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Relationship of Serum Lipid Profile and Blood Pressure with Body Mass Index (BMI)

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Abstract

Background: Obesity and overweight is a disorder of unusually increased body fat generally resulting from increased energy intake relative to energy expenditure and is a primary sustenance-related disorder globally. The extensive increase in its prevalence in current years and its association with reduced life expectancy has made obesity one of the most vital public health problems. The purpose of the study was to determine the relationship between serum lipid profile and blood pressure with body mass index (BMI). **Material & Methods:** A cross-sectional study was carried out in the Department of Physiology and Biochemistry, Rangpur Medical College, Rangpur from January 2013 to December 2013. A purposive sampling technique was followed. A total number of 90 people from 18 to 45 years old were included in the study, categorized into three groups, such as Group-A:(Control 30): Healthy subject of normal weight, Group-B:(Experimental 30): Healthy subject of overweight & Group-C(Experimental-30): Healthy subjects of obese. Verbal consent was taken before recruiting the study population. Completed data forms were reviewed, edited, and processed for computer data entry. The data analysis was performed using the "t" test, "r" test & Statistical Package for the Social Sciences (SPSS) Version 25.0. **Results:** In group A, the mean BMI of patients was 18.5-22.9, in group B mean BMI of patients was 23.0-24.9, and in group C, the mean BMI of people was 25.0 or greater. The mean ± SD serum LDL-C levels were 107.77 ± 26.720 mg/dl in group A and 134.70 ± 41.787 mg/dl in group B. There was a significant difference ($p<0.001$) between the two groups. The mean ± SD pulse pressure levels were 38 ± 6.644 mmHg in group A and 41.67 ± 11.167 mmHg in group B. There was no significant difference ($p>0.05$) between the two groups. Serum total cholesterol levels were positively correlated in groups A & B but the relationship of serum total cholesterol levels was statistically significant in groups A and B. Blood pressure levels were positively correlated in groups A &C but the relationship was statistically non-significant. **Conclusion:** In this current content, it is difficult to define the specific mechanism involved for significantly higher serum total cholesterol, serum triglyceride, and serum LDL-C levels and non-significantly lesser serum HDL-C levels in overweight & obese people and also non-significantly higher blood pressure in overweight people but significantly higher blood pressure in obese subjects.

Keywords:- Obesity, Overweight, Cholesterol, BMI.

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INTRODUCTION

Obesity and overweight are conditions of abnormally increased body fat generally resulting from increased energy intake relative to energy expenditure. It is a foremost nutrition-related disorder globally.[1] It can be influenced by heredity, age, gender, race, level of education and socioeconomic level, physical activity, eating habits and psychological factors.[2] When body weight is >20% above average mortality rises 20% in men & 10% in women.[3] Over 1 billion people all around the world are obese. Among them 650 million are adults, 340 million are adolescents and 39 million are children. Approximately 167 million people will become less healthy because they are overweight or obese by 2025 according to WHO.[4] Generally, South Asians have higher body fat and lower BMIs in contrast with white people. Malaysia tripped the ASEAN scale as having the highest share of the population being categorized as obese in 2019, with over 15 per cent of its population classed as obese.[5] The widespread increase in its prevalence in recent years and its association with reduced life expectancy has made obesity one of the most vigorous public health problems.[6] The present obesity epidemic postures a major public health issue as it inclines towards multiple chronic diseases. BMI and total adiposity are positively related to cardiometabolic disease. However, body fat distribution and impaired adipose tissue function, rather than total fat mass, better predict insulin resistance, hyperlipidemia, hypertension, certain types of cancer and osteoporosis.[7,8] Dyslipidemia is a disorder of lipoprotein metabolism including lipoprotein overproduction and deficiency which is associated with obesity.[9] They may mark as one or more of the following elevated serum total cholesterol, triglycerides and low-density lipoprotein cholesterol (LDL-C) levels or as decreased high-density lipoprotein cholesterol (HDL-C) levels with causes of insulin resistance metabolic syndrome in overweight &obese subjects.[10] Hyperlipidemia is a well-known and major risk factor for ischemic heart disease, coronary artery disease (CAD) and cardiovascular disease as elevated levels of serum triglycerides, total cholesterol, low-density lipoprotein (LDL-C) and low levels of high-density lipoprotein (HDL-C). These are documented risk factors for atherogenesis.[11] Low levels of HDL and high levels of triglycerides can also increase fat build-up in the arteries, as a result, increase peripheral resistance & increase blood pressure. High levels of HDL cholesterol however protect the heart by helping to remove the build-up of LDL from the arteries.[12,13] So the present study has been designed to assess serum total cholesterol, triglycerides, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and blood pressure in overweight and obese subjects.

