Relationship Between Visceral Fat and Blood Pressure in Indian Adolescents

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Abstract: Introduction: Risk of metabolic syndrome is 2-3 times more in persons with high visceral fat. Increased accumulation of visceral fat is associated with hypertension in adults, children and adolescents. Aims: The present study was undertaken to check association of visceral fat with blood pressure in Indian adolescents of 18-19 years of age group. Methodology: Our study was conducted on 120 healthy Indian adolescents (60 males and 60 females) of 18-19 years of age group from various colleges in vicinity of Shree Krishna Hospital, Karamsad, Gujarat, India after their voluntary consent. Body visceral fat was recorded by bioelectrical impedance technique using Omron HBF-302 body fat analyzer. Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) were measured by Omron T8 (HEM757A4-C1) Automatic Blood Pressure instrument by following all standard precautions. Results: All participants were divided into two groups on the basis of their visceral fat. Participants with visceral fat 0 to 9 were categorized as normal visceral fat group and participants with visceral fat ≥ 10 were categorized as high visceral fat group. In high visceral fat Indian adolescents, systolic blood pressure (SBP), diastolic blood pressure (DBP) & mean arterial pressure (MAP) were more and statistically significant than low visceral fat Indian adolescents. Conclusion: Visceral adiposity correlated with MAP, SBP and DBP in both gender with better correlation in females. .[Shweta P NJIRM 2017; 8(3):57-61]

Key words: Visceral fat, blood pressure, bio-impedance technique, Indian adolescents

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Introduction: India witnessed rising trends in overweight and obesity during last two decades due to industrialization. Cardiovascular morbidity and mortality are high in obese persons. Hypertension is one of the known modifiable risk factor for cardiovascular diseases. Overweight and obesity are modifiable risk factors for high blood pressure[1,2,3]. Framingham study had documented association of extra body weight with hypertension4. In overweight and obese adult's prevalence of hypertension is double as compared to normal weight5,6. Metabolic and hemodynamic alterations are seen in obese persons. Dyslipidaemia, diabetes mellitus and hypertension are commonly seen in overweight and obese. Hemodynamic alteration is root cause of hypertension. Sympathetic over activation and reduced parasympathetic tone are seen in overweight and obese[7,8.]

Risk of metabolic syndrome is higher in individuals with central obesity. Epidemiological studies have documented role of intra-abdominal fat and increased prevalence of hypertension. Along with extra body weight, fat distribution to different body parts play a key role in development of hypertension especially to central parts. Excess body fat and its compartmental distribution play a key role in development of hypertension. A person with high visceral fat has more risk for development of hypertension than person with high total body fat [9,10,11,12]. Role of visceral fat with blood pressure variation in adolescents is unknown. Therefore, the present study was undertaken to check association of visceral fat with blood pressure in adolescents.

Methodology: A cross sectional study was conducted on 120 healthy (60 males & 60 females) young Indian of 18 to 19 years of age group from various colleges, after the approval from the Institutional Ethics Committee. All participants were informed about the nature of study, their benefits to the community, risk associated with study. All participants were enrolled for the current study after their written consent. All the participants were apparently healthy and diseases free at the time of the study. Participants with history of high blood pressure, diabetes, athletes, cardiovascular disease, joint problems and arthritis were excluded from the study. Participants with habit of alcohol, smoking and any other chronic diseases were also excluded from the study.

Body Composition: The body composition was done with light clothing and on empty bladder. The body weight was recorded in kilograms on a standard weighing machine. The body weight was measured bare footed to the nearest 0.1 kg. The height was measured using meter scale without footwear to the

nearest 0.1 cm. Body Mass Index (BMI) was calculated as the weight (kg) divided by the square of height (m2)[13,14]. Total body fat percentage (TBF%) was assessed by bioelectrical impedance technique using Omron HBF-302, a body fat monitor. Fat mass was calculated based on total body fat percentage into body weight. Lean body mass (LBM) was calculated by subtracting fat mass from total body weight. Body visceral fat was recorded by bioelectrical impedance technique using Omron HBF-302,[1,14]. Participants were divided into two groups on the basis of their visceral fat. Participants with visceral fat 0 to 9 were categorized as normal visceral fat group and participants with visceral fat ≥ 10 was categorized as high visceral fat group for both genders.

