Original Research Article

A correlation study of lipid profile with body mass index and waist hip ratio in Rohilkhand region

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Abstract

Background: Central or abdominal obesity is associated with metabolic disorders such as hypertension, diabetes mellitus and cardio vascular disease (CVD). Anthropometric tools especially BMI is commonly used to categorize obesity. BMI, calculated from the weight and height of an individual, represents generalized fat distribution. Waist hip ratio (WHR) is more reliable anthropometric tool for measuring abdominal obesity as it takes waist circumference into consideration. Therefore, this study was undertaken to study the correlation of dyslipidemia with BMI and WHR and conclude if WHR could be used as a reliable tool for identifying high risk patients. **Materials and Methods**: Two hundred participants aged between 35 to 45 years were randomly chosen. Lipid profile of all the participants was determined. These participants were divided into three groups based on their BMI. Same participants were also divided based on their WHR into two groups – Low risk and high risk. Mean of lipid profile was analyzed for significance by ANOVA and independent t test using SPSS 23.0. Correlation of dyslipidemia and BMI and WHR was analyzed using Pearson Coefficient. $P<0.05$ was considered significant. **Result**: Participants with WHR in the high-risk category had TC/HDL ratio of 3.8±0.5 which was similar to those with BMI>30 Kg/m^2. Pearson correlation coefficient of Total cholesterol, LDL-C and TC/HDL with WHR was 0.505, 0.484 and 0.528 respectively which was stronger than that with BMI. **Conclusion**: WHR is a reliable tool to identify patients who are at high risk to develop CVD and other metabolic diseases.

Key words: BMI, Cardiovascular risk, Waist Hip ratio

Introduction

The World Health Organization defines obesity as an abnormal or excessive accumulation of fat which impairs health. The number of obese patients has increased considerably in the last decade making obesity a world-wide epidemic. In line with the global trend, almost 25 to 50% of the urban Indian population are overweight or have abdominal obesity [1]. Obesity is associated with hypertension, fasting and postprandial hyperglycemia, and dyslipidemia characterized by elevations in triglycerides, production of small, dense LDL particles and reduced HDL cholesterol [2,3]. Dyslipidemia of obesity is thus associated with an adverse cardiovascular risk resulting in high incidence of cardiovascular morbidity and mortality.

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A very simple and most widely used measure of body size is the Body Mass Index (BMI), which relates weight to height. BMI is frequently used to estimate the prevalence of obesity within a population. A BMI ≥ 25 Kg/m^2 is associated with morbidity where as a BMI ≥ 30 Kg/m^2 is associated with morbidity and mortality [4]. Although the BMI is commonly used to assess the obesity, it does not reflect the distribution of body fat especially the abdominal region.

Excessive deposition of adipose tissue around the viscera, also called as the apple-shaped obesity, are thought to be associated with metabolic syndrome [5]. Adipose tissue from the visceral fat releases free fatty acids adipokines such as resistins, leptin, adinopectin and retinol-binding protein 4 which affects the insulin sensitivity. In addition, macrophages from the adipose

tissue releases cytokines like TNF-α and IL-6 which are involved in pathogenesis of cardiovascular diseases [6,7]. Thus, other anthropometric indices such as waist circumference (WC), waist-to-height ratio (W/Ht), and waist-to-hip ratio (WHR) have been used as alternatives to BMI.

Waist circumference is increasingly being accepted as the best anthropometric indicator of abdominal adiposity and metabolic risk [4,8]. In view of this, this study was done with the aim to compare BMI and Waist Hip Ratio with dyslipidemia in Indian population.

Material and Methods

This study was carried out in the Department of Biochemistry, Rohilkhand Medical College Bareilly, from January 2015 to December 2015. Ethical committee clearance was taken prior to the study.

Sample size:

A total of 200 subjects were randomly selected for the study after taking their informed consent. Patients with Diabetes Mellitus, hypertension, cardiovascular disease, liver and kidney disorder and those on lipid lowering agents were excluded from the study. Height in meters and weight in kilograms were recorded and BMI was calculated. Based on the BMI, the subjects were divided as follows

Healthy weight (Group 1): Subjects with BMI 18.5 to 24.9

Overweight (Group 2): Subject with BMI 25.0 to 29.9

Obese (Group 3): Subject with BMI 30.0 and above.

In order to study the lipid profile in patients with abdominal obesity these subjects were also divided into two groups based on their waist hip ratio irrespective of their BMI. Waist and hip circumference was measured twice to the nearest 0.5 cm, with a flexible but non-elastic measuring tape. Waist circumference was measured at the approximate midpoint between the lowest rib and the top of the iliac crest.

Hip circumference was measured at the maximum circumference of the buttocks posteriorly and the symphysis pubis anteriorly, in a horizontal plane [9]. Internationally accepted cut-off points for WHR are 0.90 for men and 0.85 for women based on the National Cholesterol Education Program were considered. Men with WHR of below 0.9 and females below 0.85 below were grouped as low risk, where as those men and women with waist circumference ≥0.9 and ≥0.85 & were grouped as high risk.