Objectives

To observe the relationship of serum lipid profile and blood pressure with body mass index (BMI)

MATERIAL AND METHODS

A cross-sectional study was carried out in the Department of Physiology and Biochemistry, Rangpur Medical College, Rangpur from January 2013 to December 2013. A purposive sampling technique was followed. A total number of 90 people from 18 to 45 years old

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were included in the study, categorized into three groups, such as Group-A:(Control 30): Healthy subject of normal weight, Group-B: (Experimental 30): Healthy subject of overweight & Group-C(Experimental-30): Healthy subjects of obese. All observations were noted in the clinical data sheet. Informed written consent of the study subjects will be taken in easily understandable Bengali phrases. The results were calculated and interpreted through appropriate statistical analysis with the help of a statistician and presented with a table with other illustrations. Ethical clearance was taken from the hospital. The information was kept confidential only to be used for the study purpose.

Inclusion Criteria

- Age group of 18-45 years.
- Apparently healthy subjects of normal weight, overweight & obese person.

Exclusion Criteria

- Incomplete recorded data.
- Subjects with diabetes mellitus and other chronic diseases (liver, kidney & heart).
- Previous history of familial dyslipidemia.

Collection of blood and sample processing

On the first day, all study procedures were maintained and advised the subjects to be in an overnight (8-10 hrs) fasting state. Then attended the next day at 8.00 A.M. at the Department of Biochemistry, Rangpur Medical College, Rangpur. A fasting venous blood sample was collected from the subjects. Five (5) ml of blood was collected from the antecubital vein from each subject under all aseptic precautions by a disposable syringe. The needle was detached from the nozzle and then blood was immediately transferred into a de-ionized test tube with a gentle push to avoid haemolysis. Test tubes were kept in a standing position till the complete formation of the clot. The serum was separated by centrifuging the blood at 3000mp for 5 minutes. The clear supernatant was taken and kept in Eppendorf and stored at 40 degrees.

Cleaning of Glass-Ware

All the test tubes were kept immersed for 24 hours in the acid mixture (20% nitric acid plus 5% hydrogen peroxide mixed with 75% distilled water by volume). Finally, they were washed thoroughly with de-ionized water and dried in the hot air oven.

Study Procedure

Normal weight, overweight and obese subjects in a different area of Rangpur district, who fulfil the inclusion criteria were included by numbering. After the selection of subjects, the objectives and the procedure of the study were explained in detail and their informed written consent was taken. A standard questionnaire (Appendix) was filled out after taking history and thorough clinical examination.

Data Analysis

The study coordinators performed random checks to verify data collection processes. Completed data forms were reviewed, edited, and processed for computer data entry. Frequencies, percentages were used for descriptive analysis. For statistical analysis independent sample 't' test & Pearson's Correlation Coefficient 'r' test were performed by computer-based software SPSS-17.0 version for windows. The data analysis was performed

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using Statistical Package for the Social Sciences (SPSS) Version 25.0.

