Original article:

Correlation of anthropometric measurements with LDL levels in young adult females

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Abstract

Background: Anthropometric measurements can easily reflect changes in lipid levels and can be a valuable screening method to detect raised Low Density Lipoprotein levels which is a major risk factor for Coronary Heart Disease, thus useful in primary prevention of CHD. In the previous studies done on Indian population there is no clear consensus as to which anthropometric measurement is the best in predicting lipid profile changes, and no study has exclusively targeted the young adult female population. An attempt as been made to find out the best anthropometric measurement to detect raised LDL levels.

Objective: To find out which anthropometric measurements best correlates with LDL levels in young adult females.

Material and Methods: LDL levels were measured in 60 apparently healthy young adult females. Health status and other personal data were obtained via comprehensive questionnaire. BMI, Waist circumference, Waist to Hip ratio, and Skin fold thickness was measured. The anthropometric measurements were correlated with LDL levels using Pearson's correlation coefficient.

Result: Waist Hip ratio showed the strongest correlation with LDL levels(r = 0.7), followed by Waist circumference(r = 0.587), and BMI (r = 0.565). Skin fold thickness showed the least correlation (r = 0.284)

Conclusion: Central obesity has a higher impact on LDL levels, hence Waist Hip ratio and Waist circumference are better measures for predicting raised LDL levels compared to the traditionally used BMI.

Keywords: anthropometric measurements;LDL levels;waist hip ratio;obesity

Introduction

Obesity is an emerging problem in India, the percentage of women aged 15-49 who are overweight or obese has increased to 15% according to NFHS-3 survey (1). Overweight and obesity not only predispose to CHD and stroke, they are also associated with dyslipidemia, especially high LDL levels (2). Traditionally BMI is used for assessing adiposity related risks, though BMI correlates well with body fatness and dyslipidemia at a population level, there is significant heterogeneity in individual body fatness and pattern of dyslipidemia (3). Also Indians exhibit unique features of obesity. Based on percentage body fat and morbidity data, limits of BMI are narrower in Asian Indians than in Caucasians (4).

Intra abdominal fat has been identified as the most clinically relevant fat in human beings (5). Although the adipocyte has generally been regarded as a storage depot for fat, it is also an endocrine cell that releases numerous molecules like leptin, adiponectin, tumor necrosis factor, IL-6, adipsin, in a regulated fashion . These factors, and others not yet identified, play a role in the physiology of lipid homeostasis, insulin sensitivity, blood pressure control, coagulation, and vascular health, and are likely to contribute to obesity-related pathologies (6).

Obesity is commonly associated with high LDL levels. The possible mechanism for increased LDL levels in obesity is the impairment in the lipolysis of Triglyceride-rich lipoproteins due to reduced mRNA expression of lipoprotein lipase activity in skeletal muscle and competition for lipolysis between Very Low Density Lipoproteins and chylomicrons (7).

Currently used general and central obesity anthropometric measures for assessing adiposity related risks include BMI, waist circumference, waist hip ratio, waist to stature ratio and body adiposity index (8). Screening for dyslipidemia in middle aged women is not routinely employed, and BMI is still the most widely used measure of obesity and its related complications. Very few studies are available on anthropometric measurements as a screening technique to predict dyslipidemia, and hardly any studies have exclusively targeted the young adult female population of India. A reliable screening method would go a long way in combating the obesity epidemic and reducing the future risk of CHD. Prompt and sincere efforts towards these goals in women of reproductive age group will ensure a better health for the future mother and her child.

Materials and methods

Source of data

The subjects for the study were selected from the city of Hubli, based on inclusion and exclusion criteria. A questionnaire form was designed for the purpose of the study, which included age, marital status, family size, diet, any medications, and history of previous hospitalization if any. A thorough physical examination was carried out on each subject.

Inclusion criteria

Asymptomatic, apparently healthy females in the age group of 18 to 30 yrs.

Exclusion criteria

1). History of Diabetes Mellitus, Coronary heart disease, Thyroid disorder.

2) Females on Oral contraceptive pills, or any other drugs which may influence lipid profile.

3) Females who are < 18 yrs or > 30 yrs of age.

Study design

The collection of the samples, which is an invasive procedure to be performed in the study, and the need for overnight fasting, was explained to the subjects and an informed consent for the same was taken. They were advised to continue their normal daily diet and working routine.

Anthropometric data: Measurements were taken while subjects were relaxed, standing erect and had their arms at their sides and feet together.

Body height was measured by wall mounted Stadiometer.

Body weight was recorded by clinical weighing machine, with subjects dressed in light clothes and no shoes.

