension and obesity as demonstrated by The Bogalusa Heart Study.[12] The study also reflects the fact that the life style habits learned in young age have an affect the onset of cardiovascular disease.

In life, adolescence is an important time, as it is the phase where identity as an individual is established and the behavior and lifestyle acquired during this phase is carried for the whole life. For the primary prevention of coronary artery disease in adulthood, detection of atherosclerotic risk factors must begin early, followed by appropriate interventions to reduce it. Therefore, children with a family history of CVDs should be screened as early as possible to detect hypertension, obesity and dyslipidemia.[13] The present study would contribute to establish the influence of family history of CVDs on risk factors for atherosclerosis in adolescents with for which there are only a few studies from India.

METHODS

It was a descriptive cross-sectional study, which was conducted in Barabanki district during April 2019 to September 2019. All the Government and Private schools of Barabanki district were listed Tehsil-wise. There are 6 Tehsils in Barabanki district. From each Tehsil, three government three private schools were selected by multistage random sampling technique, thus narrowing down to 36 schools. Next, one government and one private school from each Tehsil were contacted and the school authorities were informed about the objective of the study and their consent was requested for the same. If they refused, the next school on list was contacted and by this method, from each Tehsil one government and one private school were selected and twelve schools were selected from the District.

Then a list of students of the age group 10 to 19 years was asked from each selected school, and by applying simple random sampling technique 10% students were selected for the study. A total of 557 students were selected by this method. Then the parents of these selected students were contacted to get consent for the study and 419 parents gave consent. The students whose parents gave consent were interviewed and examined. Detailed history was taken with a systematically pre-designed pro forma. A complete physical examination was done to rule out any systemic disorder. After applying the exclusion criteria, 335 students were selected. These students were given the family history proforma to be filled by parents, which included a history of coronary artery disease, cerebrovascular disease, myocardial infarction, diabetes or hypertension in either one or both parents. 286 students returned with completely filled proforma who were finally included in the study.

Height was measured by a Stadiometer. The subject to be measured was made to stand barefoot on flat surface, with the weight distributed evenly on both feet, heels together and head positioned so that the inferior orbital margin and the tragus of the ear fall in the same horizontal plane parallel to the ground and the line of vision perpendicular to the body. The head, back, buttocks and heels were in contact with the vertical board. The feet were touching each other with their ankle joints together and the great toes at an angle of 45º. The measurement was noted down to the nearest of 0.1 cm.[14] A digital weighing scale was used for taking the weight of the subjects, testing its accuracy before each use. Subjects were asked to stand erect on the balance bare feet with, minimum clothes and without touching anything else. The measurements were noted to the nearest of 0.1 kg.[14] The same equipment was used for all the subjects to ensure uniformity and accuracy. Body Mass Index (BMI) for boys and girls was calculated by using formula BMI = weight (kg)/height^2 (meters) and it was classified according to WHO Growth charts 2007.[15]

Waist circumference was measured midway between the lower rib margin and the iliac crest. Hip circumference was measured at the point yielding the maximum circumferences over the buttocks. Measurement was taken by the non-stretchable tape and their ratio was calculated. The estimated Waist Hip Ratio (WHR) was then compared according to the US Seventh Joint National Committee recommendation16 for diagnosis of abdominal obesity. (Low Risk: Males ≤0.95, Females ≤0.80; Medium Risk: Males=0.96-1.0, Females=0.81-0.85; High Risk: Males >1.0, Females >0.85)

Blood Pressure (BP) was recorded as per US National High Blood Pressure Education Program guidelines with a standard mercury sphygmomanometer using appropriate sized cuff with the subjects in sitting posture.[11] BP was recorded three times for each child and the mean was taken as the representative value. In children in whom higher BP was observed, measurement was repeated after taking rest for one hour to alleviate possible anxiety and fear. Hypertension was diagnosed using the recommendations of New American Academy of Pediatrics Hypertension Guideline.[17]

Inclusion criteria

- Healthy children (10 to 19 years) resident of Barabanki, Uttar Pradesh, India.

