**ORIGINAL ARTICLE** 

# Comparison of Anthropometry, Insulin Resistance and Lipid Parameters in Nondiabetics with and without Family History of Type 2 Diabetes Mellitus

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#### Abstract

Type 2 DM is a complex metabolic syndrome characterized by impaired insulin secretion and insulin resistance (IR). IR has a strong genetic component and the children of diabetics have an increased risk for the early onset of DM. The body mass index (BMI), waist circumference (WC), blood pressure (BP), fasting plasma glucose (FPG), fasting plasma insulin (FPI), HOMA-IR (Homeostatic model assessment - IR) and lipid parameters were measured and statistically compared in 25 nondiabetics with family history of type 2 DM (FH + group) and 25 age matched nondiabetics without family history of type 2 DM (FH + group). The FPI ( $8.76 \pm 3.6$ ), HOMA-IR ( $1.95 \pm 0.86$ ) and serum triglycerides ( $136.43 \pm 11.44$ ) were statistically significant (p<0.05) in the FH + group when compared to the FH - group. WC, total cholesterol and BP showed a trend towards increase in the FH + group. There is hyperinsulinemia, IR and an altered lipid metabolism in the FH + group predisposes such individuals to the development of type 2 DM.

## **Key Words**

Body Mass Index, Type 2 Diabetes Mellitus, Waist Circumference

## Introduction

Diabetes Mellitus (DM) is an "iceberg" disease seen in all age groups. WHO has recently acknowledged that India has the largest number of diabetics than any country and by the year 2030 would become the Diabetic capital of the world. This is attributed to the life style changes due to modernization(1). DM has a strong genetic component and the children of diabetics have an increased risk for the early onset of the disease (2). Type 2 DM is a complex metabolic syndrome, involving the carbohydrate and lipid metabolism. It is characterized by both impaired insulin secretion and insulin resistance (IR). IR is genetically programmed and is influenced by environmental and physical factors like diet and obesity (3). Intra abdominal deposition of adipose tissue contributes to the development of IR, type 2 DM and dyslipidemia (4). Obesity is associated with an adverse cardiovascular risk causing morbidity and mortality. Family history appears to increase risk of hypertension, dyslipidemia, atherosclerosis and coronary heart disease in non diabetic subjects (5). Metabolic syndrome is more prevalent among men and women with increased waist circumference (WC) / waist-hip ratio (WHR) and obesity (6). Body mass index (BMI), which relates weight to height, is widely to estimate the prevalence of obesity (7). BMI does not reflect body fat distribution. The intraabdominal deposition of adipose tissue is a major contributor to the development of hypertension, IR, DM and dyslipidemia (8). Thus, other anthropometric indices such as WC and WHR have been used as alternatives to BMI. Screening tests recommend fasting plasma glucose (FPG) estimation in subjects with a risk of type 2 DM or impaired glucose tolerance due to IR (9). In the present study, the researchers have compared the anthropometric indices (BMI, WC), lipid parameters, FPG & HOMA-IR index. This study was to determine their probable association as important type 2 DM risk factors in individuals with a family history of type 2 DM (FH + group)

## Material & Methods

This comparative study had total 50 subjects - 25 non

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diabetics with family history with at least one first degree relative being Type 2 DM (FH + group) and 25 non diabetics without family history of Type-2 DM (FH group). Subjects included both males and females in the age group 30-40 years. The study was conducted at Sree Siddhartha Medical College and Research Hospital, Tumkur, Karnataka, India. Subjects were examined for general physical health, clinical history and details of family history were taken through a standard proforma and questionnaire. Informed, written, witnessed consent was taken from all the subjects prior to the investigation. Subjects with obvious disease (i.e., Diabetes Mellitus, hypertension and endocrinopathies) were excluded from the study. Also were excluded those on like antidiabetic / antihypertensive / glucocorticoids / other drugs which might have an effect on the study. The study was approved by the Institutional Ethical Committee.