Waist and Hip circumference were measured using a stretch resistant measuring tape. The waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the ground.

Skin fold thickness was measured using a standard caliper at the mid-triceps region.

BMI was calculated as per formula: Weight (Kg)/Height (meter) ^{2} (Quetelet's Index).

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Vital parameters like pulse rate, BP were recorded. After selecting the subjects, appointment was scheduled in prior and they were requested to do an overnight fast prior to the day of the test to get fasting blood sample for lipid profile analysis. Between 7am to 10am, 2ml of venous blood was collected, in a plain bulb by venepuncture under aseptic precaution. Serum lipid profile was analyzed in Biochemistry clinical Lab, in KIMS, Hubli, with clinical chemistry Analyzer (Type Model: **XL-300 ERBA**).

Statistical Analysis

The correlation between anthropometric measurements and lipid profile parameters was done using Pearson's correlation coefficient. All the analysis was done by using SPSS-20 software.

Results

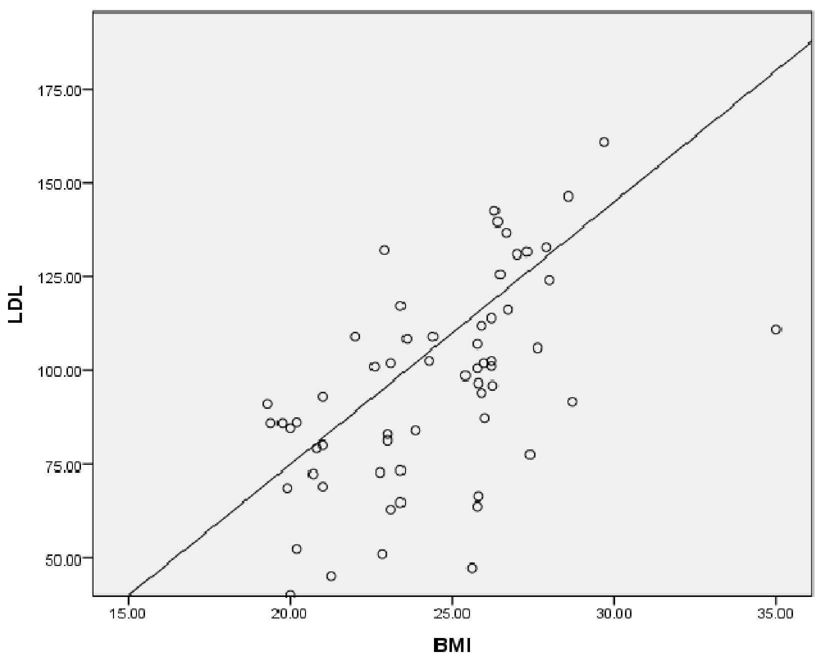
Mean anthropometric measurements and LDL levels of subjects

Parameter	Mean	Standard deviation
Age(yrs)	24.27	3.43
Height(cm)	151.63	3.55
Weight(kg)	56.06	6.13
BMI(kg/m^2)	24.4	3.07
WC(cm)	79.14	4.4
WHR	0.85	0.03
SFT(mm)	25	1.78
LDL(mg/dl)	95.87	26.9

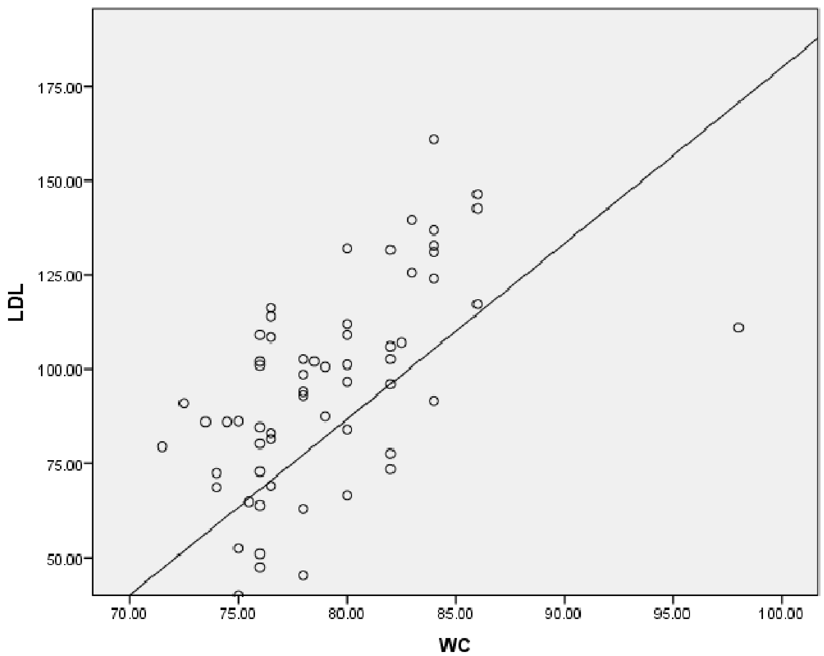
Correlation of various anthropometric measurements with LDL levels

