

## COMPARISON OF BODY MASS INDEX (BMI) WITH HIGH DENSITY LIPOPROTEIN (HDL) LEVELS IN OBESE PEOPLE

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**ABSTRACT: INTRODUCTION:** Cardiovascular disease is a major cause of morbidity and mortality in industrialized nations. Serum lipid concentrations are related to cardiovascular disease risk and one notable association is a statistically significant inverse correlation between HDL-cholesterol concentrations and the probability of developing coronary artery disease. A major related cardiovascular disease risk factor is obesity. Excess body weight is closely linked to low serum HDL-cholesterol concentrations. The general assumption now is that excessive body weight is associated with enlarged adipose tissue deposits, visceral adipose tissue in particular, which in turn are accompanied by elevated serum triacylglycerol concentrations. A well-studied inverse association exists between serum triacylglycerol and HDL-cholesterol concentrations and this may explain the observed low serum HDL-cholesterol concentrations in obesity. This study is done to confirm the above fact.

**MATERIALS AND METHODS:** The subjects for the study were 100 males in the age group of 21 to 40 years. The subjects taken as obese were 50 and those taken as controls were 50. Obesity was taken into account according to the Body Mass Index.

**RESULTS:** Paired T test is done. Results show that 34/50 subjects with BMI <25kg/m<sup>2</sup> have HDL cholesterol levels of >40mg/dl. 40/50 obese patients with BMI >25kg/m<sup>2</sup> show HDL levels of <40mg/dl. Significant P value is seen. The study shows that BMI is inversely related to HDL cholesterol levels.

**DISCUSSION:** High HDL cholesterol, above 60 mg/dl is associated with low risk of coronary heart disease. HDL cholesterol below 40 mg/dl is considered too low and appears to be an independent risk factor for coronary artery disease. Low HDL cholesterol is one of the most common phenotypes seen in persons with premature heart disease. Obesity is associated with low HDL cholesterol levels and high triglyceride levels. A negative correlation exists between HDL cholesterol and body-mass index (BMI), meaning that HDL cholesterol tends to be lower with increasing BMI.

**CONCLUSION:** The existence of a small but significant inverse correlation between serum HDL-cholesterol concentrations and BMI was confirmed in the present study. This study highlights the critical importance of early intervention directed at treatment of obesity to avert the long-term consequences of obesity on the development of various cardiovascular complications.

**KEYWORDS:** Body Mass Index (BMI) High Density Lipoproteins(HDL); Obesity, Cardiovascular Disease.

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**INTRODUCTION:** Obesity is a chronic disease that is casually related to serious medical illness. It is a state of excess adipose tissue mass. It is associated with a high rate of morbidity and early mortality if left untreated. The current practical definition of obesity is based on the relationship between body mass index and health outcome rather than BMI and body composition.

There has been a renaissance in the field of obesity research in the last ten years. Traditionally, obesity was believed to be associated with affluent lifestyles in the west. Now, however, the picture has changed & research in the field of obesity has blossomed. Obesity is increasing

at an alarming rate throughout the world. Several studies in India have shown that changes in dietary patterns, physical activity levels, lifestyles associated with affluence and migration to urban areas are related to increasing frequencies of obesity and the risk of diseases, such as coronary heart disease and diabetes etc.

It is estimated that, at the beginning of this century, more people will die from complications of over nutrition than of starvation. The pandemic of obesity is so great that it has even spawned a new word "globesity".

Considerable evidence has been accumulated for the past few years to show about the grading of obesity and its assessment by the parameters like BMI, Waist/Hip ratio abdominal circumference, skinfold thickness, and % of body fat. The complications of obesity like Hypertension & dyslipidemia can be assessed by knowing Blood Pressure, lipid profile like total cholesterol, high density lipoprotein, triglycerides. Body mass index is the index of obesity wherein W/H ratio (weight/height) is taken. In recent years, the body mass index(BMI) has become the medical

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standard used to measure overweight and obesity. BMI can be considered to provide the most useful measure of obesity. Men and women with a BMI of 25.0 to 29.9 kg/m<sup>2</sup> are considered overweight, and those with a BMI 30 kg/m<sup>2</sup> or greater are considered obese.