Exclusion criteria

- Subjects with chronic illness, having a history of hospital admission in last 6 months, having a history of weight loss in last 6 months, those who were on steroids, anticonvulsants, diuretics, having hypothyroidism or nephrotic syndrome were excluded from the study.

Pretesting was done before actual data collection and relevant modifications were made.

The Ethical Approval for the study was obtained from the Institute's Ethics Committee. The data collected was analyzed statistically with the help of SPSS software (version 17.0). Continuous variables are expressed as mean±SD and percentile. The comparison of the data was performed using appropriate statistical test, p value<0.05 were considered significant.

RESULTS

The study consisted of 286 school children, 61.2% were boys, 38.8% were girls, and their mean age was 13.01±2.32 years (170 boys and 116 girls). About 56.6% were vegetarian and 43.4% were non-vegetarian. According to the socioeconomic classification18 3.8% belonged to Upper class, 12.2% to Upper middle class, 45.5% to Middle lower middle class, 30.1% to Lower upper lower class and 8.4% to Lower class (Table 1).

Table 1: Demographic characteristics of study population in age groups.

	Parameters	Early Adolescence (n=187)	Middle Adolescence (n=80)	Late Adolescence (n=19)	Total (n=286)
Sex	Male	120 (64.2)	40 (50.0)	10 (52.6)	170 (59.4)
	Female	67 (35.8)	40 (50.0)	9 (47.4)	116 (40.6)
Dietary Habits	Vegetarian	101 (54.0)	50 (62.5)	11 (57.9)	162 (56.6)
	Non-Vegetarian	86 (46.0)	30 (37.5)	8 (42.1)	124 (43.4)
Socio Economic Class	Upper	8 (4.3)	3 (3.8)	0 (0.0)	11 (3.8)
	Upper Middle	22 (11.8)	12 (15.0)	1 (5.3)	35 (12.2)
	Middle Lower middle	87 (46.5)	38 (47.5)	5 (26.3)	130 (45.5)
	Lower Upper lower	54 (28.9)	24 (30.0)	8 (42.1)	86 (30.1)
	Lower	16 (8.6)	3 (3.8)	5 (26.3)	24 (8.4)
Religion	Hindu	166 (88.8)	67 (83.8)	16 (84.2)	249 (87.1)
	Muslim	17 (9.1)	11 (13.8)	3 (15.8)	31 (10.8)
	Sikh	1 (0.5)	1 (1.3)	0 (0.0)	2 (0.7)
	Jain	1 (0.5)	1 (1.3)	0 (0.0)	2 (0.7)
	Christian	2 (1.1)	0 (0.0)	0 (0.0)	2 (0.7)

Number in parenthesis indicate percentage

Table 2: Mean±SD of Anthropometric measures and blood pressure in different age groups.

Parameters	Early Adolescence (n=187)	Middle Adolescence (n=80)	Late Adolescence (n=19)	Total (n=286)
Age (years)	11.66±1.15	14.88±1.08	18.47±0.51	13.01±2.32
Weight (kg)	33.71±10.69	43.31±12.64	44.95±8.25	37.14±12.07
Height (cm)	142.33±10.93	152.85±8.10	158.21±9.19	146.33±11.55
BMI (kg/m^2)	16.36±3.71	18.41±4.74	17.86±2.29	17.04±4.05
Waist Circumference (cm)	59.96±9.42	66.18±12.36	66.03±4.81	62.10±10.51
Hip Circumference (cm)	71.77±9.35	79.01±11.62	79.68±6.69	74.32±10.47
Systolic Blood Pressure (mmHg)	106.32±9.93	109.68±9.51	111.90±9.67	107.63±9.94
Diastolic Blood Pressure (mmHg)	73.63±16.96	72.43±15.62	75.05±17.53	73.39±16.59

The mean weight for boys and girls were 36.30±11.65 kg and 38.39±12.60 kg, Height 146.19±12.48 cm and 146.53±10.08 cm, BMI 16.64±3.52 kg/m^2 and 17.62±4.69 kg/m^2 (Table 2).

