

## Blood Pressure Variants And Their Correlation With Physical Fitness Of Obese And Non-Obese Adolescents

**Sandhya Banik**

Research Scholar, PhD, ASPESS, Amity University Uttar Pradesh, Noida, India

**Kalpana Sharma**

Supervisor, Director, ASPESS, Amity University Uttar Pradesh, Noida, India

### **Abstract:**

**Introduction:** Raised blood pressure is associated with Cardiovascular disease, and a major health issue among school going children and adolescents. Early stage screening is required to prevent the emergence of complications in adulthood. With globalization adolescents are exposed to lifestyle modification, which includes less indulgence in physical activity and high involvement in unhealthy food habits, which leads them into obesity. Hence, early diagnosis of raised blood pressure is mandatory for prevention and treatment.

**Objectives:** the present study was done with the objectives to find out the relationship between physical fitness and systolic blood pressure and diastolic blood pressure of Obese and Non Obese adolescents

**Methods:** A status study was done under purposive sampling which included 150 (75 Obese and 75 Non-Obese) school going adolescents aged 15 years of Delhi, India. Permission from head of institutions and parents and a filled consent form from students was taken before the study. Anthropometric measurements with blood pressure were taken from each participant. Mean calculation of Blood pressure from three readings with the 30 minutes' rest time was calculated. 600 yards walk/run test was conducted to check the physical fitness. Participants were encouraged to be comfortable and complete the test either by walking or by running. The Pearson's product moment correlation was determined to assess the relationship between physical fitness and systolic blood pressure and diastolic blood pressure of Obese and Non Obese adolescents.

**Results:** The non-obese boys had no sign of systolic pre-hypertension, but showed 5.33% systolic hypertension and diastolic pre hypertension was 10.66% but no diastolic hypertension whereas obese boys had 29.33% systolic pre hypertension and 31.66% systolic hypertension while showed 24% pre diastolic hypertension and 16% diastolic hypertension. Significant correlation was found between physical fitness and systolic blood pressure 0.932, diastolic blood pressure 0.308 ( $p>0.05$ ) of non-obese boys and physical fitness and systolic blood pressure 0.313 ( $p>0.01$ ), diastolic blood pressure 0.406 ( $p>0.05$ ) of obese boys. Height percentile, age and gender specifications for Systolic blood pressure and diastolic blood pressure were taken as per the reference charts given by fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents (2004). Strong and Positive correlation was also found between body mass index and blood pressure variants in non-obese and obese adolescents.

**Conclusions& Recommendations:** Early stage diagnosis and treatment are essential for raised blood pressure in adolescents.

**Keywords:** Blood pressure, Physical Fitness, Body Mass Index and Adolescents

### I. INTRODUCTION

Raised blood pressure a silent and an invisible killer. <sup>[1]</sup> It is also a strong predictor of cardiovascular cerebro vascular

and renal disease. <sup>[2-3]</sup> The raised pressure specifically hypertension (BP above 140/90 mmHg) is also responsible for high mortality in countries like India, Taiwan and Japan. <sup>[5]</sup> In today's world, great numbers of paediatric patients' are

diagnosed with hypertension, particularly obese children, and childhood hypertension is a significant risk factor for the development of cardiovascular disease in adulthood.<sup>[6-7]</sup> the various reasons include high sodium and low potassium foods, caffeinated and alcohol beverages, high mental stress, less physical activity and sleep.<sup>[7-8]</sup> Early stage screening of blood pressure of adolescents in schools can help in reducing its harmful effects. Less physical activity and high body mass index were the major determinants of Hypertension among the urban school adolescents, Elevated blood pressure was diagnosed in overweight and obese children and adolescents,<sup>[10]</sup> the association was found between high systolic blood pressure, high diastolic blood pressure and body mass index in 10 – 13 years of overweight rural South African children. Systolic blood pressure and diastolic blood pressure were positively correlated with height, weight, waist circumference, fat percentage and body mass index.<sup>[11]</sup> So, a thoughtful attempt was undertaken with the objectives of (i) finding a relationship between physical fitness and systolic blood pressure and diastolic blood pressure (ii) relationship between body mass index and systolic blood pressure and diastolic pressure.

## II. METHOD

**SELECTION OF SUBJECTS:** Status study conducted with purposive sampling on private school going adolescents (N=150) aged 15 years of urban areas of Delhi, India.

