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A Study on Lipid Profile and Body Fat in Patients with Diabetes Mellitus

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ABSTRACT The present study deals with the distribution of six anthropometric measurements, viz, height, weight, body mass index, waist hip ratio, percent body fat and percent lean body mass and six lipid profiles, viz. serum cholesterol, S.triglycerides, S.HDL-C, S.LDL-C, S.VLDL and TC: HDL-C in 40 randomnly selected confirmed cases of diabetes mellitus aged 25-70 years of Amritsar. An adequate number of controls were also taken for comparisons. The results indicate that percent body fat was positively related to VLDL and TC: HDL-C and percent lean body mass vice versa.

INTRODUCTION

According to the report of International Diabetes Federation on the estimated projections regarding diabetes, South East Asian countries have the highest prevalence of diabetes in the world. Due to the high degree of genetic predisposition and high susceptibility to environmental insulin, characterised by a low BMI, high upper body adiposity, a high body fat percentage and a high level of insulin resistance, Indian population faces higher risk for diabetes and its complications. A low level of HDL-C is a key feature of the type 2 diabetes (Rosenson, 2005 and Martinez et al., 2002) diabetes being one of the strongest risk factors with associated age adjusted risk ratios about 2.2 for men and about 3.7 for women. Diabetes often coexists with obesity, hypertension, dyslipidaemia. Certain racial and ethnic groups (Africans, Americans, and Asians) have a greater risk of developing diabetes. The risk for diabetes increases if waist circumference measurements in men are more than 90 cm and in women they are more than 80. There are several factors responsible for this tendency including sedentary lifestyle and improper eating habits. An increase in body fat leads to less action of insulin as well increases several other toxic substances in the body. Changes occurring in diabetic dyslipidaemia include quantitative and qualitative changes. Quantitative changes include increase in VLDL as compared to normal due to increase availability of glucose for VLDL synthesis and decrease in lipoprotein lipase activity leading to decrease of VLDL from peripheral circulation, increase in LDL-C levels and decrease in HDL-C levels due to increase in hepatic lipase activity decrease in VLDL clearance. Qualitative changes include increase amount of triglycerides, LDL-C and HDL-C, non enzymatic glycation of LDL and non enzymatic glycation of HDL, thus increasing risk of heart diseases. Nowadays frequency of diabetes mellitus is increasing many folds. Research findings show that it is the body composition components, mainly body fat and lipid profiles that are responsible for increase prevalence of this disease. Hence the purpose of the present study is to present the evidence on the important role of body fat distribution in making the lipidogram abnormal, thus leading an insight into one of the major causes of these diseases.

MATERIALS AND METHODS

The study location is in the state of Punjab, North India. A total of 40 samples were taken to assess the lipid profile in diabetes mellitus group. Samples of normal individuals which served as controls were evaluated for their lipid profile. Age group in both diabetics and controls were taken from 25-70 years. They were measured for height, weight, body mass index, waist and hip circumferences along with six lipid profile components. Data collection was done during July to September 2005. Measurements of the weight to the nearest 0.1 kg by a weighing machine and height to the nearest of 0.1 cm by an anthropometer rod were done. BMI was calculated as weight (in kgs) divided by height

(in meters) squared as indicated by the World Health Organization (WHO).

Circumferences were evaluated using a 1 cm wide metal measuring tape with the subject in the standing position and breathing normally. The waist circumference was measured as the minimum girth between the lower rib margin and the iliac crest and the hip circumference was measured as the widest girth over the greater trochanters, both to the nearest 0.1 cm. waist to hip ratio (WHR) was calculated as indicated by WHO. Venous blood samples were taken from all the subjects in the morning after fasting overnight. Plasma levels of fasting plasma glucose, total cholesterol, triglycerides, High Density Lipoprotein- Cholesterol (HDL-C), Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) were analyzed. Total cholesterol and triglyceride concentrations were determined with a semi-automated enzymatic analyzer (RA 50, Semi-auto Chemistry Analyzer, Bayer's India Ltd, India). HDL- Cholesterol serum level was measured by using phospho-tungstate precipitation method. Plasma glucose was measured by Glucose Oxidase and Peroxidase (GOD-POD) method. The ratio of total cholesterol-to-high density lipoprotein cholesterol (HDL-C) is considered to be the best predictor of heart disease and has been used in our study. Exclusion criteria included pregnancy, chronic infectious diseases, drug allergy, etc. were confirmed from the subject's personal physician report and a detailed history. The relationship among anthropometric measurements (body fat) and lipid profile was assessed through analysis of variance (F ratio).

RESULTS AND DISCUSSION

The association between lipid profile and body fat distribution had been much discussed during the past decades. Both lipid profile and body fat have been shown to be the important predictors for metabolic disturbances including dyslipidaemia, hypertension, diabetes, cardio-vascular diseases, hyperinsulinaemia etc. Any alteration in the levels of lipids in body makes the individuals more prone to develop these diseases.