#### Procedures

The anthropometric measurements were recorded with the subjects in light clothing without shoes. Height and weight were both measured standing. Height was measured with a horizontal wall mounted height meter to the last complete 0.1 cm and weight with a digital weighing scale to the last complete 0.1 kg. BMI (in  $kg/m^2$ ) was calculated for each subject. WC (in cm) was measured with an insertion tape at the midpoint between the iliac crest and the lower ribs measured at the sides. The subject rested briefly for 10-15 mins and the blood pressure (BP) was measured on the right arm in the sitting position, using a standard mercury manometer. Two readings at 5 min intervals were recorded from each subject. The lower of the two was recorded as subject's BP. BP was measured by the same doctor for all subjects. A 3 ml blood sample was drawn from the anterior cubital vein by a trained technician at the laboratory between 08:00 and 09:00 AM from all subjects after an overnight fast of 08-10h. Samples were centrifuged, plasma separated within 30 minutes of collection and stored at - 20 °C. Fasting plasma glucose (FPG) and lipid analyses were done on the day of blood collection using auto analyser. FPG was estimated by using ERBA diagnostics liquixx glucose kit (3). Lipid parameters: fasting plasma concentration of total cholesterol, HDL-Cholesterol and Triglycerides (TG) was assayed by ERBA diagnostics Mannheim GmbH kit. VLDL (triglycerides / 5) and LDL (Total cholesterol - [HDL + VLDL]) were indirectly calculated 3. Fasting plasma insulin (FPI) was determined by radioimmuno assay (RIA) using human specific antibody RIA kit. HOMA (Homeostatic Model Assessment), to assess IR (HOMA-IR) was calculated (10).

## Statistical Analysis: (11, 12)

All data were analysed by SPSS 11.0 and Systat 8.0. Two tailed independent student t test has been used to find the significance of anthropometry parameters, BP, FPG, FPI, HOMA-IR and lipid parameters between the FH + group and FH - group. MS offices' excel and word was used to generate the tables.

#### Results

This comparative study comprised total 50 subjects. FH - group - 25 without family history and FH + group -25 with family history (with at least one first degree relative being Type 2 DM) of Type 2 DM. Anthropometric measurements, BP, FPG, FPI, HOMA-IR and lipid parameters of the two groups were compared. Anthropometry parameters did not show significant difference between the two groups (p > 0.05). (*Table-1*) The baseline BP (systolic, diastolic) did show significant difference between the two groups (p > 0.05). (*Table-2*) The FPG did not show significant difference between the groups (p > 0.05). (*Table-2*) The FPI, HOMA-IR was significantly higher in the FH + group (p < 0.05). (*Table-2*) The serum triglycerides were significantly higher in the FH + group (p < 0.05). (*Table-2*) Total cholesterol and HDL did not show significant difference between the groups (p > 0.05). (*Table-2*)

#### Discussion

In the present study, the FH + group had higher fasting plasma insulin, HOMA-IR and elevated serum

FH <sup>-</sup> group	FH <sup>+</sup> group	p value
$35.45 \pm 3.11$	$36.85 \pm 2.41$	0.108
$23.29 \pm 1.43$	23.88 ± 1.25	0.145
94.36 ± 8.93	$100.32 \pm 9.27$	0.059
	FH <sup>-</sup> group 35.45 ± 3.11 23.29 ± 1.43 94.36 ± 8.93	FH · group FH + group   35.45 ± 3.11 36.85 ± 2.41   23.29 ± 1.43 23.88 ± 1.25   94.36 ± 8.93 100.32 ± 9.27

Table.1 Comparison of Age, BMI and WC between the FH - group and the FH + group

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Parameters	FH <sup>-</sup> group	FH <sup>+</sup> group	P value
Systolic BP (mmHg))	$114.18 \pm 3.94$	$116.85 \pm 4.27$	0.061
Diastolic BP (mmHg)	$74.54 \pm 3.11$	$76.85 \pm 3.82$	0.058
Fasting Plasma Glucose (FPG) (mg/dl)	88.45 ± 8.21	$90.35 \pm 6.46$	0.261
Fasting Plasma Insulin (FPI) (µU/ml)	$5.56 \pm 1.34$	8.76 ± 3.6	0.005 **
HOMA-IR	$1.21 \pm 0.31$	$1.95 \pm 0.86$	0.006 **
Total Cholesterol (mg/dl)	$164.08 \pm 29.15$	$183.80 \pm 31.79$	0.062
HDL (mg/dl)	$38.35 \pm 3.83$	$39.68 \pm 3.18$	0.176
Serum Triglycerides (mg/dl)	$127.14 \pm 9.76$	$136.43 \pm 11.44$	0.021 **

Table. 2 Comparison of BP, FPG, FPI, HOMA-IR and Lipid parameters between the FH - group and the FH + group

triglycerides. These findings strongly suggest a genetic predisposition to the development of Type 2 DM later.