**Informed consent:** Permission from head of institutions and parents and a filled consent forms from all 150 participants taken. The inclusion criteria were those who consented and were healthy. The exclusion criteria for those who did not consent or were unhealthy reported.

**Selection of Variables:** The blood pressure and fitness selected as the variables for the study and measured as per standard procedures of measurement.

**Administration of the test:** The calibrated digital weighing machine (WS593, 2014), stadiometer (WS700, 2014), steel measuring tape (WS024, 2014) was used for weight (kg), height (cm) and waist circumference (cm) respectively with barefoot and lightest clothing on. BMI (weight (kg)/height (m<sup>2</sup>) standard classification values were taken as underweight, normal weight, overweight, or obese<sup>[14-15]</sup>. The collected data was applied the descriptive statistics and correlation. The level of significance was set at .05 level to draw conclusions. Automatic digital blood pressure instrument (Omron HEM757) used and participant were instructed not to consume any eatables, drugs or caffeinated drink and avoid any exercise at least 30 minutes before and be relaxed while giving their blood pressure readings. The chair adjusted as per the sitting height of the participants to make sure the cuff is parallel to the heart and it wrapped in the left arm approximately one-half inch above the elbow. Mean of three blood pressure readings with the interval of 30 minutes recorded for statistical analysis.

## III. RESULTS

The relationship between physical fitness and Systolic blood pressure and diastolic blood pressure of obese and non-obese adolescents was analysed by calculating Pearson's product-moment correlation.<sup>[14]</sup> Mean and Standard deviation were also analysed using SPSS 16.0 version.

Table 1 shows the men & Standard Deviation of the subjects (N=150 and the Obese boys (N=75) ND NON Obese Boys (N=75). Table: 2 shows the blood pressure categories according to systolic & diastolic blood pressure n=150 and the Obese boys (N=75) ND NON Obese Boys (N=75). Table: 3 shows the blood pressure categories according to systolic & diastolic blood pressure of non-obese & obese boys. Table: 4 shows the Correlation of Physical fitness with systolic blood pressure and diastolic blood Pressure of Non-Obese & Obese Boys. Table: 5 shows Correlation of Body mass index with Systolic Blood pressure and Diastolic Blood Pressure of Non-Obese boys and Obese Boys. Table: 6 shows Correlation of Systolic Blood pressure with Diastolic Blood Pressure of Non-Obese boys and Obese Boys. Table: 6 shows the correlation of Systolic Blood pressure with Diastolic Blood Pressure of Non-Obese boys and Obese Boys. Table:7 shows Physical fitness 600yards walk/run test- time (minimum to maximum range) taken by the Non-Obese and Obese boys.

Variables	All Subjects (N=150)		Non-obese Participants (N=75)		Obese Participants (N=75)	
	Mean	S. D	Mean	S.D	Mean	S.D
Age (years)	15.5		15.5		15.5	
Height (cm)	165.66	8.59	169.6	6.56	161.62	8.52
Weight (m)	72.1	13.33	62.8	9.30	82.3	8.93
Body mass index (kg/m <sup>2</sup> )	26.43	5.30	21.74	2.30	31.48	1.78
Physical fitness (sec.)	5.16	1.56	3.90	0.65	6.64	1.11
Systolic blood pressure (mmHg)	127.8	12.01	121.77	10.35	77.96	10.32
Diastolic blood pressure (mmHg)	82.18	11.22	133.96	9.31	86.41	11.43

Table 1: Descriptive Characteristics of Subjects (Mean and Standard Deviation) n=150

Blood pressure category	Systolic Blood Pressure		Diastolic Blood Pressure	
	Boys Participants	Percentage	Boys Participants	Percentage
Normotension	98	65.33%	122	81.33%
Pre-hypertension	22	14.66%	26	17.33%
Stage 1 (hypertension)	20	13.33%	9	6%
Stage 2 (hypertension)	10	6.66%	3	2%

Table 2: Blood pressure categories according to systolic & diastolic blood pressure n=150

BP category	Systolic Blood Pressure n=75		Diastolic Blood Pressure n=75	
	(Non-obese)	(Obese)	(Non-obese)	(Obese)
Normotension	71 (94.66%)	27 (36%)	67 (89.33%)	45 (60%)
Pre-hypertension	None	22 (29.33%)	8 (10.66%)	18 (24%)

Stage 1 (hypertension)	1 (1.33%)	19 (25.33%)	None	9 (12%)
Stage 2 (hypertension)	3 (4%)	7 (9.33%)	None	3 (4%)

Table 3: Blood pressure categories according to systolic & diastolic blood pressure of non-obese & obese boys

Blood pressure Variants	Physical Fitness of Non-Obese Boys (n=75)	Physical Fitness of Obese Boys (n=75)
Systolic Blood Pressure	0.932*	0.313**
Diastolic Blood Pressure	0.308*	0.406*

\*\* Correlation is significant at (p < 0.01) level of confidence (2-tailed).