Statistically significant differences ($p < 0.05$) were found between diabetes mellitus and controls for percent body fat ($t = 2.21$) and for percent lean body mass ($t = 2.10$). Slight variations in waist circumference reflected alterations in subcutaneous and visceral fat which showed that it was associated with elevated risk factors because of its relation with visceral fat accumulation due to exposure of liver to fatty acids. Our study was in favour with the studies conducted on waist circumference which showed that it is independently associated with an increased risk of diabetes as well as deleterious effect on the metabolic risk variables which predispose individual to develop these diseases. Variations in hip circumferences ($p<0.05$) were found in patients with diabetes mellitus. Both waist and hip circumferences are influenced by behavioral characteristics – smoking, alcohol consumption etc. Self reported family history of diabetes is important among diabetes mellitus subjects. Variations were found as subjects with diabetes mellitus had more of sedentary lifestyle and less of physical activity. Studies conducted

Table 1: The distribution of mean values and standard deviations of various variables in patients with diabetes mellitus.

Variables	*Patients with diabetes mellitus*		*Controls*		*t-value*
	Mean	*S.D*	*Mean*	*S.D*	
Height (cm)	160.62	± 5.93	158.53	± 6.24	1.02
Weight (kg)	68.38	± 12.11	68.48	± 12.43	0.024
Body mass index (kg/m^2)	26.47	± 5.04	27.61	± 4.85	0.697
Waist hip ratio	0.987	± 0.062	0.943	± 0.07	1.874
S.cholesterol(mg/dl)	197.38	± 19.78	90.52	± 30.50	0.74
S.triglycerides(mg/dl)	167.85	± 27.90	158.07	± 42.46	0.76
S.HDL-C (mg/dl)	51.54	± 9.96	48.31	± 11.32	0.89
S.LDL-C (mg/dl)	115.82	± 19.65	111.78	± 19.68	0.61
S.VLDL (mg/dl)	33.26	± 5.49	31.47	± 8.51	0.69
TC:HDL-C	3.89	± 0.69	3.98	± 0.72	0.37
% Body fat	34.71	± 8.57	39.24	± 4.74	2.21*
% Lean body mass	65.13	± 8.82	60.75	± 4.73	2.10*

* indicates $p<0.05$

had shown that inactivity is associated with increase in intra abdominal adiposity in off springs of patients with type 2 diabetes mellitus and is strongly related with impaired insulin sensitivity (Oseid et al., 1991). It was in favour of the study (Kanaley et al., 2001) that indicated impact of physical activity, age and menopausal status on fat distribution. The hormonal environment plays a key role in determining body fat distribution because sex hormones are known to affect regional fat deposition. The changing hormonal environment during puberty may contribute to development of sex differences and large individual changes in fat distribution. Body fat distribution is important risk factor for type 2 diabetes (Rosenson, 2005). Central adiposity and insulin resistance represents risk factors for cardiovascular diseases and diabetes mellitus (Slyper, 1994).

Significant positive correlation was found between percent body fat and weight in diabetes mellitus group in table 2. Results were in favour of study that showed increase in weight resulted in increase in body fat accumulation and hence metabolic risk factor (Pihl and Jurimae, 2001) along with significant positive correlation between percent body fat and anthropometric variables i.e. with BMI and WHR. These anthropometric variables can be clinically used as a substitute to measure fat distribution in body (Maki et al., 1997). The prevalence of diseases associated with insulin resistance (diabetes and CHD) increase as BMI increase due to increase in adiposity characterized by decreased HDL-C and increased triglycerides .In this study percent body fat was found to be negatively related to HDL-C and positively to VLDL, TC: HDL-C in diabetes mellitus. An increase in VLDL occurred in diabetes mellitus due to increase availability of glucose for VLDL synthesis and decrease in lipoprotein lipase activity leading to decrease of VLDL from peripheral circulation. An increased percent body fat was identified with higher levels of TC: HDL-C and decreased HDL-C due to decrease in hepatic lipase activity resulting in decrease VLDL clearances which are metabolic abnormalities characterizing metabolic syndrome. The present study was in agreement with the findings (Imamura et al., 1993) on relationship between fat distribution and serum lipids. Theory supporting this relation between percent body fat and HDL-C is that with increase in adiposity, increase in serum triacylglycerol concentration occurs due to increase production of VLDL and reduced clearance of it. This results in increase opportunity for lipid exchange leading to depletion of cholesterol esters in HDL to cholesterol ester enrichment in triacylglycerol rich lipoprotein (Dietschy, 1997) whereas negatively significant association was found between percent lean body mass and weight, as well as with anthropometric variables i.e. BMI and WHR, triglycerides, positively with HDL-C and negatively to TC: HDL-C .It coincided with the study conducted that showed increased HDL-C and decreased LDL-C decreases risk factor for metabolic syndrome (Wirth and Steinmetz, 1998).

Table 2: Correlation coefficient of percent body fat and percent lean body mass with other variables in patients with diabetes mellitus.

Variables	*Percent body fat*	*Percent lean body mass*
Height (cm)	0.447	0.463
Weight (kg)	0.665*	-0.659*
Body mass index (kg/m^2)	0.795***	-0.798***
Waist hip ratio	0.561*	-0.565*
S.cholesterol(mg/dl)	0.163	0.517
S.triglycerides(mg/dl)	0.550	0.546
S.HDL-C(mg/dl)	0.449	0.439
S.LDL-C(mg/dl)	0.493	0.479
S.VLDL(mg/dl)	0.573*	- 0.569*
TC:HDL-C	0.609*	- 0.592*

* indicates $p<0.05$; ***indicates $p<0.001$

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