Association of Blood Pressure with Overweight in Young Adult Student

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Abstract

Background: Obesity and overweight in young adult is rising & its deleterious health hazard is becoming a major threat now a days. It is one of the major public health problems globally. Overweight may cause metabolic and endocrinological changes. If untreated, hypertension, cardiovascular disease, hyperglycemia, dyslipidemia, atherosclerosis, metabolic syndrome, cancer may occur. Hypertension is more common in obese and overweight people. This study aimed to observe the association of blood pressure with overweight in young adult students.

Materials and methods: This case control study was conducted in the Department of Physiology, Chittagong Medical College, Chattogram. Total 120 students, aged between 18-24 years were included in the study. 60 young adult students with a Body Mass Index (BMI) of 25-29.9kg/m^2 were included in case group as overweight subject and 60 students of same age with a BMI of 18.5-24.9kg/m^2 were taken as a control group. General physical examination was done, anthropometric measurements-Height, weight, BMI and pulse, systolic blood pressure and diastolic blood pressure were measured. Pulse Pressure (PP) and mean arterial pressure were calculated. For statistical analysis unpaired student's 't' test, chi-square test and correlation coefficient were done by using SPSS for windows version-25.

Results: Systolic Blood Pressure (SBP) Diastolic Blood Pressure (DBP) and Mean Arterial Pressure (MAP) were significantly high in overweight (Case) students ($p<0.001$). Frequency of prehypertension was more in overweight group ($p<0.001$) comparing to normal weight group. Significant positive correlations ($p<0.05$) were observed among BMI with SBP, DBP and MAP in overweight young adult students.

Conclusion: According to present results it was concluded that apparently healthy overweight young adult students were associated with increased blood pressure than normal weight students.

Key words: Blood pressure; BMI; Overweight; Prehypertension; Young adult.

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Introduction

Obesity is an important modifiable risk factor for large number of non communicable diseases including hypertension.[1] As the prevalence of overweight and obesity are morbidly increased, it is need to concern about the co-morbidities of overweight and obesity. High blood pressure is a major global health risk affecting 1.13 billion people worldwide in 2015, responsible for major cause of premature deaths. One of the global targets for non communicable diseases is to reduce the prevalence of hypertension by 25% by 2025.[2] Overweight together with hypertension represent major threats to 21st century.[3]

The ongoing rise in the prevalence of hypertension (HTN) becomes a common problem of adolescent which is alarming.[4] Some researchers found 33% prehypertensives in young adult. They proposed to screen out prehypertensive and hypertensive subjects at an early stage.[5]

A decrease in BMI was found beneficial for blood pressure. In a study the researchers showed a positive relationship between BMI and blood pressure. BMI is the best index and strong predictor of high blood pressure comparing to WC and WHR.[6] The researchers also found that the association between overweight and high SBP was much stronger than high DBP. But dissimilar finding was also observed. In one study, the researchers reported no relation between BMI and blood pressure. Possible cause might be due to variation in adiposity, socioeconomic status, dietary and physical activity.

Overweight young people were more hypertensive than normal group.[7] This may be due to high sympathetic activity in kidney, skeletal muscle & peripheral vessels of overweight people by increasing peripheral vascular resistance, reducing renal blood flow and there by activating the renin-angiotensin–aldesterone axis.

The structural changes in vasculature, following hyperlipidemia and diabetes, perpetuate and aggravate hypertension. High salt intake, consumption of alcohol, obesity, lack of exercise are other contributors of hypertension.[8]

Overweight was significantly associated with blood pressure among university going Hindu and Punjabi female students.[9] Beyond genetic and environmental components ethnic differences have also significant impact on the variation of BMI, WHR and blood pressure. In this study they found similar association of BMI, WHR with blood pressure in both groups and it might be due to same ethnic groups and cultural homogeneity.

Overweight and obesity might increased the risk of high blood pressure. Hypertension present in younger generation and it may be suggested that HTN can begin in early life and it may be related to adulthood hypertension.

Study about blood pressure status in overweight young adult students in Bangladesh is scarce. Therefore, the study is aimed to assess and evaluate the association of blood pressure in overweight young people. Thus future risk from cardiovascular diseases can be prevented at an early age. This will decrease the undue burden on medical cost. Social and economical prosperity can thus be achieved by healthy man power.

