Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: www.saspublishers.com

OPEN ACCESS

Physiology

Effect of General Obesity Index (BMI) and Body Fat Percentage on Blood Pressure in Female School Going Children (Aged between 14 – 17 Years)

Dr. Anuradha Upadhyay[1], Dr. Kamla Choudhary[2*], Dr. Raghuveer Choudhary[3], Dr. N. D. Soni[4], Dr. Sona Budaniya[1], Dr. Harshit Punamiya[1]

[1]M.Sc. (Med.) Student, Department of Physiology, Dr. S. N. Medical College, Jodhpur, Rajasthan, India
[2]Assistant Professor, Department of Physiology, Dr. S. N. Medical College, Jodhpur, Rajasthan, India
[3]Professor & Head, Department of Physiology, Dr. S. N. Medical College, Jodhpur, Rajasthan, India
[4]Senior Professor, Department of Physiology, Dr. S. N. Medical College, Jodhpur, Rajasthan, India

***Corresponding author:** Dr. Kamla Choudhary
| **Received:** 01.03.2019 | **Accepted:** 05.03.2019 | **Published:** 30.03.2019
DOI: 10.36347/sjams.2019.v07i03.006

Abstract **Original Research Article**

The increase in Body Mass Index and body Fat% in adolescent's results in increase in Blood Pressure which may contributes to cardiovascular complication. The aim of present study was to determine the association between general obesity i.e. BMI & BF% with Blood Pressure in obese and non obese.70 female subjects aged between 14 to 17 years were enrolled for present study after they had signed written consent. The anthropometric data i.e. Height (ht), Weight (Wt) to calculate Body Mass Index (BMI) and Body Fat % (BF%) of subjects was taken followed by measurements of blood pressure. All the subjects were divided into two groups according to BMI and Body Fat % (BF%). The observed valued obtained was then analyzed by students- t test and the data for blood pressure in both groups i.e. on basis of BMI and BF% was then compared by pearson's coefficient correlation. There was a significant increase in SBP and DBP in both groups' obese subjects.
Keywords: Body Mass Index (BMI), Body Fat% (BF%), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP).

Introduction

Obesity is one of the most challenging health problem [1] and a medical condition in which excess body fat has accumulated to extent that it may have negative effect on health [2]. Obesity in adolescents is major health problem in developed countries and some parts of developing countries, too [3]. It is caused by adoption of sedentary lifestyles, combination of excessive food intake, lack of physical activity and genetic susceptibility [2]. General obesity is described in body mass index (BMI) by categorizing a person with BMI>25 as overweight / obese. According to WHO definition, obesity is BMI greater than or equal to 30 kg/m^2 [4].

Obesity is associated with hemodynamic abnormalities, including hypertension and high resting heart rate as well as metabolic risk factors such as hyperlipidemia and hyperinsulinemia [5]. Cardiovascular disorders due to obesity results in complications such as coronary artery disease, arrhythmias and sudden cardiac death [6]. Body size and obesity also affect the blood pressure among children [7]. Since, Studies related to adolescent obesity and its effect on blood pressure in urban Indian population are unfortunately less, So the present study was aimed to investigate the effect of body composition and adiposity on blood pressure in adolescents individual and correlation of blood pressure with BMI and Body Fat %.

Materials and Methods

In this study, we selected 70 female school going children (Age between 14-17 years) of Jodhpur, Rajasthan during the year of 2018-2019. Institutional ethical clearance was obtained before commencement of the study. An informed consent was taken from each subject during the study. The participants were first given an explanation about the purpose and procedure of the experiment.

Inclusion Criteria

- Age between 14-17 years.
- Physically and mentally fit.
- Not suffering from any known medical problems.

Exclusion Criteria

- Age below 14 years and above 17 years.
- Smokers.

- Not physically fit.
- Hypertensive, diabetic or suffering from any long term systemic illness.
- Uncooperative.

The anthropometric data i.e. Height (ht), Weight (Wt) to calculate Body Mass Index (BMI) and Body Fat % (BF%) of subjects was taken followed by measurements of blood pressure. All the subjects were divided into two groups according to BMI and Body Fat % (BF%).

Procedure for Measurement

Body Mass Index (BMI) – was calculated by dividing the weight taken in kg by the square of height taken in meters. It was calculated by *Quetlet's index* [Wt (kg) / Ht (m^2)]

Body Fat (%) – It was calculated from the formula (1.2×BMI) + (0.23×Age) -10.8×sex) -5.4
[Where male =1 & female = 0] (Deurrenberg P, Westsrate JA, Seidell JC, 1991:)

The **Blood Pressure (BP)** was measured by using mercury sphygmomanometer. BP was measured in seated position on right hand with appropriate size of cuff (covering approximately 2/3 of upper arm) after 10 minute rest.