Recording of Resting Heart Rate and Arterial Blood Pressure: Participants were given prior instructions for not getting involved in any unusual physical efforts for at least 12 hours before testing. The subjects were instructed for not having heavy meals 3 hours before the test[15]. The participants were instructed to avoid the intake of tea, coffee, tobacco or any other stimulants for a period of at least 30 minutes before the measurement of cardiovascular profile. The participants were asked to empty the bladder before the measurement of blood pressure and heart rate[15,16] and relaxed quietly in sitting position for a period of at least 5 minutes. Heart Rate (HR) was measured by Polar heart rate monitor[17]. Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) were measured using the Omron T8 (HEM757A4-C1) Automatic Blood Pressure instrument at the brachial artery from the left arm by following all standard precautions[5]. Resting heart rate and blood pressure were recorded for three times at interval of 1 minute till the difference between two consecutive readings is less than 5 mm Hg[16]. The average of the three consecutive readings was used for data analysis. Pulse pressure (PP) was calculated using average SBP & DBP by standard formula (PP=SBP-DBP) and mean arterial blood pressure (MAP) was derived from the formula (MAP= DBP + PP/3)[16,18].

Statistical Analysis: Standard descriptive data (means ± standard deviations) were plotted to describe the sample. T tests were performed to confirm statistical association among the normal visceral fat and high visceral fat groups. Pearson Correlation (R) was used to test the hypothesis to determine the relation between visceral fat and blood pressure in Indian adolescents. A p-value <0.05 was considered significant.

Results: The present study was conducted on 120 Indian adolescents (60 boys and 60 girls). General characteristics, anthropometric variables and blood pressure of the participants are presented in Table 1. Boys had significantly higher height, lean body mass, systolic blood pressure (SBP), diastolic blood pressure (DBP) & mean arterial pressure (MAP) than girls (p-value < 0.05). However, girls had significantly higher age, fat mass, body mass index and total body fat% than boys (p-value < 0.05). There was no statistically significant difference in visceral fat and waist circumference between adolescent boys and girls. As per Table 2 & 3, SBP, DBP & MAP were more in high visceral fat group in comparison to normal visceral fat group in both gender and it was statistically significant also (p-value < 0.05). Table 4 represents association of visceral fat with blood pressure in Indian adolescents of both genders. Visceral fat had shown positive association with SBP, DBP & MAP in Indian adolescents.

Table No.1 Basic characteristics of subgroup of Adolescents:

Variables	Boys (n=60)Mean ± SD	Girls (n=60)Mean ± SD	P Value
Age (years)	18.16±0.37	18.56±0.49	<0.001
Height (m)	1.70±0.057	1.53±0.067	<0.001
Weight (kg)	73.81±17.16	69.95±17.87	0.230
Fat mass (kg)	18.24 ±9.22	25.38 ±9.99	0.0001
Lean body mass (kg)	55.56±8.54	44.56±8.21	<0.001
BMI (kg/m2)	25.30±5.50	28.56±6.69	0.0042
Total body fat%	23.32 ±7.01	35.02 ±5.92	<0.001
WC(cm)	89.30±15.85	88.92±13.60	0.887
Visceral Fat (VF)	8.55 ± 5.60	9.3 ± 6.31	0.180

Heart Rate (HR)	86.99±9.23	90.81±8.97	0.023
SBP(mmHg)	118.92± 6.71	109.56±9.08	<0.001
DBP(mmHg)	72.17±5.99	71.7± 8.11	0.716
MAP(mmHg)	87.76± 5.61	84.32±7.88	0.006

Table No 2: Basic characteristics of Indian Adolescents Boys:

Variables	Normal VF Group (n=30)	High VF Group (n=30)	P Value
Age (year)	18.1±0.30	18.23±0.43	0.171
Height (m)	1.70±0.062	1.71±0.051	0.700
Weight (kg)	60.10±8.15	87.51±11.99	<0.001
Fat mass(kg)	11.07 ± 4.42	25.41 ± 6.85	<0.001
Lean body mass	49.02±5.17	62.09±5.79	<0.001
BMI (kg/m2)	20.73±2.31	29.86±3.63	<0.001
TBF%	18.02 ± 5.24	28.63 ± 3.78	<0.001
WC(cm)	75.8± 6.84	102.81±9.31	<0.001
VF	3.96 ± 2.14	13.13 ± 3.98	<0.001
HR	87.1 ± 10.44	86.88 ± 8.01	0.929
SBP(mmHg)	117 ± 6.53	120.65 ± 6.54	0.045
DBP(mmHg)	69.76 ± 4.81	74.58 ± 6.15	<0.001
MAP(mmHg)	85.57 ± 4.63	89.94 ± 5.71	0.001