Cardiovascular disease is a major cause of morbidity and mortality in industrialized nations <sup>1</sup> Serum lipid concentrations are related to cardiovascular disease risk <sup>(1)</sup> and one notable association is a statistically significant inverse correlation between HDL-cholesterol concentrations and the probability of developing coronary artery disease.

A major related cardiovascular disease risk factor is obesity <sup>(2)</sup> and excess body weight is closely linked to low serum HDL-cholesterol concentrations.<sup>(3)</sup>

**Classification of Obesity:** Classification of BMI for people aged 18 and over - <18.5 Underweight; 18.5–24.9 Healthy weight range; ≥25 Overweight; 25.0–29.9 Preobese; ≥30 Obese 30.0–34.9 BMI Class I obesity; 35.0–39.9 BMI - Class II obesity; ≥40 BMI - Class III obesity.

The prevalence of obesity - related diseases, such as diabetes, begin to increase at BMI values below 25 kg/m<sup>2</sup>. Adipose tissue excess or obesity, particularly in the visceral compartment, is associated with insulin resistance, hyperglycemia, dyslipidemia, hypertension, and prothrombotic and proinflammatory states <sup>(4)</sup>. The prevalence of obesity and these associated morbidities, known as metabolic syndrome has reached epidemic proportions.<sup>(5)</sup>

Studies indicate that the presence of obesity increases the risk for developing cardiovascular diseases and diabetes.<sup>(6)(7)(8)</sup>

Dyslipidemia is an important major risk factor for coronary heart disease which is the leading cause of death.

The World Health Organization estimates that dyslipidemia is associated with more than half of global cases of ischemic heart disease and more than 4 million deaths per year.<sup>(9)</sup>

Dyslipidemia are disorders of lipoprotein metabolism, including lipoprotein overproduction and deficiency which is associated with obesity regardless of ethnic group. They may manifest as one or more of the following: elevated total cholesterol, low-density lipoprotein cholesterol (LDL), and triglyceride levels or as decreased high-density lipoprotein cholesterol (HDL) level with promotion of insulin resistance causing metabolic syndrome in obesity.<sup>(10)</sup>

Dyslipidemia is a widely accepted risk factor for coronary heart disease. Huges et al, showed that relative risk of MI correlates directly with increased TG and inversely with HDL-c levels in both Caucasians and Asian Indians. Kaul et al, have found inverse co relationship between thrombus formation and HDL-c levels, with enhanced platelet-dependent thrombus at low HDL-c levels and vice versa.

The primary dyslipidemia related to obesity is characterized by increased triglycerides, decreased HDL levels, and abnormal LDL composition. The dyslipidemia associated with obesity no doubt plays a major role in the

development of atherosclerosis and CVD, a life threatening diseases in obese individuals. All of the components of the dyslipidemia, including higher triglycerides, decreased HDL levels, and increased small, dense LDL particles, have been shown to be atherogenic.

An inverse relationship exists between HDL cholesterol and the development of coronary artery disease. In other words, high levels of HDL cholesterol are associated with low risk of heart disease, and low levels are linked to high risk. Based on data from the Framingham Heart Study the risk of heart attack increases about 25 percent for every 5mg/dl decrement in blood levels of HDL cholesterol.

The National Cholesterol Education Program (NCEP) and others have recently suggested the use of the term metabolic syndrome to identify the common cluster of metabolic abnormalities, defined as three or more of five criteria:

1. Abdominal obesity (waist circumference) >102 cm in men and >88 cm in women.
2. Hypertriglyceridemia >150 mg/dl,
3. Low HDL <40 mg/dl in men and < 50 mg/dl in women
4. Hypertension >130/85 mmHg, and
5. Elevated fasting glucose >110 mg/dl.

Present study is done to compare Body Mass Index (BMI) with High Density Lipoprotein (HDL) levels in overweight and obese people.

**MATERIALS AND METHODS:** The subjects for the study were 100 males in the age group of 21 to 40 years. The subjects taken as obese were 50 and those taken as controls were 50. Obesity was taken into account according to the Body Mass Index.