Materials and methods

This case control study was conducted in the Department of Physiology, Chittagong Medical College in collaboration with Enayet Bazar Girls College, Chattogram Science College and Premiere University Chattogram during 2019. 60 overweight young adult students aged 18-24 years were selected as a case and 60 normal weight young adult students of same age were selected as control by consecutive sampling. The study and ethical aspects were reviewed and approved by ethical review committee of Chittagong Medical College. Subjects with diabetes mellitus, known hypertension, any systemic illness or acute illness, pregnancy or receiving any medication and subjects unwilling to participate were excluded from this study.

After proper counseling, the aim, objectives and the procedure of the study were explained in details to all subjects. Informed written consent was taken. A predesigned data collection form was provided to the students for collecting demographic information, general health, dietary habits, physical activities and sedentary activities of each participant. For the purpose of exclusion we took history, general examination and systemic examination.

Heights, weight, BMI, pulse and blood pressure of students were measured. Weight was measured on bare foot and avoiding excess clothing or any baggage by analogue standard weight machine (CAMRY model BR 2017-China) and was measured in kilogram (Kg).

Height was measured by a meter scale, drawn on the wall of the classroom. It was made by the researchers by using wood scale, measuring tap and pencil. Subjects were stood up straight with their bare feet together back to the wall and the back of their heads, backs and heels were touched the wall against the meter scale. Then height was measured from the top of the vertex to the bottom of the foot.

BMI was calculated as a ratio of the weight in kg and height in square meter. According to WHO guideline, BMI 18.5-24.9 Kg/m^2 were considered as normal weight and BMI 25-29.9 Kg/m^2 were taken as overweight.

Normal blood pressure was considered between < 120 mmHg (SBP) and <80 mmHg (DBP). Prehypertension is defined as systolic BP 120-139 mmHg and diastolic BP 80-89 mmHg. Systolic BP 140-159 mmHg and diastolic BP 90-99 mmHg were classified as stage-I hypertension. Systolic BP 160-179 mmHg and diastolic BP 100-109 mmHg were classified as stage-II hypertension.

Blood pressure was measured by palpatory and auscultatory method. Pulse pressure is defined as the difference between systolic and diastolic blood pressure, measured in millimeters of mercury (mmHg).

Mean arterial pressure is the average pressure throughout the cardiac cycle. Systole occupies about one third of the cardiac cycle in resting condition and diastole occupies about two thirds, so approximately mean pressure equal to the diastolic pressure plus 1/3 pulse pressure.

Finally, after analysis of all records, total 120 subjects were selected and each group included 60 subjects. After collection, all data were compiled and processed. For statistical analysis unpaired‘t’ test, chi-square (χ^2) test and Pearson’s correlation coefficient test were done by using SPSS for

windows version-25 (Statistical Package for Social Sciences, Inc. Chicago, IL, USA).
95% confidence limit was taken as minimum level of significance. In the interpretation of results, p value <0.05 was accepted as level of significance.

Results

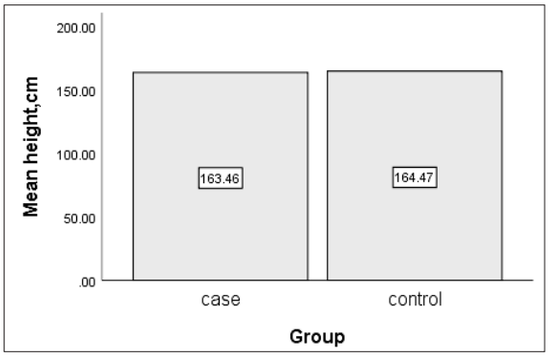

Fig 1 Mean height in overweight (Case) group and normal weight (Control) group

Figure 1 showing mean height was 163.46 cm in overweight (Case) group and 164.47 cm in normal weight (Control) group. Height was not significantly differ between normal weight (Control) and overweight (Case) group (p >0.05) (t=0.61).