The adolescents were grouped into three age groups: Early adolescence (10-13 years), Middle adolescence (14-16 years) and Late adolescence (17-19 years).

Adolescents who were overweight (BMI>85th percentile) or obese (BMI >95th percentile) were clubbed in one group and those with WHR in medium or high-risk category were grouped as abdominal obesity. 55 adolescents were found to be overweight/obese and 68 had abdominal obesity. Systolic hypertension (≥130 mmHg) was seen in 48 and Diastolic hypertension (≥80 mmHg) in 52 adolescents (Table 3).

In this study population, there was a family history of CAD or MI in 68, diabetes in 58 and hypertension in 63 adolescents, present in either one or both parents. Family history of any one or more CVDs was present in 118 adolescents. The influence of family history of CVDs on BMI, WHR and BP is presented in Table 4 and 5.

Table 3: Adolescents with obesity and hypertension in different age groups.

	Early Adolescence (n=187)	Middle Adolescence (n=80)	Late Adolescence (n=19)	Total (n=286)
Overweight and Obese	35	20	0	55
Abdominal Obesity	43	22	3	68
Systolic Hypertension	29	14	5	48
Diastolic Hypertension	38	10	4	52

Table 4: The influence of family history of CVDs on BP.

	Total Cases	Systolic Hypertension (n=48)	p value	Diastolic Hypertension (n=52)	p value
Family history of CAD, MI	68	23 (33.8)	<0.01	33 (48.5)	<0.01
Hypertension	63	14 (22.2)	0.19	22 (34.9)	<0.01
Diabetes	58	15 (25.9)	0.04	21 (36.2)	<0.01
Any risk factor	118	31 (26.3)	<0.01	42 (35.6)	<0.01

Number in parenthesis indicate percentage

CVDs Cardiovascular Diseases, BP Blood Pressure, CAD Coronary Artery Disease, MI Myocardial Infarction

Table 5: The influence of family history of CVDs on BMI and WHR.

	Total Cases	Overweight and obese (n=55)	p value	Abdominal Obesity (n=68)	p value
Family History of CAD, MI	68	36 (52.9)	<0.01	42 (61.8)	<0.01
Hypertension	63	23 (36.5)	<0.01	31 (49.2)	<0.01
Diabetes	58	21 (36.2)	<0.01	30 (51.7)	<0.01
Any risk factor	118	40 (33.9)	<0.01	54 (45.8)	<0.01

Number in parenthesis indicate percentage

CVDs Cardiovascular Diseases, BMI Body Mass Index, WHR Waist Hip Ratio, CAD Coronary Artery Disease, MI Myocardial Infarction

DISCUSSION

It is reported that the prevalence, morbidity and mortality due to CAD in Asian Indians is three to four times higher than Americans and Europeans, and even higher in comparison to all other Asians.[19] Children with a history of CVD in the family are prone to develop CVD in the future. In this study, authors found 19.2% adolescents had BMI above the 85th percentile and 23.8% adolescents had WHR in the moderate to high-risk category. Significantly higher number of adolescents were found to be overweight/obese or had abdominal obesity, if they had a family history of CAD, MI, diabetes or hypertension.

In a cross-sectional study, in Pune, 1000 healthy children, in the age group of 12-19 years were screened for anthropometric measurements and BP; those found to be overweight and obese were further investigated for blood sugar and lipid profile, to detect metabolic syndrome.[20] Parental history of diabetes was present in 43 of 1000 (4.3%) adolescents, in which 10 of 16 (62.5%) adolescents had associated metabolic syndrome.