	BMI	Waist Circumference	Waist Hip ratio	Skin fold thickness
'r' value	0.565	0.587	0.7	0.284
P value	< 0.0001	<0.0001	<0.0001	0.028

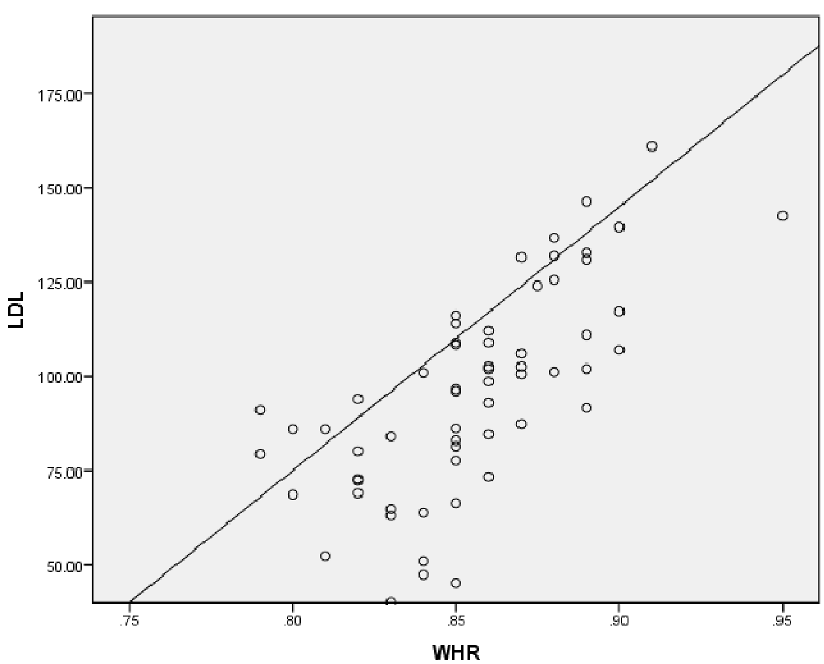
1. Scatter diagram showing BMI and LDL levels



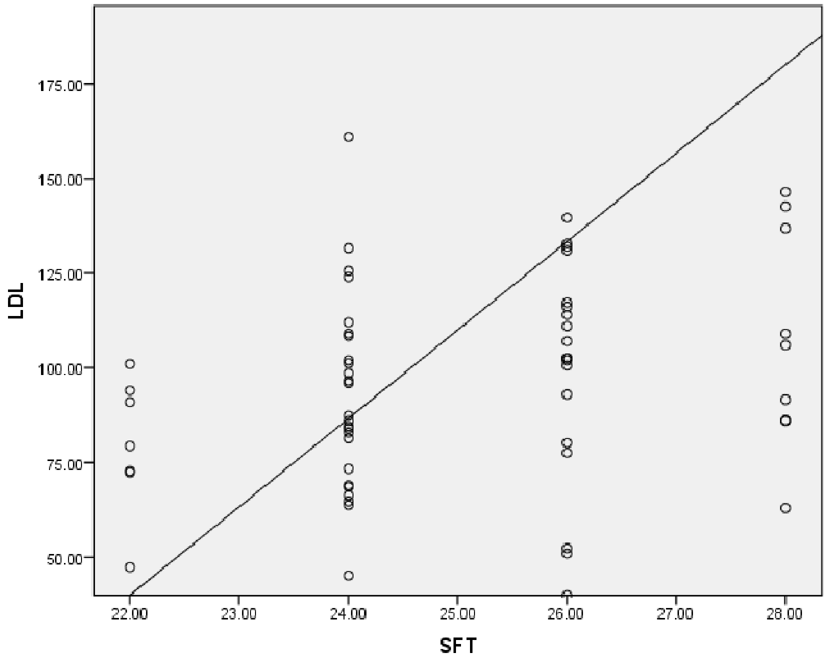
2. **Scatter diagram showing waist circumference and LDL levels**



3. **Scatter diagram showing waist hip ratio and LDL levels**



4. **Scatter diagram showing Skin fold thickness and LDL levels**



Discussion

Obesity is one of today's blatantly visible- yet most neglected- public health problems. It is a major risk factor for cardiovascular diseases, diabetes, musculoskeletal disorders and some cancers. Although the molecular pathways regulating energy balance are beginning to be illuminated, the causes of obesity remain elusive. In part, this reflects the fact that obesity is a heterogeneous group of disorders. At one level, the pathophysiology of obesity seems simple: a chronic excess of nutrient intake relative to the level of energy expenditure. However, due to the complexity of the neuroendocrine and metabolic systems that regulate energy intake, storage, and expenditure, it has been difficult to quantitate all the relevant parameters (e.g., food intake and energy expenditure) over time in human subjects (6).