RESULTS

Among the study population, people were categorized into three groups. Group A included healthy subjects of normal weight, group B included healthy subjects of overweight, and group C included healthy subjects of obesity. All people were from 18 to 45 years old. In group A, the mean BMI of people was 18.5-22.9, in group B mean BMI of patients was 23.0-24.9, and in group C, the mean BMI of patients was 25.0 or greater [Table 1]. The mean ± SD serum total cholesterol levels were 169.87 ± 27.597 mg/dl in group A and 203.33 ± 44.543 mg/dl in group B. There was a significant difference ($p<0.001$) between the two groups. The mean ± SD serum total triglyceride levels were 134.50 ± 50.43 mg/dl in group A and 169.90 ± 80.265 mg/dl in group B. There was a significant difference ($p<0.005$) between the two groups. The mean ± SD serum LDL-C levels were 107.77 ± 26.720 mg/dl in group A and 134.70 ± 41.787 mg/dl in group B. There was a significant difference ($p<0.001$) between the two groups. The mean ± SD serum HDL-C levels were 34.80 ± 5.176 mg/dl in group A and 35.03 ± 4.021 mg/dl in group B. The mean serum total HDL-C levels were compared between group A and group B. There was no significant difference ($p>0.05$) between the two groups. The mean ± SD serum creatinine levels were 0.617 ± 0.191 mg/dl in group A and 0.663 ± 0.192 mg/dl in group B. There was no significant difference ($p>0.05$) between the two groups. The mean ± SD serum ALT levels were 40.07 ± 18.850 U/L in group A and 40.37 ± 15.767 U/L in group B. There was no significant difference ($p>0.05$) between the two groups [Table 2]. The mean ± SD serum total cholesterol levels were 169.87 ± 27.597 mg/dl in group A and 212.30 ± 51.458 mg/dl in group C. There was a significant difference ($p<0.001$) between the two groups. The mean ± SD serum total triglyceride levels were 134.50 ± 50.43 mg/dl in group A and 198.47 ± 118.555 mg/dl in group C. There was a significant difference ($p<0.05$) between the two groups. The mean ± SD serum LDL-C levels were 107.77 ± 26.720 mg/dl in group A and 150.07 ± 57.107 mg/dl in group C. There was a significant difference ($p<0.001$) between the two groups. The mean ± SD serum HDL-C levels were 34.80 ± 5.176 mg/dl in group A and 33.03 ± 4.853 mg/dl in group C. There was no significant difference ($p>0.05$) between the two groups. The mean ± SD serum creatinine levels were 0.617± 0.191 mg/dl in group A and 0.673 ± 0.170 mg/dl in group C. There was no significant difference ($P>0.05$) between the two groups. The mean ± SD serum ALT levels were 40.07 ± 18.850 U/L in group A and 51.27 ± 33.776 U/L in group C. There was no significant difference ($P>0.05$) between the two groups [Table 3]. The mean ± SD systolic blood pressure levels were 106 ± 7.701 mmHg in group A and 110 ± 10.667 mmHg in group B. There was no significant difference ($p>0.05$) between the two groups. The mean ± SD diastolic blood pressure levels were 68 ± 6.644 mmHg in group A and 68.33 ± 7.232 mmHg in group B. There was no significant difference ($p>0.05$) between the two groups. The mean ± SD pulse pressure levels were 38 ± 6.644 mmHg in group A and 41.67 ± 11.167 mmHg in group B. There was no significant difference ($p>0.05$) between the two groups. The mean ± SD mean pressure levels were 80.65 ± 6.271 mmHg in group A and 82.22 ± 6.630 mmHg in group B. There was no