\*Correlation is significant at (p < 0.05) level of confidence (2-tailed)

Table 4: Correlation of Physical fitness with systolic blood pressure and diastolic blood Pressure of Non-Obese & Obese Boys

Blood pressure Variants	BMI of non-obese boys n=75	BMI of obese boys n=75
Systolic Blood Pressure	0.829*	0.355**
Diastolic Blood Pressure	0.900*	0.626*

\*\* Correlation is significant at (p < 0.01) level of confidence (2-tailed).

\*Correlation is significant at (p < 0.05) level of confidence (2-tailed)

Table 5: Correlation of Body mass index with Systolic Blood pressure and Diastolic Blood Pressure of Non-Obese boys and Obese Boys

Systolic Blood Pressure with Diastolic Blood Pressure Non-Obese boys	0.498**
Systolic Blood Pressure with Diastolic Blood Pressure Obese boys	0.240*

\*\* Correlation is significant at (p < 0.01) level of confidence (2-tailed).

\*Correlation is significant at (p < 0.05) level of confidence (2-tailed)

Table 6: Correlation of Systolic Blood pressure with Diastolic Blood Pressure of Non-Obese boys and Obese Boys

Body mass index category	Physical fitness (600yards Walk/run test timings)
Non-Obese boys	3minutes - 5minutes 47 seconds
Obese boys	4minutes 42seconds-9minutes 33seconds

Table 7: Physical fitness 600yards walk/run test- time (minimum to maximum range) taken by the Non-Obese and Obese boys

Table 1 The mean age ± 16 years, Height (169.69cm), Weight (62.8kg), body mass Index (21.74kg/m<sup>2</sup>), systolic blood pressure (121.77mmHg), diastolic blood pressure (77.96mmHg) and physical fitness test (3minutes 90 sec). Standard deviation of Height (6.56cm), Weight (9.30kg), Body mass Index (2.306kg/m<sup>2</sup>), systolic blood pressure (10.35mmHg), diastolic blood pressure (9.31mmHg) and physical fitness test (0.651sec) of non-obese adolescents and the Mean age ± 16 years, Height (161.62cm), Weight

(82.3kg), body mass Index (31.48kg/m<sup>2</sup>), systolic blood pressure (133.96mmHg), diastolic blood pressure (86.41mmHg) and physical fitness test (6minutes 42 sec). Standard deviation of Height (8.52cm), Weight (8.93kg), Body mass Index (1.78kg/m<sup>2</sup>), systolic blood pressure (10.32mmHg), diastolic blood pressure (11.43mmHg) and physical fitness test (1.11sec) of obese adolescents recorded.

Table 2 divides all participants (150) into systolic blood pressure's category, normative 98 (65%), pre-hypertensive 22 (14.66%), stage-1 hypertensive 20 (13.33%) and stage-2 hypertensive 10 (6.66%) and diastolic blood pressure's category, normative 122 (81.33%), pre-hypertensive 26 (17.33%), stage-1 hypertensive 9 (6%) and stage-2 hypertensive 3 (2%).

Table 3 explains the number of non-obese boys in systolic blood pressure, (normotension - 71), (pre-hypertension- none), (stage 1 hypertension- 1) and (stage 2 hypertension- 3) in obese boys systolic blood pressure was, (normotension- 27), (pre-hypertension- 22), (stage 1 hypertension- 19) and (stage 2 hypertension- 7). The readings of diastolic blood pressure of non-obese boys were (normotension- 67), (pre-hypertension- 8), (stage 1 hypertension- none) and (stage 2 hypertension- none) in obese boys the readings came out to be (normotension- 45), (pre-hypertension- 18), (stage 1 hypertension- 9) and (stage 2 hypertension- 3).