These findings support previous findings of elevated triglycerides and depressed HDL-C in well controlled type 2 DM patients. This probably develops concomitantly with the failure of insulin activity, which in turn leads to the release of fatty acids from adipose tissue, increased delivery of free fatty acids to the liver, and increased hepatic synthesis of very low-density lipoproteins (13). Such abnormal lipid profile, as seen in this study, can markedly increase cardiovascular risk among diabetic patients (14).

Earlier reports also suggest that hypertensive patients demonstrate an altered lipid profile than does the general population (15). This study involved normotensive subjects which suggest that the elevated serum triglycerides observed was not because of hypertension. Further, the inclusion of hypertensive subjects would probably have shown more lipid abnormalities.

Obesity is associated with many metabolic risks. Fewer studies of obesity-related disorders have been performed in the Asian countries (5).BMI is the widely used measurement to reflect general obesity. However, BMI does not take into account the proportion of weight related to increased muscle or the distribution of excess fat within the body, both of which affect the health risks associated with obesity (16). Individuals with a similar BMI can vary considerably in their abdominal fat mass (17). Also its limitations are its dependency on race, with Asians having large percentages of abdominal fat at low BMI values (18). This difference may be explained by the different ethnicity and nutritional status. For these reasons, WC is a desirable measure of the increased risk of obesity related illnesses (19). The serum triglycerides were elevated in the FH + group. These subjects, though not significant, had an increasing WC (p = 0.059). The increased WC may involve excess exposure of the liver to fatty acids (20). The molecular mechanisms by which obesity contributes to glucose intolerance and dyslipidemia remain elusive. It probably involves a combination of genetic factors and mechanisms by which skeletal myocytes and central adipocytes play a determining role (5). Thus this study supports the use of WC as a simple and non-invasive method for detection of dyslipidemia as an important cardiovascular risk factor.

The FH + group had a normal FPG, fasting hyperinsulinemia and IR. These findings are probably due to target tissue insensitivity to insulin or a reduced number of insulin receptors on the target cell surface. Fasting hyperinsulinemia reflects the compensatory beta cell response to the underlying IR. This maintains a normal FPG. Further decrease in insulin response to a glucose load suggests decreased beta cell responsiveness, is a predictive factor of type 2 DM (21). The IR can be attributed to obesity and it seems to have a genetic predisposition. Also, the contribution of physical inactivity to the development of IR is unknown (22).

The high prevalence of DM and the considerable percentage of nondiagnosed diabetics make it necessary to generalise the screening methods of DM. Especially for those who have cardiovascular risk factors such as positive family history, are overweight or obese and older than 30 years of age. Additional promotion knowledge on the risk factors, symptoms and side effects of DM can play an effective role in the prevention, timely diagnosis and control of the disease. The favourable impact of regular physical activity on diabetes risk extends beyond issues of weight management. Physical activity is directly associated with improved glycometabolism, as demonstrated by decreased insulin levels, increased insulin sensitivity, and a lower incidence of diabetes (22). There is hyperinsulinemia, IR and an altered lipid metabolism in the FH + group. The complex genetic predisposition to IR and its association with the increasing WC in the FH + group predisposes such individuals to the development of type 2 DM. This strong genetic (familial) aggregation cannot be modified after birth. There is also an interaction between environmental, metabolic and genetic factors in the pathogenesis of type 2 diabetes (23).

*Limitation:* OGTT was not done in this study. By doing OGTT and insulin assay simultaneously, the dynamic continuum glucose and insulin from the fasting levels to the stimulated level would give a superior correlation with the sensitivity index. The study lacked hip circumference measurement. This would help to choose the best anthropometric measure between BMI, WC, W/Ht, and WHR as a predictor of cardiovascular disease. The subjects' family history of type 2 DM was defined based on the presence of type 2 DM in only one of the two parents. Considering the complex genetic background of type 2 DM, this definition of family history of type 2 DM is an apparent simplification. Also considering the history of regular exercise in a larger sample might give better validated results.

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