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significant difference (p>0.05) between the two groups [Table 4]. The mean ± SD systolic blood pressure levels were 106 ± 7.701 mmHg in group A and 131 ± 11.987 mmHg in group C. There was a significant difference (P>0.001) between the two groups. The mean ± SD diastolic blood pressure levels were 68 ± 6.644 mmHg in group A and 90.166 ± 8.757 mmHg in group C. The mean diastolic blood pressure levels were compared between group A & group C. There was a significant difference (P>0.001) between the two groups. The mean ± SD pulse pressure levels were 38 ± 6.644 mmHg in group A and 41.50 ± 5.894 mmHg in group C. There was no significant difference (P>0.05) between the two groups. The mean ± SD mean pressure levels were 80.65 ± 6.271 mmHg in group A and 104.40 ± 9.765 mmHg in group C. There was a significant difference (p<0.001) between the two groups [Table 5]. Serum total cholesterol levels were positively correlated in groups A & B but the relationship between serum total cholesterol levels was statistically significant in groups A and B. Serum triglycerides were positively correlated in groups A & B but the relationship of serum triglyceride levels was statistically non-significant in group A & B. Serum LDL-C levels were positively correlated in both group A &B but the relationship was statistically non-significant. Serum HDL-C levels were negatively correlated in groups A & B. Blood pressure levels were positively correlated in both groups A &B but the relationship was statistically non-significant [Table 6]. Serum total cholesterol levels were positively correlated in groups A & C but the relationship of serum total cholesterol levels was non-significant in groups A &C. Serum triglycerides were positively correlated in groups A & C but the relationship of serum triglyceride levels was statistically non-significant in group A &C. Serum LDL-C levels were positively correlated in both group A &B and group A & C. but the relationship was statistically non-significant. Serum HDL-C levels were negatively correlated in group A & C but the relationship was statistically significant in group A &C. Blood pressure levels were positively correlated in group A &C but the relationship was statistically non-significant [Table 7].

Table 1: Distribution of the Study population based on mean age, sex and BMI (N=90)

Group	Age-year (L-H)	Sex	BMI kg/m^2
A n=30	(18-45)	Male =18 Female=12	18.5-22.9
B n=30	(18-45)	Male =15 Female =15	23.0-24.9
C n=30	(18-45)	Male =20 Female =10	25.0 or greater

Table 2: Distribution of the study population based on mean ± SD serum total cholesterol levels in group A & group B

Group	Serum cholesterol level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	169.87 ± 27. 597 (99-218)	4.339	<0.001***
B n=30	203.33 ± 44.543 (120-288)		
Group	Serum triglyceride level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	134.50 ± 50.43 (73-250)	2.01	<0.05*

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B n=30	169.90 ± 80.265 (79-377)		
Group	Serum LDL-C level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	107.77 ± 26.720 (32-148)	3.573	<0.001***
B n=30	134.70 ± 41.787 (69-229)		
Group	Serum HDL-C level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	34.80 ± 5.176 (19-44)	0.19	>0.05NS
B n=30	35.03 ± 4.021 (27-41)		
Group	Serum creatinine level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	0.617 ± 0.191 (0.2 -1.0)	0.921	>0.05NS
B n=30	0.663 ± 0.192 (0.3- 1.1)		
Group	Serum ALT level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	40.07 ± 18.850 (19 -94)	0.062	>0.05NS
B n=30	40.37 ± 15.767 (25-86)		

Table 3: Distribution of the study population based on mean ± SD serum total cholesterol levels in group A & group C.

Group	**Serum cholesterol level Mean ± SD mg/dl Range (L-H) mg/dl**	**'t' value**	**'p' value**
A n=30	169.87 ± 27. 597 (99-218)	4.432	<0.001***
C n=30	212.30 ± 51.458 (123-392)		
Group	Serum triglyceride level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	134.50 ± 50.43 (73-250)		
C n=30	198.47 ± 118.555 (51-445)	2.946	<.05*
Group	Serum LDL-C level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	107.77 ± 26.720 (32-148)	3.785	<0.001***
C n=30	150.07 ± 57.104 (76-309)		
Group	Serum HDL-C level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	34.80 ± 5.176 (19-44)	1.146	>0.05NS
C n=30	33.03 ± 4.853 (24-42)		
Group	Serum creatinine level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	0.617 ± 0.191 (0.2 -1.0)		
C n=30	0.673 ± 0.170 (0.4-0.9)	1.255	>0.05NS
Group	Serum ALT level Mean ± SD mg/dl Range (L-H) mg/dl	't' value	'p' value
A n=30	40.07 ± 18.850 (19 -94)		
C n=30	51.27 ± 33.776 (22-167)	1.697	>0.05NS