Table 4 shows the Pearson's product-moment correlation between physical fitness with systolic blood pressure of non-obese boys, positively correlated: (r = 0.932) and physical fitness with diastolic blood pressure of non-obese boys. The positive correlation (r = 308) at (p < 0.05) whereas correlation between physical fitness with systolic blood pressure of obese boys, positively correlated: (r = 313) at (p < 0.01) and diastolic blood Pressure of obese boys, which also found positively correlated: (r = 406) at (p < 0.05)

Table 5 explains the Pearson's product-moment correlation between body mass index with systolic blood pressure of non-obese boys, positively correlated: (r = 0.829) and body mass index with diastolic blood pressure of non-obese boys. Positive correlation: (r = 900) at (p < 0.05) whereas correlation between body mass index with systolic blood pressure of obese boys, positively correlated: (r = 355) at (p < 0.01) and diastolic blood Pressure of obese boys, which also found positively correlated: (r = 626) at (p < 0.05)

Table 6 explains the Pearson's product-moment correlation between Systolic Blood pressure with Diastolic Blood Pressure of non-obese boys which positively correlated: (r = 0.488) at (p < 0.01) and Systolic Blood pressure with Diastolic Blood Pressure of obese boys which positively correlated: (r = 0.220) at (p < 0.05)

Table 7 summarizes the total time taken in completion of Physical fitness 600yards walk/run test (minimum to maximum range) by each of the category of boys as per Body mass index. The prevalence of normal weight category participants was 50% performed the physical fitness test in (3minutes - 5minutes 47 seconds), and obese 50% category of participants given the physical fitness score was (4minutes 42seconds - 9minutes 33seconds).

#### IV. DISCUSSION

The study found that physical fitness positively correlated with the systolic blood pressure and diastolic blood pressure in non-obese and obese adolescent boys. Results are similar to the study done with Californian adolescents that revealed physical fitness and systolic blood pressure significantly correlate in adolescents of both sexes. A study on Gujarati adolescent boys showed a significant correlation of systolic blood pressure with physical fitness in terms of predicted VO<sub>2</sub> max whereas physical fitness in terms of predicted VO<sub>2</sub>max negatively correlated with systolic and diastolic blood pressure in adolescent boys from Maharashtra. .

In the present study, the result showed a significant correlation between the blood pressure variants and body mass index, the finding is consistent with the other studies done in India. Low BMIs children were less hypertensive and a significant association noted between high diastolic blood pressure and high BMI in South African children<sup>[3]</sup> BMI was found an independent predictor for systolic blood pressure in Delhi adolescents<sup>[17]</sup> systolic and diastolic blood pressure positively correlated with BMI in Delhi school going adolescents<sup>[11]</sup> BMI and hypertension in obese adolescents significantly correlated for Chennai Urban school children.<sup>[9]</sup>

The non-obese boys had low systolic and diastolic hypertension as compared to their obese counterparts. Out of the total 150 boys, there were 75 (50%) non-obese boys and 75 (50%) obese boys. Out of 75 non-obese boys 71 (94.66%) had normal pressure, and 4(5.33%) systolic hypertension while in diastolic blood pressure category 67 (89.33%) had normal blood pressure 8 (10.66%) pre-hypertension, but there were no boy who had diastolic hypertension. Studies in recent times showed a strong association of high blood pressure with obesity indicate that both hypertension and pre hypertension are becoming a significant health issue in the young.<sup>[19-20]</sup> In the present study out of 75 obese boys, 27 (36%) had normal systolic pressure, 22 (29.33%) pre-hypertension and 26 (34.66%) had systolic hypertension whereas 45 (60%) were found to have normal diastolic pressure, 18 (24%) were pre-hypertensive and 12(16%) had diastolic hypertension.

#### V. CONCLUSION

It was raised blood pressure has negative effect on physical fitness. Early diagnosis of raised blood pressure is mandatory for prevention and treatment.

High body mass index is directly associated with high systolic and diastolic blood pressure.

#### VI. RECOMMENDATIONS

A daily-based physical activity class should be a part of school curriculum for adolescent which will be helpful in maintaining and improving vascular function and will benefit the obese children in reducing blood pressure.

A time-to-time measurement of blood pressure as part of physical examinations of schoolchildren can be taken and a

systematic record also be kept for future reference for the same.

The effect of obesity on blood pressure be detected in early years of life and proper treatment can be followed up with the concern physician.

Parents can be made aware of the increasing risk of raised blood pressure so that they can inculcate good and healthy food habits in their wards.