Statistical analysis

Mean and standard deviation of all measured parameters with blood pressure of all subjects were calculated by Microsoft Excel. The data were computed by student t test in 'Open Epi' software and Pearson's correlation analysis. The $p<0.05$ was considered as statistically significant.

RESULTS

Table-1: Descriptive analysis *based on BMI* of School going Normal and Obese group of female subjects (14-17 years)

Parameters (N=70)	BMI < 25kg/m^2	BMI > 25kg/m^2	Students -t- test	
	Normal Weight [N=36(51%)]	Obese [N=34(48%)]		
	Mean ± SD	Mean ± SD	T value	P value
Age	15.66±1.11	15.76±1.07	-0.38	>0.05 N.S.
Height (cm)	155.55±5.98	154.05±6.12	1.03	>0.05N.S.
Weight (kg)	48.38±7.89	63.41±8.4	-7.71	<0.01H.S.
BMI (kg/m^2)	19.91±2.41	26.67±2.05	-12.6	<0.01H.S.

Note- S- Significant, N.S. Non significant, H. S. Highly significant
*For BMI overweight and obese subjects included in obese group.

Table-1: showing descriptive analysis of normal and obese female subjects selected as per BMI status. Both the groups are showing significant difference between weight, height and BMI.

Table-2: Cardiovascular parameter *based on BMI* of School going of normal & obese group of female subjects (14-17 years)

Parameters (N=70)	BMI < 25 kg/m^2	BMI > 25 kg/m^2	Student – t test	
	Normal Weight [N= 36(51%)]	Obese [N= 34(48%)]		
	Mean ± SD	Mean ± SD	T value	P value
SBP (supine)	118.3 ± 3.92	131 ± 3.21	-14.78	<0.01 H.S.
DBP (supine)	71.91 ± 2.58	79 ± 2.61	-11.42	<0.01 H.S.

Note- S- Significant, N.S. Non significant, H. S. Highly significant
*For BMI overweight and obese subjects included in obese group.

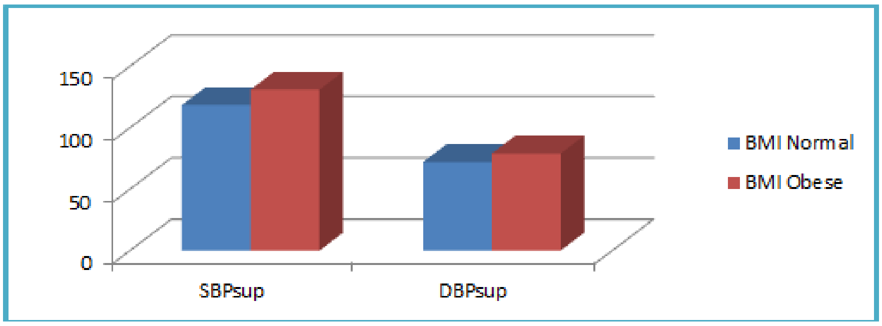

Fig-1: Cardiovascular parameters of Normal & Obese Female subjects.

Table-3: Descriptive analysis *based on BF%* of School going of normal & obese group of female subjects (14-17 years)

Parameters (N=70)	BF% < 30% Normal Weight [N=58 (82%)]	BF% > 30% Obese [N=12 (17%)]	Students -t- test	
	Mean ± SD	Mean ± SD	T value	P value
Age	15.63±1.1	16.08±0.99	-1.31	>0.05N.S.
Height (cm)	154.37±5.76	157±7.09	-1.38	>0.05N.S.
Weight (kg)	52.56±8.46	70.75±9.66	-6.61	<0.01H.S.
BMI (kg/m2)	22.08±3.36	28.56±2.43	-6.33	<0.01H.S.

Table - 2 and Fig – 1 the obese group of B.P. is showing raised level of Systolic, Diastolic, in supine posture.

Table - 3 is showing the descriptive analysis of normal and obese groups based on BF%. Obese group is showing the raised values of weight and BMI.

Table-4: Cardiovascular parameter based *on BF%* of School going of normal & obese group of female subjects (14-17 years)

Parameters (N=70)	BF% < 30% Normal Weight [N=58(82%)]	BF% > 30% Obese [N=12(17%)]	Students -t- test	
	Mean ±SD	Mean ± SD	T value	P value
SBP (Supine)	122.94±6.91	134±3.23	-4.42	<0.01H.S.
DBP (Supine)	74.51±4.2	79.5±2.46	-3.96	<0.01H.S.