**Inclusion Criteria:** Patients with BMI >25kg/m<sup>2</sup> as cases and BMI <25kg/m<sup>2</sup> as controls.

**Exclusion Criteria:** Patients with cardiovascular diseases and diabetes mellitus were excluded.

**The commonly employed measurements and calculations are as follows:**

**Height:** Standing height is measured using a stadiometer, with an accuracy of 0.1 cm graduations and sliding headpiece. The measurement is taken with the subject wearing no shoes, standing erect on a horizontal surface with heels together, the shoulders relaxed and arms at the sides.

**Weight:** weight assessment provides important data in assessing status of an individual and serves as an indicator of intentional or unintentional weight loss.

**Body weight = body fat + lean body mass (fat free mass).**

**BMI (Body Mass Index) or Quetelet Index:-** It is a statistical measure of the weight of a person scaled according to height. It is used as a simple means of classifying inactive individuals of an average body composition according to their body fat content. It was originally developed between 1830 and 1850 by the

Belgian polymath, Adolphe Quetelet during the course of developing Social Physics.

It is a reliable and easily obtainable objective anthropometric criterion for the definition and diagnosis as well as an estimate of the severity of under nutrition or chronic energy deficiency (CED) in adults.<sup>(11)</sup>

BMI was calculated from the following equation.

$$\text{Body Mass Index (kg/m}^2\text{)} = \frac{\text{Weight in Kg}}{\text{Height in m}^2}$$

The Body Mass Index value ranging between 18.5 - 25.0 is considered as normal, < 18.5 indicates the status as undernourished, while value above 25 as overweight and above 30.0 as obese.

**Biochemical Analysis:** The patient was asked to fast overnight for 8-10 hours, 10ml of fasting venous blood without any anticoagulant was collected into sterile clean, dry bottles. The blood was allowed to clot for 30 min. The serum after separation was centrifuged and transferred to the sterile, clean dry bottle, labeled and stored in refrigerators at 4° C. and analyzed for serum lipid profile.

**Estimation of Total Cholesterol:** Method 2 Latkis, 2AK and Boyle method (1953)

**Estimation of HDL- cholesterol:** Method - calorimetric method (Phosphothystate/Magnesium method)

## RESULTS:

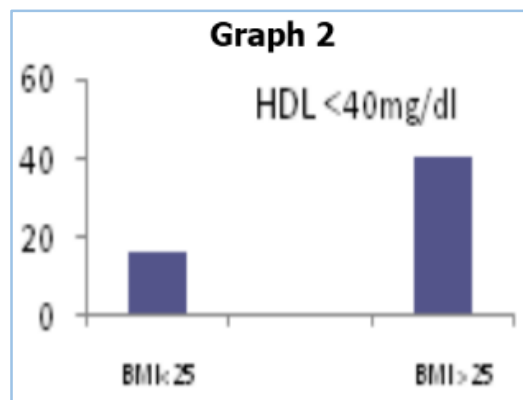
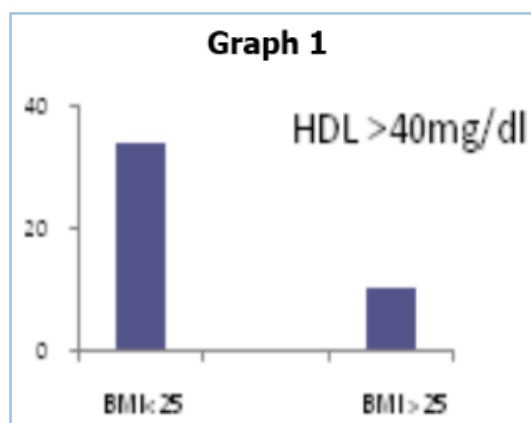
BMI Kg/m <sup>2</sup>	HDL >40mg/dl	HDL <40mg/dl	TOTAL
<25	34	16	50
>25	10	40	50
<b>TOTAL</b>	<b>44</b>	<b>56</b>	<b>100</b>

**TABLE 1**

**COMPARISON OF HDL LEVELS IN SUBJECTS WITH BMI <25 AND BMI >25:** Paired T test is done. Results show that 34/50 subjects with BMI <25kg/m<sup>2</sup> have HDL cholesterol levels of >40mg/dl (Graph-1).