Table 4: Distribution of the study population based on mean ± SD Systolic blood pressure levels in group A & group B

Group	**Systolic blood pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg**	**'t' value**	**'p' value**
A n=30	106 ± 7.701 (90-120)	1.682	>0.05NS
B n=30	110 ± 10.667 (95-130)		

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Group	Diastolic blood pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg	't' value	'p' value
A n=30	68 ± 6.644 (60-80)	0.189	>0.05NS
B n=30	68.33 ± 7.232 (60-90)		
Group	Pulse pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg	't' value	'p' value
A n=30	38 ± 6.644 (20-50)	1.613	>0.05NS
B n=30	41.67 ± 11.167 (25-55)		
Group	Pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg	't' value	'p' value
A n=30	80.65 ± 6.271 (73-93)	0.936	>0.05NS
B n=30	82.20 ± 6.630 (72-98)		

Table 5: Distribution of the study population based on mean ± SD Systolic blood pressure levels in group A, & group C

Group	**Systolic blood pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg**	**'t' value**	**'p' value**
A n=30	106 ± 7.701 (90-120)	10.512	<0.001***
C n=30	131 ± 11.987 (110-150)		
Group	Diastolic blood pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg	't' value	'p' value
A n=30	68 ± 6.644 (60-80)	10.772	<0.001***
C n=30	90.166 ± 8.757 (70-100)		
Group	Pulse pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg	't' value	'p' value
A n=30	38 ± 6.644 (20-50)	1.613	>0.05NS
C n=30	41.50 ± 11.167 (25-55)		
Group	Pressure level Mean ± SD mm/Hg Range (L-H) mm/Hg	't' value	'p' value
A n=30	80.65 ± 6.271 (73-93)	11.906	<0.001***
C n=30	104.40 ± 9.765 (77-116)		

Table 6: Distribution of the study variables based on Relationship with body Mass Index (BMI) in different groups.

Parameters	**Groups**			
	Group-A		**Group-B**	
	r value	**p value**	**r value**	**p value**
Serum total cholesterol	0.153	0.033*	0.391	0.033*
Serum triglyceride	0.039	0.837NS	0.002	0.837^{NS}
Serum LDL cholesterol	0.114	0.068NS	0.338	0.068^{NS}
Serum HDL cholesterol	0.003	0.789NS	-0.051	0.789^{NS}
Systolic blood pressure	0.011	0.912NS	0.021	0.912^{NS}
Diastolic blood pressure	0.001	0.851NS	0.036	0.851^{NS}
Pulse pressure	0.009	0.625NS	0.093	0.625^{NS}
Mean pressure	0.015	0.963NS	0.009	0.963^{NS}

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Table 7: Distribution of the study variables based on Relationship with body Mass Index (BMI) in different groups.

Parameters	Groups			
	Group-A		Group-C	
	r value	p value	r value	p value
Serum total cholesterol	0.054	0.217NS	0.232	0.217^{NS}
Serum triglyceride	0.042	0.963NS	0.009	0.963^{NS}
Serum LDL cholesterol	0.006	0.69NS	0.075	0.695^{NS}
Serum HDL cholesterol	0.175	0.021*	-0.418	0.021*
Systolic blood pressure	0.017	0.491NS	0.131	0.491^{NS}
Diastolic blood pressure	0.003	0.780NS	0.053	0.782^{NS}
Pulse pressure	0.003	0.782NS	0.053	0.782^{NS}
Mean pressure	0.016	0.512NS	0.153	0.512^{NS}

DISCUSSION

The present study was carried out to assess the serum total cholesterol, serum triglyceride, serum LDL cholesterol levels, serum HDL cholesterol and blood pressure in overweight and obese subjects. The parameters were also studied in age-matched healthy control subjects for comparison.