Biochemical analysis- Two ml venous blood sample was collected after a fasting period of 10 – 12 hours. Sample was then centrifuged and serum was used for the analysis. Lipid profile was determined by Erba 360 auto analyzer by using enzymatic methods such as CHOD-PAP method total cholesterol (TC), GPO-PAP method for triglycerides (TG) and direct method for High Density Lipoprotein – Cholesterol (HDL-C) and Low Density Lipoprotein – Cholesterol (LDL-C). TC/ HDL ratio was calculated.

Statistical analysis- Statistical analysis was done using the statistical package for social sciences (SPSS) version 23.0. All data is expressed as mean ± S.D. Significance of mean was analyzed using one way analysis of variance (ANOVA) for BMI groups and independent t test for WHR groups. The mean of the three groups was compared using multiple comparison post hoc test. Pearson correlation coefficient was used to analyze the correlation of lipid parameters with BMI and WHR. P value of <0.05 was considered statistically significant.

Results

The mean age of the participants in this study was 39.23 ± 3.43 years. In was observed that 70 participant had BMI with in healthy range, 86 participants were overweight and 44 were having BMI of 30.0 and above and hence belonged to obese category (Table 1). As seen in Table 2, study of lipid profile showed that the total cholesterol, serum triglyceride level and TC/HDL ratio were significantly elevated in participant belong to overweight and obese group as compared to those in healthy group.

Although there was increase in serum LDL levels in overweight and obese participant, this increase was neither clinically nor statistically significant. Though the serum HDL levels were comparable between the participant in the normal and overweight categories, participants of the obese group has statistically significant lower levels of HDL in comparison to both the groups. Table 3 shows the correlation between parameters of lipid profile and BMI. A significant correlation was seen between increasing total cholesterol, triglyceride and TC/HDL ratio and decreasing HDL levels with increasing BMI.

Table-1: Table showing the distribution of the participants based on their body mass index and waist hip ratio

	BMI			Waist Hip Ratio	
	Healthy (18.5 to 24.9)	Overweight (25.0 to 29.9)	Obese (30.0 and above)	Low risk (< 0.85 in females and < 0.9 in males)	High risk (≥ 0.85 in females and ≥ 0.9 in males)
Males	31	52	17	39	61
Females	39	34	27	37	63
Total	**70**	**86**	**44**	**76**	**124**

Table-2: Comparison of lipid profile in different groups based on the BMI and WHR

Parameter	BMI			Waist hip ratio	
	Healthy (n=70)	**Overweight (n=86)**	**Obese (n=44)**	**Low risk (n=76)**	**High risk (n=124)**
Total Cholesterol [mg/dL(SD)]	156.6± 21.3	166.1 ± 20.1*	176.5 ± 25.9***	152.0 ± 17.0	174.2 ± 22.3***
Triglyceride [mg/dL(SD)]	108.4 ± 68.2	136.0 ± 52.8**	186.7± 61.6***	114.6 ± 63.6	153.4 ± 65.5**
HDL [mg/dL(SD)]	48.2 ± 3.6	48.1± 2.7	46.2 ± 4.2***	48.6 ± 2.9	47.8 ± 3.7
LDL [mg/dL(SD)]	86.9 ± 19.4	90.72± 17.8	92.6 ± 23.3	80.5 ± 15.85	96.25 ± 19.63*
TC/HDL	3.3 ± 0.5	3.5± 0.5**	3.8± 0.6***	3.1 ± 0.4	3.8 ± 0.5***

** <0.05 ** < 0.01 *** < 0.001*

Table-3: Table showing the Pearson Correlation Coefficient (r) and with its significance of lipid parameters with BMI and WHR.

		Total Cholesterol	**Serum Triglyceride**	**HDL-C**	**LDL-C**	**TC/HDL**
BMI	r	0.308	0.431	- 0.202	0.098	.362
	P value	< 0.001	< 0.001	< 0.01	NS	< 0.001
WHR	r	0.506	0.231	- 0.190	0.484	0.528
	P value	< 0.001	< 0.01	< 0.001	< 0.001	< 0.001

As seen in Table 1, based on the waist-hip ratio, 76 participants were categorized in the low risk group wheres 124 participants belonged to the high-risk category. Study of lipid profile showed that patient in the risk group had significant higher total cholesterol, serum triglyceride, LDL and TC/HDL ratio as compared to those in the low risk group. The level of HDL was comparable in both the groups. As indicated in table 3, increases in total cholesterol, serum triglycerides, LDL-C and the TC/HDL ratio significantly correlated with increase in the WHR.