In 2019, a cross-sectional study was done in Brazil involving 1243 children (680 girls, 563 boys) aged between 7 and 17 years, to verify the possible existence of an association between overweight/obesity of school children and cardiovascular risk factors for their parents.[21] Overweight/obesity was present in 29.1% of students. This is higher than this study where authors found 19.2% adolescents to be overweight or obese, this can be explained by the fact that Brazilian children may have different genetic and nutritional factors such as intake of animal foods, carbohydrate, and high fiber consumption. The study results revealed that students with overweight/obesity have a higher probability of having a father with hypertension (OR=1.49; p=0.038) and obesity (OR=2.36; p=0.002) and a mother with obesity (OR=1.72; p=0.016).

Goyal et al, studied 5664 children of 12-18 years of age and found a 17.2% prevalence of overweight/obesity in boys and a 10.7% prevalence of overweight/obesity in girls.[22] They also found a strong independent association with a family history of diabetes and increased Body Mass Index (BMI). This is in line with these findings of 19.2% prevalence of overweight/ obesity in the study group and significant association with family history of CAD, MI, diabetes or hypertension.

Romaldini et al, studied a group of 109 children and adolescents with a family history of premature coronary artery disease to investigate the association between dyslipidemia and other risk factors for atherosclerosis.[23] They observed obesity and excess weight in 25.7% of the cases. Dyslipidemia was observed in 38.5%, either alone or in combination with other risk factors. Hypertension was observed in 2.7% cases.

In The FRICELA Study done in 2003, a population of 2,599 adolescents, age 12 to 19 years, both sexes, was studied to check the prevalence of behaviors and risk factors that predispose to coronary heart disease and learn their associations.[24] There was a positive correlation between hypertension, body mass index, and family history of hypertension, and a negative correlation with physical exercise. Obesity in the young correlated with obesity in their parents. In this study, authors found that in the presence of any risk factor of CVDs 33.9% of the adolescents were overweight/obese and 45.8% had abdominal obesity, which is statistically significant.

In a study conducted at Shimla on 127 children aged 11-18 years who had a history of CVD was present in one or more family members, for screening of obesity, hypertension, dyslipidemia and diabetes.[25] Of these, hypertension was the most common CVD (53%) followed by diabetes (23%) and CAD (12%). One or more cardiovascular risk factors were seen in around 38% and no risk factors were present in around 62% adolescents. Around 13% had dyslipidemia, 11% had reported increased BP records followed by 9% with increased fasting blood sugar. BMI was increased in 9.5% of adolescents.

In this study population, 16.8% had elevated systolic BP and 18.2% had elevated diastolic BP as per the recommendations of New American Academy of Pediatrics Hypertension Guideline.[17] Higher cases reported in this study may be attributed to the recent changes in classification of pediatric hypertension and inclusion of both pre-hypertension and hypertension in a single category in this study group. Adolescents with family history of CAD, MI, diabetes or hypertension were observed to have more cases of systolic and diastolic hypertension. The difference was statistically significant in all except for family history of hypertension and systolic hypertension seen in adolescents. The adolescents with family history of any risk factors had 26.3% cases of elevated systolic BP and 35.6% cases of elevated diastolic BP. The results are similar to those found by investigators in Pune, Brazil, Ahmedabad, Spain, Argentina and Shimla.[20-25] A positive correlation was found family history of CVDs and presence of hypertension and/or obesity in adolescents.

CONCLUSION

The present studied showed an important association between family history of CVDs and BP, WHR and BMI.

Recommendations

BP, BMI and WHR assessment should be part of family health programs even in the first two decades of life and should also be part of interventions directed at health and quality of life maintenance in childhood.

There is a need for further studies, using a larger sample size to be more representative of the society. It is recommended that children should have their BP checked yearly after the age of 10 years, to detect imbalances early, so that necessary modifications like adoption of healthy lifestyles, reduction of fat and carbohydrate consumption and encouragement of physical activity can be done.

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