40/50 obese patients with BMI >25kg/m<sup>2</sup> show HDL levels of <40mg/dl (Graph-2). Significant P value is seen.

The study shows that BMI is inversely related to HDL cholesterol levels.



**DISCUSSION:** In India although obesity is in the starting phase compared to western country it needs to be tackled aggressively before it assumes serious epidemic properties. In near future obesity would emerge as a challenging problem for India due to urbanization and modernization as our lives are becoming more sedentary and less physically active than it was before. Obesity is associated with low HDL cholesterol levels and high triglyceride levels. A negative correlation exists between HDL cholesterol and body-mass index (BMI), meaning that HDL cholesterol tends to be lower with increasing BMI. Weight loss usually raises HDL cholesterol. Excess body weight is associated with lower levels of HDL cholesterol.<sup>(12)</sup>

The Lipid Research Clinics Program Prevalence Study also showed a significant negative correlation between HDL cholesterol and body weight in those aged 12–79 years (reviewed by Denke et al. 1993). The NHANES II study found that HDL cholesterol levels were negatively correlated with BMI and this was significant across age groups. (Denke et al. 1993)

The most widely accepted hypothesis regarding the protective properties of HDL when it comes to atherosclerosis is that it promotes the uptake of cholesterol from tissues, including the vascular wall, and returns the cholesterol to the liver from where it is excreted.

It has also been postulated that HDL's may promote normal function of the endothelium, the innermost layer of the arteries. Furthermore, HDL's may reduce inflammation, protect against oxidation of LDL, and positively affect blood clotting.

HDL Cholesterol – Normal Range: < 40mg/dl – too low; 40-59mg/dl—acceptable; >60mg/dl – very good.

High HDL cholesterol, above 60 mg/dl is associated with low risk of coronary heart disease. This pattern is more likely to occur in women than men.

HDL cholesterol below 40 mg/dl is considered too low and appears to be an independent risk factor for coronary artery disease. Furthermore, the definition of metabolic syndrome includes low HDL cholesterol as one of the five criteria for classification. Low HDL cholesterol is one of the most common phenotypes seen in persons with premature heart disease.

HDL cholesterol in the range of 20-40 mg/dl may appear in isolation, but is often associated with high triglyceride concentration, insulin resistance and increased

risk of type 2 diabetes. Furthermore, some drugs, such as beta-blockers may lower HDL cholesterol. Anabolic steroids can markedly reduce HDL cholesterol and should be suspected particularly in healthy young men with unexpectedly low HDL cholesterol levels.

HDL cholesterol can be influenced by lifestyle modification. Certain changes in diet and exercise may have a positive impact on raising HDL levels:

- Decreased intake of simple carbohydrates.<sup>(13)</sup>
- Aerobic exercise.<sup>(14)</sup>
- Weight loss.<sup>(15)</sup>
- Magnesium supplements raise HDL-C.<sup>(16)</sup>
- Addition of soluble fiber to diet.<sup>(17)</sup>
- Consumption of omega-3 fatty acids such as fish oil or flax oil.<sup>(18)</sup>
- Increased intake of cis-unsaturated fats.<sup>(19)</sup> Consumption of medium-chain triglycerides (MCTs) such as caproic acid, caprylic acid, capric acid, and lauric acid.
- Removal of trans fatty acids from the diet.<sup>(20)</sup>
- Smoking reduces HDL-cholesterol and smoking cessation is associated with a modest increase in HDL cholesterol.

**CONCLUSION:** The existence of a small but significant inverse correlation between serum HDL-cholesterol concentrations and BMI was confirmed in the present study. Our results therefore suggest that a low BMI is important for maintaining serum concentrations of HDL cholesterol and triacylglycerol which in turn are associated with minimum cardiovascular risk.

This study highlights the critical importance of early intervention directed at treatment of obesity to avert the long-term consequences of obesity on the development of various complications.

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