In the present study, the findings of the parameters in the healthy control group were within the normal range and also similar to those reported by the various investigators from different countries and serum creatinine and serum alanine-aminotransferase levels were estimated in both the groups of the present study for exclusion of diabetes mellitus, kidney disease and liver disease. The valves of these parameters were within the normal range and the subjects had not been suffering from diabetes mellitus and they had no impairment of kidney and liver functions.

In this study, the mean serum total cholesterol level was significantly higher ($p<0.001$) in overweight & obese subjects than those of control subjects. This finding was in agreement with other articles.[14,15,16] Another article found that the serum total cholesterol level was higher in overweight & obese subjects which might be due to a reduction in physical activity, a high fatty diet, increased television viewing hours and those transiting from traditional lifestyle to urbanization and also the explosion of the home video entertainment industry.[14] The increased serum total cholesterol level in overweight& obese subjects might be due to metabolic alterations of both total body fat and regional fat caused by excess body fat deposition depicted in another journal.[15]

Another article observed that increased serum total cholesterol levels in overweight & obese might be due to unhealthy lifestyle factors such as eating unhealthy high-fat convenience foods such as French fries and inexpensive high-calorie foods such as muffins, and potato chips and less physical activity [16]. These unhealthy lifestyle factors influence the accumulation of fat. Fat cells secrete free fatty acids, which stimulate hepatic triglyceride and very low-density lipoprotein cholesterol | (VLDL-C)

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production that causes an increased serum total cholesterol level.

In this study, the mean serum triglyceride level was significantly higher ($p<0.05$) in overweight & obese subjects than those of control subjects. This finding was similar to other articles.[14,17,18,19]

Another article revealed that serum triglyceride level was higher in overweight & obese subjects which might be due to unhealthy life style factors such as eating high-fat convenience foods, inexpensive high-calorie foods and physical inactivity.[16] Unhealthy lifestyle factors influence the accumulation of fat in the storage site. Fat cells secrete free fatty acid which might be stimulated hepatic triglyceride production and ultimately increase serum triglyceride.

A related article showed that serum triglyceride level was higher in overweight &obese subjects which might be due to an alteration of lipid metabolism.[15]

In this study, the mean serum LDL-C level was significantly higher($p<0.001$) in overweight & obese subjects than those of control subjects.

A similar article found that serum LDL cholesterol was significantly higher in overweight & obese subjects which might be due to smoking status, less physical activity, truncal fat, uric acid and total cholesterol concentration.[20] Another article observed that serum LDL cholesterol was an increase in overweight & obese subjects which might be due to unhealthy life style factors such as eating unhealthy high-fat convenience foods and inexpensive high-calorie foods.[21] High-fat convenience and high-calorie foods cause accumulation of fat which in turn relates to the development of major chronic heart disease risk factors these fat cells secrete free fatty acid which may stimulate the synthesis of hepatic triglyceride and secretion of VLDL cholesterol and also the elevation of LDL cholesterol.

In this study, the mean serum HDL-C level was lower but not significant ($p>0.05$) in overweight & obese subjects than those of control subjects.

A similar study observed that serum high-density lipoprotein cholesterol was decreased in overweight & obese subjects which might be due to an alteration in lipid metabolism.[15] Another related article found that serum high-density lipoprotein cholesterol was lower in overweight & obese subjects which might be due to physical inactivity and eating unhealthy foods that leads to the accumulation of excess fat which has been associated with an elevated level of LDL-C values & triglycerides levels and increased lipid mobilization leading to decrease in HDL-C.[21]

Another similar observation found that serum high-density lipoprotein cholesterol was lower in overweight & obese subjects which might be due to marked metabolic alteration in association with the accumulation of cholesterol as a result increased LDL-C but decrease HDL-C.[22]

In this study, all types of blood pressure were significantly higher ($p<0.001$) in obese subjects than those in healthy subjects. An author observed that blood pressure was higher in overweight & subjects which might be due to increasing energy intake, a fat-rich diet, relatively less energy expenditure and less involvement in physical activity leading to