Undoubtedly, genes influence the susceptibility to obesity in response to specific diets and availability of nutrition. Identification of the ob gene mutation in genetically obese (ob/ob) mice represented a major breakthrough in the field. The ob/ob mouse develops severe obesity, insulin resistance, and hyperphagia. The product of the ob gene is the peptide leptin, a name derived from the Greek root leptos, meaning thin. Another mouse mutant, db/db, which is resistant to leptin, has a mutation in the leptin receptor and develops a similar syndrome. Mutations in several other genes cause severe obesity in humans, each of these syndromes is rare. Mutations in the genes encoding pro-opiomelanocortin(POMC) cause severe obesity through failure to synthesize Melanocyte stimulating hormone(MSH), a key neuropeptide that inhibits appetite in the hypothalamus. Proenzyme convertase 1 (PC-1) mutations are thought to cause obesity by preventing synthesis of MSH from its precursor peptide, POMC. MSH binds to the type 4 melanocortin receptor (MC4R), a key hypothalamic receptor that inhibits eating (6).

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It is clear that the environment plays a key role in obesity, as evidenced by the fact that famine prevents obesity in even the most obesity-prone individual. Cultural factors are also important-these relate to both availability and composition of the diet and to changes in the level of physical activity (6). A change in dietary habits coupled with a sedentary lifestyle has lead to an increase in prevalence of obesity in India, especially prone to this are the younger population.

Obesity is frequently associated with dyslipidemia, especially high LDL levels. LDL is the major atherogenic lipoprotein and a risk factor for cardiovascular diseases. Lowering of LDL levels is associated with a reduced risk of developing CHD (2). In vivo oxidative modification of LDL leads to the formation of ox-LDL. Exposure to ox-LDL induces an array of endothelial responses, including inhibition of endothelial-induced release of nitric oxide, a vasorelaxation factor that also has anti-inflammatory and antithrombotic properties, regulation of endothelial permeability and inflammation, and altered angiogenesis. These changes ultimately lead to an increased susceptibility to cardiovascular diseases (9).Regular screening for LDL levels in young females could hence be valuable in preventing future risk for CHD and other complications.

In the present study we found that waist hip ratio had the best correlation with LDL levels. The results are similar to a previous study done by Divya Bishnoi, et al., which showed that WHR is a more appropriate predictor for dyslipidemia and raised LDL levels (10).In a similar study done on Indian population by Sumit Garg, et al., it was concluded that all anthropometric measurements show significant correlation with LDL levels, with Waist circumference showing the best correlation, followed by skin fold thickness, waist hip ratio and BMI (11). Another similar study done by Priyanka N Pawaskar, et al., it was shown that waist circumference and waist hip ratio are more sensitive and waist hip ratio has a higher positive predictive value in identifying dyslipidemia in healthy adults (12).

In a similar study done on Korean population by Bum Ju Lee and Jong Yeol Kim, BMI was the strongest predictor for raised LDL levels, followed by WHR (13). Whereas in a study done on Iranian women by T Shahraki, et al., waist circumference was better indicator for raised LDL levels (14).

Conclusion

The present study concludes that Waist Hip ratio is the best anthropometric measurement for predicting LDL levels in young adult females, followed by Waist circumference, BMI, and Skin fold thickness. The anatomical distribution of fat plays a major role in dyslipidemia, with central fat deposition being associated with an unfavorable lipid profile. Efforts to recommend "optimal" weight, or relying on traditionally used BMI to predict raised LDL levels may prove erroneous as individuals with same weight may have varying amount of fat as well as fat distribution. There is considerable variation in body composition for a given BMI, and some individuals may have as much fat as an overweight person. Fat distribution also depends on gender, country and ethnicity. Hence using BMI for screening may result in poor sensitivity and thus altogether miss the primary goal of the screening process. Since central adiposity is the prime determinant for raised LDL levels and dyslipidemia, employing waist hip ratio and waist circumference will yield much better results and make the screening process more efficient.

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