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

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Abstract
Introduction*: Overweight and obesity are stated as excessive fat accumulation that may harm health and they are prime nutrition-related complaint. 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 aim of the study was to understand the relationship between serum lipid profile with body mass index (BMI).*
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.*
Result: *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.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.*
Conclusion: *Obesity has become global prevalent in the last few years. In this present content, it is arduous to control the specific mechanism involved for significantly higher serum total cholesterol, serum triglyceride, and serum LDL-C levels. Fat cells secret fatty acids which stimulate the production of hepatic triglyceride, LD-C & entire cholesterol but the lessening of HDL-C levels. The lipid abnormalities in patients who are obese include elevated serum triglyceride, VLDL, and non-HDL-C levels.*
Keywords: *Overweight,Obesity, Cholesterol, BMI*

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I. Introduction

Overweight and obesity are stated as excessive fat accumulation that may harm health and they are prime nutrition-related complaints [1]. It can be inclined by heredity, age, gender, race, level of education and socioeconomic level, physical activity, eating habits and psychological factors [2]. Body mass index (BMI) is an uncomplicated index of weight for height that is usually used to classify overweight and obesity in adults. When body weight is more than 20% above average mortality increases by 20% in men & 10% in women [3]. Mostly, white people have lower body fat and higher BMIs in contrast with South Asians. Malaysia topped the ASEAN measure as having the largest part of the population being termed as obese in 2019, with over 15 per

cent of its population termed as obese [4]. according to WHO, over 1 billion people all around the world are obese & of them 650 million are adults, 340 million are adolescents and 39 million are children [5]. The epidemic rise in its occurrence in current ages and its link with condensed life anticipation has made obesity one of the serious vigorous public health concerns [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 complaint of lipoprotein absorption which is associated with fatness and may mark as one or more of the following raised 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 people [9] [10]. High levels of triglycerides and low levels of HDL can also upsurge fat build-up in the arteries, consequently increasing peripheral resistance. High levels of HDL cholesterol yet protect the heart by helping to remove the build-up of LDL from the arteries [11,12]. So the current topic has been intended to evaluate serum total cholesterol, triglycerides, low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) in overweight and obese subjects.

II. Objectives

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

III. 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. 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 of18-45 years.
- Apparently healthy subjects of normal weight, overweight & obese person.

Exclusion criteria:

- Partial recorded data.
- Subjects with diabetes mellitus and other chronic diseases (liver, kidney & heart).
- Earlier 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 using Statistical Package for the Social Sciences (SPSS) Version 25.0.

IV. Result

Among the study population, people were categorized into three groups. Group A included apparently healthy subjects of normal weight, group B includedapparently healthy subjects of overweight, and group C included apparently healthy subjects of obese. All peaple were from 18 to 45 years old. In group A, mean BMI of patients was 18.5-22.9, in group Bmean BMI of patients was 23.0-24.9, and in group C, mean BMI of people 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 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 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 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 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 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 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].**Serum total cholesterol levels were positively correlated in group A & B but the relationship of serum total cholesterol levels were statistically significant in group A and B.Serum triglycerides were positively correlated in group A & B but the relationship of serum triglyceride levels were statistically non-significant in group A & B.Serum LDL-C levels were positively correlated in both group A &Bbut the relationship were statistically non-significant.Serum HDL-C levels were negatively correlated in group A & B.**[Table 4].**Serum total cholesterol levels were positively correlated in group A & C but the relationship of serum total cholesterol levels were non-significant in group A &C. Serum triglycerides were positively correlated in group A & C but the relationship of serum triglyceride levels were 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 were statistically non-significant. Serum HDL-C levels were negatively correlated in group A & C but the relationship was statistically significant in group A &C**[Table 5].**

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*
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	$>0.05^{NS}$
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)	2.946	<.05*
C n=30	198.47 ± 118.555 (51-445)		
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)	1.255	>0.05NS
C n=30	0.673 ± 0.170 (0.4-0.9)		
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)	1.697	$>0.05^{NS}$
C n=30	51.27 ± 33.776 (22-167)		

Table-4: 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	0.837^{NS}	0.002	0.837^{NS}
Serum LDL cholesterol	0.114	0.068^{NS}	0.338	0.068^{NS}
Serum HDL cholesterol	0.003	0.789^{NS}	-0.051	0.789^{NS}

Table-5: 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	0.217^{NS}	0.232	0.217^{NS}
Serum triglyceride	0.042	0.963^{NS}	0.009	0.963^{NS}
Serum LDL cholesterol	0.006	0.69^{NS}	0.075	0.695^{NS}
Serum HDL cholesterol	0.175	0.021*	-0.418	0.021*

V. Discussion

This present analysis depicted 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 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. A related article presented that the serum total cholesterol level was higher in overweight & obese subjects which might be due to a reduction in physical activity, and a high fatty diet [13]. The growing 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 [14].

Another article perceived that greater serum total cholesterol levels in overweight & obese might be due to unhealthy lifestyle factors such as eating unhealthy high-fat convenience foods and inexpensive high-calorie foods, and less physical activity [15].

In this current content, 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 [13,16,17,18].

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 parallel article showed that serum LDL cholesterol was significantly maximum in overweight & obese subjects which might be due to smoking status, less physical activity, truncal fat, uric acid and total cholesterol concentration [19]. Another alike observation found that serum LDL cholesterol was an increase in overweight & obese subjects which might be due to unhealthy lifestyle factors [20].

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 [14]

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

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 [20].

A similar observation established that serum high-density lipoprotein cholesterol was lesser 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 [21].

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

The current study established that 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.

Additionally, Pearson's Correlation Coefficient 'r' test presented that 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 [22].

Serum LDL-cholesterol was increased because of 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 increased hepatic lipase enzyme activity, thereby accelerating the metabolism and clearance of HDL-C & lowering plasma HDL-C levels [23].

A diminutive level of HDL-C and a high level of triglyceride can also increase fat build-up in the arteries, then increase peripheral resistance [24].

VI. Conclusion

Obesity has become a global epidemic in the last few years. Body mass index (BMI) is sufficient pointers for detecting obesity in people and was inversely associated with lipid levels. In this current gratified, it is laborious to control the particular mechanism involved for significantly higher serum total cholesterol, serum triglyceride, and serum LDL-C levels. Fat cells secret fatty acids which stimulate the production of hepatic triglyceride, LD-C & entire cholesterol but the reduction of HDL-C levels. The lipid abnormalities in patients who are obese include elevated serum triglyceride, VLDL, and non-HDL-C levels.

VII. Recommendations

A comparable 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 vital to get the correct data. There is a necessity for setting a screening docket to cover all age groups for 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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