Table No 3: Basic characteristics of Indian Adolescents Girls:

Variables	Normal VF group(n=30)	High VF group (n=30)	P Value
Age	18.53±0.50	18.60±0.49	0.609
Height (m)	1.56±0.065	1.56±0.070	0.733
Weight (kg)	55.01±7.43	84.90±11.50	<0.001
Fat mass(kg)	16.94±4.48	33.83 ± 5.94	<0.001
Lean body mass	38.06±3.84	51.06±5.92	<0.001
BMI (kg/m2)	22.74 ±3.51	34.37±2.95	<0.001
TBF%	30.36 ± 4.71	39.69 ± 2.01	<0.001
WC(cm)	77.55±7.59	100.30 ± 7.15	<0.001
VF	3.93 ± 2.27	14.66 ± 4.04	<0.001
HR	89.46±6.80	92.16± 10.67	0.247
SBP(mmHg)	104.06±7.73	115.06± 6.74	<0.001
DBP(mmHg)	67.66±7.68	75.73±6.43	0.001
MAP(mmHg)	79.8±7.10	88.44±5.78	<0.001

Table 4: Correlation of visceral fat with blood pressure:

	HR	SBP	DBP	MAP
Boys	0.072	0.286*	0.403**	0.401**
Girls	0.097	0.615***	0.523***	0.595***

Values indicate mean ± SD. * indicates P value < 0.05 and ** indicates P value < 0.01, *** indicates P value < 0.001

Discussion: In this cross sectional study, we examined association of visceral fat with blood pressure in Indian adolescents. SBP, DBP & MAP were high and statistically significant (p-value < 0.05) in high visceral fat group as compared to normal visceral fat group. In Indian adolescent boy's visceral fat is positively associated with SBP (r =0.286, p=0.026), DBP (r =0.403, p=0.001) and MAP (r =0.401, p=0.001). There is direct association of visceral fat with SBP (r =0.615, p < 0.001), DBP (r =0.523, p < 0.001) and MAP (r =0.595, p < 0.001) in Indian adolescent girls. Our study was supported earlier by Daniel SR et al who reported association of central fat with blood pressure in children and adolescents. Fat distribution to various

body parts plays a key role in development of cardiovascular diseases in children and adolescents. Accumulation of intra-abdominal fat is associated with metabolic syndrome in adolescents. Normally school going children and young adolescent are less prone for development of central obesity with accumulation of visceral fat. Greater deposition of visceral fat in South Asian is reported than Caucasian children and adolescents and they have greater risk for development of hypertension and type-2 diabetes in future[19, 20].

Yukako Tatsumi et al, reported risks for metabolic diseases were high in normal weight Japanese with high visceral fat[21]. Hiuge-Shimizu et al, had also documented elevated blood pressure in Japanese with increased visceral fat area[22]. Miazgowski et al, documented positive association of visceral fat with blood glucose level but negative association with blood pressure in Caucasian women[23]. Anna Maria Sironi et al had documented high visceral fat in abdominal visceral region in hypertensive men than normotensive men[24]. Deposition of fat to visceral regions is associated with high blood pressure, insulin resistance and dyslipidaemia. Accumulation of fat to intra-abdominal organs facilitates development of metabolic syndrome and risks for cardiovascular diseases are increased[9,10,11,12,24]. The exact mechanism for development of high blood pressure with visceral obesity is not explained clearly by scientist but more and more newly diagnosed hypertensives are seen with visceral obesity. Lack of exercise, physical inactivity and excess consumption of calorie dense foods are the main culprit for the development of visceral obesity. Abnormal feeding behaviour like, fast eating, meal skipping and over-eating are the main causes for the development of visceral fatness. Smoking, drinking, meal skipping along with over-eating, the new trends in adolescents and young adults with visceral obesity is rising in developing countries. Life style modification is required for young generation for prevention of early onset metabolic syndrome. Weight reduction programme, healthy eating behaviour and regular exercises are useful for prevention of cardiovascular diseases in adolescents and adults [25, 26, 27].

The present study has several limitations like visceral fat was not measured by CT scan. Visceral fat measurement by bioelectrical impedance method may be influenced by total body water level. Small sample size is also one limiting factor.

Conclusion: Present study concludes that excessive distribution of fat to visceral organs is positively associated with blood pressure in Indian adolescents. Visceral fatness influences risk for development of cardiovascular diseases. Nutritional programmes and fitness programmes are needed for school and college going students.

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