Discussion

Obesity has been identified as a global health problem. It is a common perception to relate obesity with accumulation of fat. Although true, individual with obesity also differ in their regional fat distribution. Distribution of fat around the abdominal area and upper trunk is referred to as android obesity or central obesity and is associated with greater health risk such as diabetes mellitus, athero sclerosis, coronary artery disease (CAD) etc. compared to those individuals with gynoid obesity i.e.fat distribution around the hips and thighs [10]. In India different studies has reported different prevalence for obesity and overweight. A study done in rural Kerala reported 54% of the study population to be overweight or obese [11]. In another

study in Delhi, the prevalence for obesity and over weight was 34% in males and 40% in females [12]. This variation in the prevalence can be attributed to different dietary preferences, life styles and lack of awareness all of which affects the body weight. In this study it was demonstrated that about 65% of the participants had a BMI of 25.0 and above. Of these 22% were obese and another 43% were overweight. Similar observation was made when the participant were classified basis of the Hip Waist ratio where 62% were classified as high risk (Table 1).

It has been well established that non communicable diseases such as diabetes mellitus, hypertension, CAD etc have been proved to be associated with dyslipidemia. Elevated serum triglycerides and LDL-C along with reduced levels of HDL-C are common altered lipids in these patients [13]. Anthropometric parameters are a very common and simple tool to screen high risk population for these non-communicable diseases [14]. BMI is a common and most widely used tool to classify obesity. However the BMI does not reflect on the regional distribution of fat in an individual. Individuals with similar BMI may vary in distribution around their abdominal area [15]. Moreover BMI is also reported to be affected by race and age [16].

Increased accumulation of intra-abdominal fat is associated with increased risk for development of cardio vascular disorders as excess visceral fat exposes the liver to excess fatty acid which stimulates over production of atherogenic VLDL-C and LDL-C [17]. In view of this a measure of obesity should take into consideration the intra-abdominal fat. Various tools such as waist circumference, waist to height and waist hip ratio should also be taken into consideration while classifying obesity. This study was done with an intention to observe the association and correlation between the changes in the lipid profile with anthro-pometric parameter especially BMI and waist hip ratio and to conclude if WHR would be an effective tool for identifying high risk population.This study revealed that serum cholesterol and serum triglycerides levels were higher in participants who were categorized in overweight and obese group in comparison to those with normal BMI. Although the increase in the cholesterol levels were statistically significant ($p < 0.05$ for overweight and $p < 0.001$ for obese group), this increase was still within the normal range. Similar pattern was observed when the participant were divided based on their WHR (Table 2). The serum triglyceride levels were however elevated both statistically ($p < 0.001$) and clinically in obese group as it was above the normal recommended 150.0mg/dL. This increase in triglyceride levels can be explained by the fact that the triglycerides are stored in the adipose tissue which contributes directly to elevated BMI. In case of high risk group participants, although a slight elevation was seen in the serum triglyceride levels were seen it was statistically significant ($p < 0.01$).

Similar findings were reported in a study by Shamai et al where they reported a significant rise in serum triglyceride level and no association with total cholesterol levels [18]. In the present study, although there was an inverse association with HDL-C with increasing BMI, no association was found with LDL-C. However, with respect to WHR the opposite was observed where there was a statistically significant elevated LDL in the high risk group. This variation in LDL-C could be due to the reason that it is the size and number of the LDL particle that influence its atherogenic activity rather than the concentration. Small dense LDL particle are more atherogenic that larger LDLs as small dense LDLs are removed by scavenger cells which is a critical step in the development of atherosclerosis [19]. Therefore irrespective of the concentration it is the number of LDL particle that makes the diabetic patient more prone for CAD [19,20].

TC/HDL-C ratio which is a predictor of CAD was significantly increasedin high risk group and obese group participants which validates thathigher fat content is associated with increased risk for CAD. In this study we also investigated the correlation between different parameters of lipid profile with BMI and WHR (Table 3). Correlation between total cholesterol, LDL-C and TC/HDL was stronger with increasing WHR in comparison to BMI but serum triglycerides and HDL showed stronger correlation with BMI. Various studies have reported contrasting reports regarding the dyslipidemic changes [21-25]. In a study done on 100 diabetic individuals, it was observed that WHR showed non-significant correlation with total cholesterol and LDL-C [23]. In another study done on 251 individuals only triglyceride was found to correlate with anthropometric measurements [24]. Akhelya et al in their study observed that VLDL showed positive relation and HDL-C showed inverse correlation with WHR [25]. Similarly Shamai et al found BMI to correlate positively with triglycerides and LDL-C [18]. These variation in the studies could be because obesity in particular central obesity is associated with insulin resistance due to which the metabolism of lipids are affected resulting in increased lipolysis and derangement of lipoprotein levels. As per this study

increased WHR correlated more strongly with LDL-C and TC/HDL ratio pointing towards that fact with increase in waist circumference the risk for development for cardio vascular disease increases.

Conclusion

This study was done in order to evaluate the abnormalities in lipid profile with BMI and WHR and to establish whether WHR would be a better tool than BMI is screening the population at high risk for dyslipidemia. WHR is a direct indicator of abdominal obesity as it takes the waist circumference and hence the abdominal deposition of fat into consideration BMI on the other hand indicates the fat distribution throughout the body. This study showed that the atherogenic markers such as increased LDL-C and TC/HDL ratio correlated more strongly and significantly with WHR than with BMI. Therefore we can conclude that WHR is a good anthropometric tool to screen for high risk patients. However, in order to substantiate our finding further large scale population based study would be required.

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