Note- S- Significant, N.S. Non significant, H. S. Highly significant

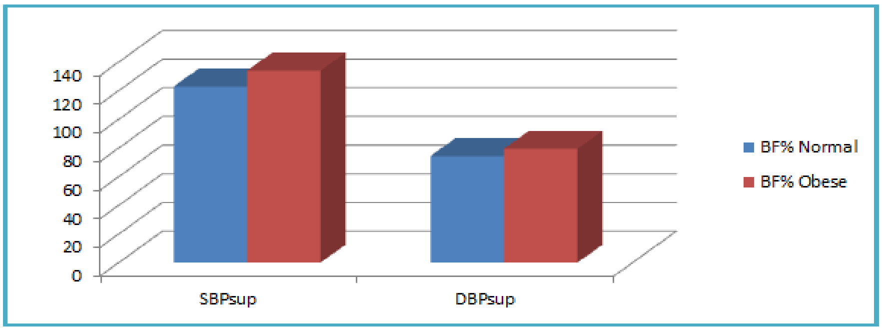

Fig-2: Cardiovascular Parameters of Normal & Obese Female subjects

Table – 4 & Fig - 2 is showing comparison of cardiovascular parameters among normal and obese group (Based on BF%). Obese group is showing the raised level of SBP, DBP as compared to normal group.

Table-5: Correlation of obesity indices with Blood Pressure in female subjects

Name of parameters	BMI	BF%
SBP (supine)	0.85	0.85
DBP (supine)	0.76	0.76

Table – 5 is showing correlation between obesity indices & Blood Pressure. The SBP & DBP in supine condition was strongly correlated with BMI, BF%.

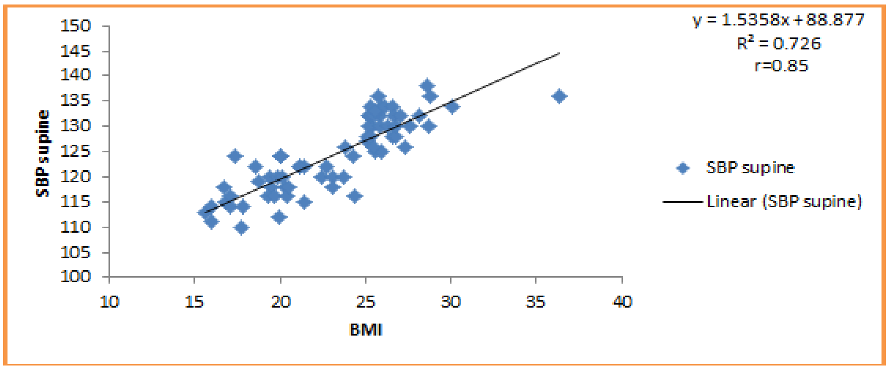

Fig-3: Correlation of BMI with SBP (Supine) in female subjects

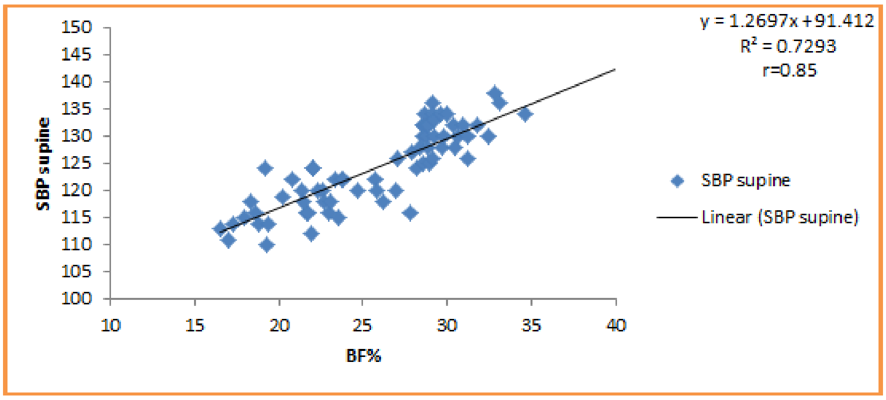

Fig-4: Correlation of BF% with SBP (Supine) in female subjects

Fig: 3 Shows the correlation of BMI with SBP in supine posture in female subjects. BMI explained 85% of cases of SBP in supine posture respectively and Fig: 4 the correlation of BF% with SBP in supine posture in female subjects. BF% explained 85% of cases of SBP in supine posture respectively.