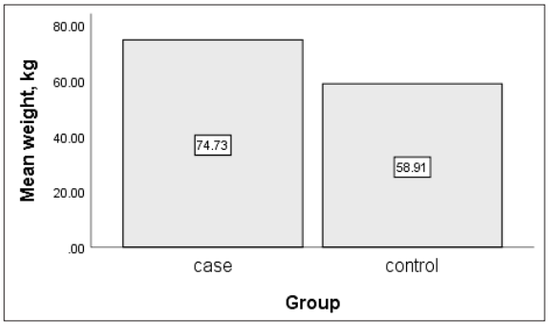

Fig 2 Mean weight in overweight (Case) group and normal weight (Control) group

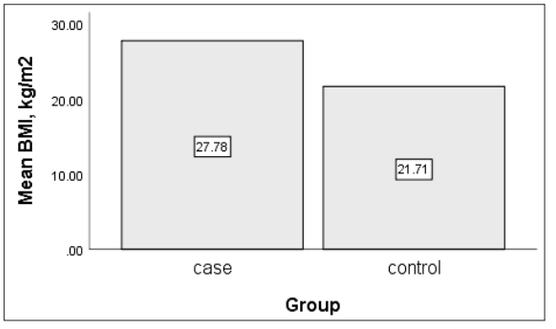

Fig 3 Mean BMI in overweight (Case) group and normal weight (Control) group

Figures 2, 3 showing mean weight, mean BMI in case groups were 74.73 kg, 27.78 kg/m^2 respectively. In control group mean weight, mean BMI were 58.91kg, 21.71 kg/m^2 respectively. Weight and BMI were significantly higher in overweight (Case) comparing to normal weight group (Control) (p <0.05) (t=10.65 for weight, t=21.52 for BMI).

Table I Statistical differences between mean value of pulse and blood pressure between normal weight and overweight young adult students

Parameters	Normal weight (Control) (n=60)	Overweight (Case) (n=60)	p value unpaired 't' test
Pulse (Beats/min)	79±9.30	79.61±6.25	0.722^{ns} (0.357)
Systolic blood pressure (mm of Hg)	109.17±9.96	117.23±10.94	$<0.001^{***}$ (4.22)
Diastolic blood pressure (mm of Hg)	70.50±8.58	80.27±9.23	$<0.001^{***}$ (6.00)
Pulse pressure (mm of Hg)	38.67±9.67	36.97±7.61	0.287^{ns} (1.070)
Mean arterial pressure (mm of Hg)	83.39±7.84	92.59±9.16	0.001^{***} (5.912)

Unpaired student's t-test was done, values are expressed as mean ± SD (Standard Deviation). n= number of subjects; ns= statistically not significant (p>0.05), *= statistically significant (p<0.05), ***= statistically highly significant (p<0.001).
No statistical difference was observed regarding pulse rate and pulse pressure between normal weight (Control) group and overweight (Case) group (p>0.05) (Table I) in this study.
Systolic, diastolic and mean arterial pressure were significantly higher in overweight group (Case) than normal weight group (Control) (p<0.001) (Table I). Prehypertension and hypertension were significantly associated with BMI (p<0.001). 18 subjects (30.0%) were prehypertensive and 1 subject (1.7%) had hypertension (Table II) in overweight (Case) group.

Table II Distribution of blood pressure status of normal weight group (Control) and overweight group (Case) (n=120)

	Normal weight Frequency (Percentage) (n=60)	Overweight Frequency (Percentage) (n=60)	p value (χ^2value)
Normal Pressure (120/80 mmHg)	57(95.0%)	41(68.3%)	
Pre-hypertension (>120/80-<140/90 mmHg)	3(5.0%)	18(30.0%)	$<0.001^{***}$ (14.32)
Hypertension (≥140/90 mmHg)	0(0%)	1(1.7%)	

Chi-square test was done, values are expressed as frequency (Percentage), n= number of subject, ***= statistically highly significant (p< 0.001).

BMI showed no significant correlation with pulse rate and PP (p>0.05) (Table III). Significant positive correlation was observed between overweight and blood pressure. BMI was significantly correlated with SBP, DBP and MAP (p<0.05) (Table III).

Table III Correlation coefficient of BMI with blood pressure in overweight young adult students

	Overweight (BMI)
Pulse	0.064 ^{ns} (p value)
	0.240 (r value)
SBP	0.004* (p value)
	0.364 (r value)
DBP	0.005* (p value)
	0.361 (r value)
PP	0.472^{ns} (p value)
	0.095 (r value)
MAP	0.003* (p value)
	0.383 (r value)

Pearson's correlation coefficient test was done, ns= statistically not significant (p >0.05), * = statistically significant p (<0.05), r=Pearson's correlation coefficient, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure, PP= Pulse Pressure, MAP= Mean Arterial Pressure, BMI= Body Mass Index.