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accumulation of fat in the arterial wall that causes increase blood pressure.[15]

From an observational study, the author found that blood pressure was higher in overweight & obese subjects which might be due to, excessive alcohol intake, increase consumption of animal fat or salted food, salted milk tea, low consumption of vegetables, smoking and hypercholesterolemia.[16] A similar analysis also suggested that blood pressure was higher in overweight & obese subjects which might be due to increasing sympathetic nervous activity, sodium retention and enhanced vascular reactivity.[14]

A similar study observed that blood pressure was higher in overweight & obese subjects which might be due to dyslipidemia and metabolic syndrome.[18] Another observational analysis also depicted that blood pressure was higher in overweight &obese subjects which might be due to metabolic abnormalities and altered HDL-cholesterol.[19]

However, in our country, no published data are available regarding these types of findings for comparison.

In this cross-sectional study, serum total cholesterol, serum triglyceride, and serum LDL cholesterol levels are significantly higher and serum HDL cholesterol is lower but non-significant in overweight & obese subjects than those healthy control subjects. Blood pressure is significantly higher in obese subjects but non-significantly higher in overweight subjects than those in healthy control subjects.

In addition, in Pearson's Correlation Coefficient 'r' test showed serum total cholesterol was positively correlated in overweight & obese subjects and the relationship was statistically significant. But serum HDL-C was negatively correlated in overweight & obese subjects and statistically significant in obese subjects. Serum triglyceride was increased may be due to modern living style, familial or genetic factors, smoking status, excess carbohydrate diet & more adipose tissue in the storage site that adipose tissue containing more fat which also stimulates the production of more triglyceride.[23]

Serum LDL-cholesterol was increased may be due to smoking status, truncal fat, uric acid & total cholesterol concentration and also high-fat convenience foods which stimulate secretion of VLDL-C and ultimately elevation of LDL-cholesterol.[24] Serum HDL-cholesterol was decreased may be due to increasing hepatic lipase enzyme activity, thereby accelerating the metabolism and clearance of HDL-C & lowering plasma HDL-C levels.[25]

Blood pressure was increased may be due to increased LDL-C levels.[26] Because more and more oxidized LDL-C are engulfed by macrophages & large monocyte in the arterial wall. Then these macrophages become dead & form foam cells. This foam cell accumulates and releases growth factors and cytokine that stimulate the proliferation & growth of smooth muscle in the arterial wall.[27] A low level of HDL-C and a high level of triglyceride can also increase fat build-up in the arteries, then increase peripheral resistance and ultimately causes an increase in diastolic blood pressure.[28] And also increase sympathetic activity & sodium retention may be involved in the development of increased systolic blood pressure. Thus, all types of blood pressure are

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increased in overweight &obese subjects than those healthy control subjects.[29]

CONCLUSIONS

In this current content, it is hard to determine the particular mechanism involved for significantly higher serum total cholesterol, serum triglyceride, and serum LDL-C levels and non-significantly lesser serum HDL-C levels in overweight & obese subjects and also non-significantly higher blood pressure in overweight subjects but significantly higher blood pressure in obese subjects. Fat cells secret fatty acids which stimulate the production of hepatic triglyceride, LD-C & entire cholesterol but the reduction of HDL-C levels. Blood pressure also increases in overweight and obese subjects due to increasing energy intake, increased sympathetic nervous activity, sodium retention and an upsurge in peripheral resistance. In addition, serum total cholesterol, triglyceride, LDL-C and blood pressure levels were higher in overweight & obese subjects and these alterations are directly related to BMI. Blood pressure was higher in overweight & obese subjects and this alteration is directly related to BMI.

Recommendation

A similar type study with a larger sample size should be performed. The measurement of waist circumference and waist/hip ratio in overweight and obese subjects should be required to get the correct analysis. There is a necessity for setting a screening docket to cover all age groups for early detection and treatment of cases. To get robust data, multicenter studies are in great need of policymakers to interpret the demonstrable scenario and to take necessary steps towards mitigating this problem.

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