#### REFERENCES

- [1] Dr. Margaret Chan, Director-General, World Health Organization. 2013. A global brief on hypertension Foreword pg-5
- [2] Satyajit Bagudai, Pranati Nanda, Satyanath Reddy Kodidala. PREVALENCE OF OBESITY & HYPERTENSION IN ADOLESCENT SCHOOL GOING CHILDREN OF BERHAMPUR, ODISHA, INDIA. *Int J Physiother Res* 2014; 2(6): 777-780. DOI: 10.16965/ijpr.2014.685
- [3] KD Monyeki, HCG Kemper and PJ Makgae. The association of fat patterning with blood pressure in rural South African children: the Ellisras Longitudinal Growth and Health Study. *International Journal of Epidemiology* 2006; 35: 114-120. doi: 10.1093/ije/dyi219.
- [4] Exercise physiology- energy, nutrition and human performance (Fourth edition). 1996. William D. McArdle, Frank I. Katch, Victor L. Katch. Pg269
- [5] Khor GL. Cardiovascular epidemiology in the Asia-Pacific region. *Asia Pac J Clin Nutr* 10: 76-80.
- [6] Berenson, G.S., Srinivasan, S.R., Bao, W. et al, Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults: the Bogalusa Heart Study. *N Engl J Med*. 1998;338:1650-1656.
- [7] Banker AC, Chavda J, KAKKAD KM, Damor P. A Study of Prevalence of Hypertension in School Children. *GUJARAT MEDICAL JOURNAL / DECEMBER – 2013* vol. 68 No.2
- [8] Mitsnefes MM. Hypertension in children and adolescent. *Pediatr Clin North Am*. 2006. Volume 53 Issue 3, Pages 493-512. doi: 10.1016/j.pcl.2006.02.008
- [9] Sundar JS, Adaikalam JMS, Parameswari S, Valamarthi S, Kalpana S, et al. (2013) Prevalence and Determinants of Hypertension among Urban School Children in the age group of 13- 17 Years in, Chennai, Tamilnadu. *Epiemiol* 3: 130. doi: 10.4172/2161 – 1165. 1000130
- [10] Aronovitch KM, Lotan D, Moses MD, Fradkin A and Hamiel PO. Blood Pressure in obese and overweight children and adolescents. *IMAJ*. VOL 16. March 2014. Pg 157- 161
- [11] Bahl D, Singh K, Sabharwal M. Screening and Identifying Delhi school going adolescents (12-15 years) with Pre Hypertension and hypertension. *International journal of Scientific and Research Publications*, Volume 5, Issue 10, October 2015. ISSN 2250 – 3153. www.ijsrp.org
- [12] WHO expert consultation. Appropriate body mass index for Asian population and its implications for policy and

- intervention strategies. THE LANCET. Vol 363. January 10 2004. www.thelancet.com
- [13] National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. 2004. "The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents." *Pediatrics*. 114(2 Suppl. 4th report):555-576.
- [14] Shaikh WA, Patel MC and Singh SK. ASSOCIATION OF PHYSICAL ACTIVITY AND PHYSICAL FITNESS WITH BLOOD PRESSURE PROFILE IN GUJARATI INDIAN ADOLESCENTS. *Indian J Physiol Pharmacol* 2011; 55 (4) : 322-328.
- [15] Fraser GE, PHILLIPS RL, Harris R. Physical Fitness and Blood Pressure in School Children. *Circulation* 1983 ; 67:405-412. doi: 10.1161/01.CIR.67.2.405. Available on <http://circ.ahajournals.org/content/67/2/405>
- [16] Parkhad SB and Palve SB. Association of physical activity and physical fitness with blood pressure profile in Maharashtrian adolescent boys and girls. *Internet Journal of Medical Update* 2014 January; 9 (1): 4-9
- [17] Anand T, Ingle GK, Meena GS, Kishore J and Kumar R. Hypertension and its Correlates Among School Adolescents in Delhi. *Int J Prev Med*. 2014 Mar; 5 (Suppl 1): S65-S70
- [18] Maldonado J, Pereira T, Fernandes R, Santos R, Carvalho M. An approach of hypertension prevalence in a sample of 5381 Portuguese children and adolescents. The AVELEIRA registry. "Hypertension in children". *Blood Press*. 2011 Jun; 20(3):153-7. doi: 10.3109/08037051.2010.542649. Epub 2010 Dec 9.
- [19] Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends overweight among US children and adolescents, 1999-2000. *JAMA* 2002; 288:1728-32.
- [20] Sorof J, Daniels S. Obesity hypertension in children: A problem of epidemic proportions. *Hypertension* 2002; 40:441-7.

IJIRAS