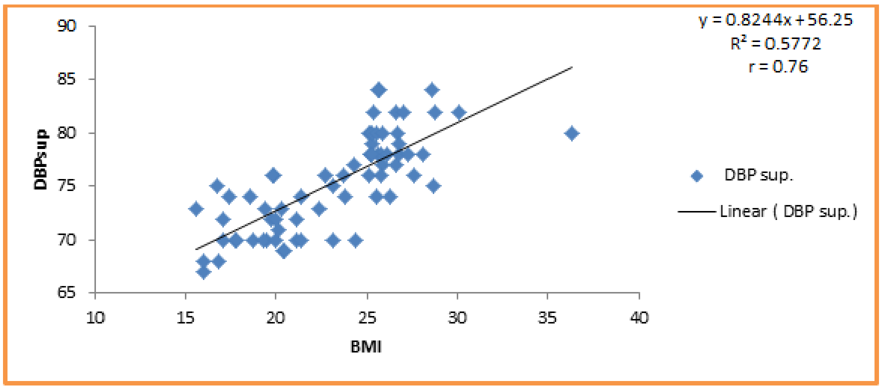

Fig-5: Correlation of BMI with DBP (Supine) in female subjects

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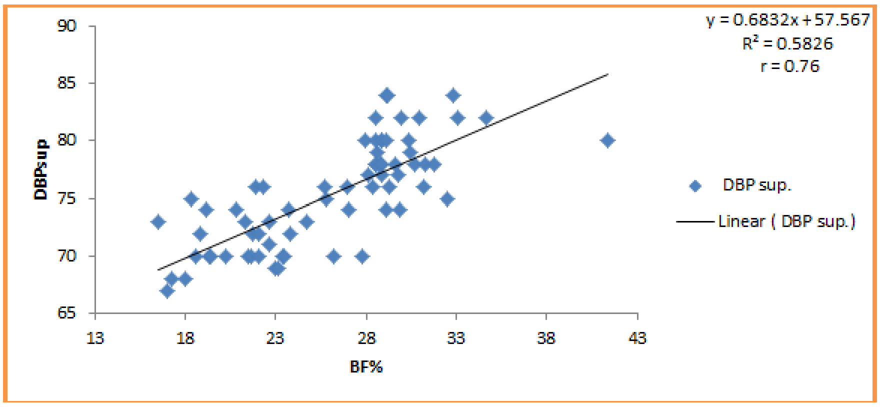

Fig-6 Correlation of BF% with DBP (Supine) in female subjects

Fig: 5 is showing the correlation of BMI with DBP in supine posture in female subjects. BMI explained 76% of cases of DBP in supine posture respectively and Fig: 6 is showing the correlation of BF% with DBP in supine posture in female subjects. BF% explained 76% of cases of DBP in supine posture respectively.

DISCUSSION

To our knowledge there are very less studies investigating the relationship between indices of general obesity and body fat% and blood pressure in Indian school going female subjects (14-17 years). To best our knowledge this study might be the first to assess relationship of blood pressure with body fat% and general obesity among school going female subjects (14-17 years).

The present study carried out in 70 healthy female school going children in the age range of 14-17 years, to assess the effect of general obesity and body fat (%) on blood pressure. The subjects were distributed into 2 groups. Out of total 70 subjects, using the BMI criteria 36(51%) subjects were of normal category and 34(48%) were found under obese category and BF% showed 58(82%) subjects in normal group and 12(17%) comes under obese group.

In our present study the BP was significantly greater in 48% subjects having general obesity i.e. BMI > 25kg/m^2 and 17% on based on body fat% as compared to non obese subjects.

On applying Pearson's coefficient correlation analysis we observed a significant correlation of BP with BMI and BF% in the SBP & DBP in supine posture, explained as 85% SBP & 76% DBP variation. This increase may be due to increased sympathetic nerve activity. Other reason may be increase insulin level and activity of rennin angiotensin aldosterone system that also contribute to increase in BP.

Table-1: Comparison of present study with other studies

Present study	Jodhpur	70 school going female children Aged (14-17 years)	Cross sectional	To determine the association between general obesity & BF% and Blood Pressure in obese and non obese.	In female subjects, SBP & DBP in supine posture was higher in obese compared to non obese.
Abolfotouh *et al.* [8]	Egypt	1500 adolescents (11-19 years)	Cross sectional	Investigate the relationship between HBP and obesity	HBP was significantly associated with overall obesity based on BMI (OR=2.18, 95%, Cl=1.38-3.44)
Casonatto *et al.* [9]	Brazil	656 adolescents with age (10-13 years)	Cross sectional	To analyze the association between abdominal obesity and HBP among adolescents	Association between abdominal obesity and HBP was present in both geneders. Abdominal obesity was associated with higher BP independently of age.

Conclusion

In this study, we found significant positive correlation between general obesity index i.e. BMI and Body Fat % with Blood Pressure in obese group female subjects compared to normal weight group subjects. Thus, to make aware the healthy lifestyle including dietary and physical activity modification specially in early age in female subjects so, that they can be prevented from various life threatening consequences with advancing age. Because the continuous high Blood Pressure in these female school going children (Aged between 14-17 years) exhibiting general obesity and BF% could contribute to various cardiovascular problems later in life. Further research with large number of subjects is required for confirming our present study results and applying these results to be effectively for these subjects.

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