Discussion

In this study, mean height showed no significant difference between overweight (Case) and normal weight (Control) groups. This finding is consistent with other study.[10] There were significant differences of weight and BMI between the groups. These findings are similar with some studies.[7,10]

The study showed no statistical difference regarding pulse rate between overweight (Case) group and normal weight (Control) group. This finding simulates with the observation of a study.[11]

Some researchers found a significant high pulse rate in overweight subjects comparing to normal weight group which dissimulates with this study.[7]

Results of this study showed that blood pressure was significantly increased in overweight young adult group. SBP, DBP and MAP were increased in overweight (Case) group than normal weight (Control) group. Prehypertension and hypertension were significantly associated with BMI. Pulse pressure was not increased in overweight group in this study. These finding is consistent with some previous studies.[4,6,12] In a study the researchers found 12.59% overweight had systolic HTN and 6.67% overweight had diastolic HTN in adolescent group. They also observed high BMI significantly increased the incidence of high blood pressure and was good predictors of high SBP and DBP[12]. Subjects with high BMI had high prevalence of pre-HTN and hypertension.[4]

Overweight acts as a risk factor for HTN[13]. Increased visceral fat mass may cause high free fatty acid load to the liver via portal blood. These activate hepatic afferent pathway leading to sympathetic activation.[13] Adipocytes secrete several inflammatory cytokines. Thus these promote insulin resistance and hyperinsulinemia. Insulin predispose to hypertension by stimulating renal sodium reabsorption, stimulating sympathetic nervous system, by increasing secretion of endothelin.[13] The endothelial modulators such as vasoactive endothelial growth factors, plasminogen activator inhibitor-1, angiotensinogen, renin and angiotensin-II are secreted by fat cells that contribute to vasomotor dysfunction, hypertension and endothelial injury.[13]

Overweight significantly influences not only the level of BP but also the prevalence of HTN and PHTN.[4] In this study 18 subjects (30.0%) were prehypertensive and 1 subject (1.7%) had hypertension. This findings are different in different studies[14,15]. Prevalence may differ in various studies.[14] This difference could be due to small study sample, differences of regions, genetic inheritance, dietary pattern and lifestyle factors.[14]

Hypertension in overweight people might be due to increased cardiac output, increased blood volume, excessive salt intake, increased steroid production and alteration of receptors for vasoconstrictors substances.[16] Also unhealthy diet, sedentary activity, physical inactivity of overweight young adult students may be responsible for this result.

In present study significant positive relation was observed between overweight and blood pressure. BMI was positively related to SBP, DBP and MBP. This finding is consistent with the observation of some previous studies.[9,17,18] They supposed that excess carbohydrate and fat intake leads to high plasma insulin and thus results in an increased BP.[18]

Limitations

This study was conducted for academic purpose in a short period of time. The limitations were:

- Small sample size, Short period of study.
- Study was done with limited age group.
- Blood pressure was measured only in right arm.
- Some diseases like coronary heart diseases, polycystic ovarian syndrome, renovuscular diseases which can affect blood pressure could not be diagnosed.
- Follow up the subjects were not done.

Conclusion

Based on this results it may be concluded that overweight young adult are more prone to risk of increased blood pressure than normal weight young adult students. This suggests that our first priority is maintenance of weight among young adult student by creating awareness about proper diet, exercise programmes and counseling that promotes a healthy lifestyle.

Recommendation

Similar study with large sample size, different age groups and longer duration can be done. Early and immediate interventional measures like increase in physical activity, healthy dietary habits and regular follow up of the subjects can be done to prevent development of irreversible obesity related complications. This type of study can be done in school with active participation of teachers and parents to prevent early onset of overweight and other non-communicable diseases. Mass screening programs for the whole population in the communities can be carried out regularly to detect overweight people in the community. Awareness can be made in population about overweight, its causes, consequences and prevention.

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Contribution of authors

DB- Conception, design, acquisition of data, interpretation of data, drafting and final approval.
NN- Conception, data collection, manuscript writing and final approval.
MB- Conception, design, critical revision and final approval.
SA- Conception, manuscript writing, critical revision and final approval.
SB- Conception, data collection, data analysis, manuscript writing and final approval.
NJ- Design, data collection, data analysis and final approval.

Disclosure

All the authors declared no competing interests.

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