IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 6 Ser. 8 (June. 2019), PP 07-10
www.iosrjournals.org

Status of Anthropometric Indices and Lipid Profile in Prediabetic Obese Subjects.

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Abstract
Background: *Prediabetes is an intermediate hyperglycemic and insulin resistant state. The association of anthropometric indices with plasma lipid profile is more strongly associated with prevalence of prediabetes in obese subjects.*
Methods: *The aim of our study was to evaluate serum lipid profile level and anthropometric parameters in prediabetic obese subjects and to compare it with the control subjects. We also studied correlation of anthropometric parameters with lipid profile. Study included 200 prediabetic subjects and 100 control subjects. Blood samples were analyzed for fasting blood glucose and lipid profile. According to BMI, subjects were separated into obese (BMI ≥ 30) and control (BMI < 25) groups. Anthropometric parameters were noted during screening time using standardized techniques.*
Results: *Mean BMI and W/H ratio were statistically significant and were different in control and obese prediabetic groups (p<0.001). Serum total cholesterol, triglyceride, LDL cholesterol and VLDL-C levels were significantly higher in obese prediabetic group as compared to control group (p<0.001) whereas HDL cholesterol levels were significantly lowered in obese prediabetics (p<0.001).*
Conclusions: *Our study shows a strong association between anthropometric parameters and lipid profile in obese prediabetics as compared with control subjects.*
Keywords: *Prediabetes; Obesity; Lipid Profile, Type 2 diabetes mellitus*

Date of Submission: 29-05-2019 Date of acceptance: 15-06-2019

I. Introduction

Prediabetes is an intermediate hyperglycemic state between normoglycaemia and type 2 diabetes[1]. It includes subjects with impaired fasting glucose (IFG), impaired glucose tolerance (IGT) and both [2]. Every year, approximately 11% individuals with prediabetes progress to type 2 diabetes [3]. Prediabetes is considered as a risk factor for cardiovascular disease and macrovascular disease development and is not only a significant risk factor for progression of type 2 diabetes. Evidences suggest that prediabetic patients have a significantly greater risk for cardiometabolic diseases and death, when compared with normal subjects [4-5]. Thus, it is very important to diagnose the prediabetes to reduce the prevalence of type 2 diabetes. Moreover diagnosis of prediabetes is also important for reducing the cardiovascular risks that develop even before development of type 2 diabetes [6]. Prediabetes can be diagnosed by fasting plasma glucose and or OGTT [3]. However these tests have certain limitations [7]. Indian diabetics manifest T2DM a decade earlier than their western counterparts [8]. The association of abdominal obesity and T2DM based on anthropometric measurements such as waist circumference (WC) has been documented in previous studies [9]. Obese individuals are more prone to develop prediabetes, and are additionally expected to have multiple risk factors for cardiovascular disease (CVD), including dyslipidemia and hypertension [10]. W/H ratio and plasma triglyceride levels were more strongly associated with prevalence of prediabetes and T2DM [11]. Low HDL-C levels are observed in prediabetic subjects than controls [12]. The present study is designed to evaluate the status of anthropometric parameters and lipid profile in prediabetic obese subjects and to compare it with the control subjects.

II. Methods

This study was conducted on 200 prediabetic obese subjects, selected via screening through survey in the Gwalior (M.P.) and the samples were processed in the Department of Biochemistry, G.R. Medical College & J. A. group of hospitals, Gwalior (M.P.). We had excluded the Patients with current insulin use or any medication that can affect blood glucose level, other diseases & agents that altered glucose metabolism and pregnant women. The screening questionnaires and written consents were taken from all the subjects. The study proforma which includes the anthropometric parameters like age, sex, height, weight etc. were noted during screening time using standardized techniques[13]. Ethical approval was taken from Institutional Ethical Committee, G.R. Medical College Gwalior. The participants completed the laboratory tests, including standard 75 g -two-hour oral glucose tolerance test (OGTT), total cholesterol, triglycerides, HDL-C (measured using standardized procedures), LDL (calculated by the Friedwald equation, provided the total triglyceride did not exceed 400 mg/dL). OGTTs were performed according to American Diabetes Association criteria. The prediabetic state was defined as a state with an Impaired Fasting Glucose (IFG) (a fasting plasma glucose (FPG) of 100-125 mg/dL) and/or an impaired glucose tolerance (IGT) (two-hour post load glucose of 140-199 mg/dL) [14]. In addition, a questionnaire on health status and the various potential risk factors of prediabetes was completed. This questionnaire included gender, age at diagnosis, educational level and duration of diabetes (time between diagnosis and baseline examination). All samples were estimated by Mindray BS-400 fully autoanalyser. BMI was calculated using the formula, weight in kilograms divided by the square of height in meters. The homeostasis model assessment of insulin resistance (HOMA-IR), an index of insulin resistance, was calculated using an equation as described by Matthews DR et al. [15].

Statistical Analysis:

Data were summarized using standard procedures. All the data of overall status of anthropometric and biochemical parameters of obese prediabetic subjects were expressed as mean ± standard deviation (SD). Pearson's correlation analyses were used to estimate the r value of IGT with age, BMI, waist circumference, hip circumference, W/H ratio, fasting glucose, lipid profile and HOMA-IR. All analyses were performed using Statistical Package for the Social Sciences, version 23.0 (SPSS software). The graph was prepared by using Excel and graph pad prism7. The p value < 0.001 was considered significant.

III. Results

A total of 200 patients aged 31-69 years old subjects were taken in the present study with impaired glucose tolerance. Table no. 1 shows the status of anthropometric parameters (age, BMI, waist circumference, hip circumference and waist circumference/hip circumference ratio) and biochemical parameters (IGT, HOMA-IR, total cholesterol, triglycerides, HDL-C, LDL-C and VLDL-C) in control and prediabetic obese subjects. Prediabetic obese subjects had elevated levels of age, BMI, waist circumference, hip circumference and waist circumference/hip circumference ratio (W/H ratio), IGT, total cholesterol, triglycerides, LDL-C and VLDL but the HDL-C were decreased significantly (Table 1). Table no. 2 showing the correlation of IGT with age, waist circumference, hip circumference, Waist/Hip ratio, BMI and HOMA-IR). HDL-C was correlated negatively with BMI, W/H ratio, IGT and HOMA-IR as shown in table no. 2.

Table 1: Status of anthropometric indices and biochemical parameters of control and prediabetic obese subjects.

Parameters	Mean ± SD (Control)	Mean± SD (Case)
Age (Yrs.)	34.19 ± 13.76	50.41 ± 9.00***
BMI (Kg/m^2)	24.87 ± 3.05	30.80 ± 1.93***
Waist circumference (cm)	82.83 ± 12.28	104.98 ± 10.95***
Hip circumference (cm)	75.66 ± 14.55	112.04 ± 12.78***
W/H Ratio	0.91 ± 0.06	0.94 ± 0.04***
Fasting glucose (mg/dl)	85.00 ± 5.39	114.35 ± 7.88***
IGT (mg/dl)	104.27 ± 10.06	152.34 ± 8.81***
HOMA IR	1.80 ± 0.86	3.00 ± 2.28***
Total cholesterol (mg/dl)	193.49 ± 18.04	203.16 ± 20.77***
Triglyceride (mg/dl)	98.33 ± 23.70	136.28 ± 28.46***
HDL-C (mg/dl)	47.24 ± 4.75	45.27 ± 4.74***
LDL-C (mg/dl)	119.92 ± 21.20	129.85 ± 21.18***
VLDL (mg/dl)	22.48 ± 6.70	29.06 ± 5.69***

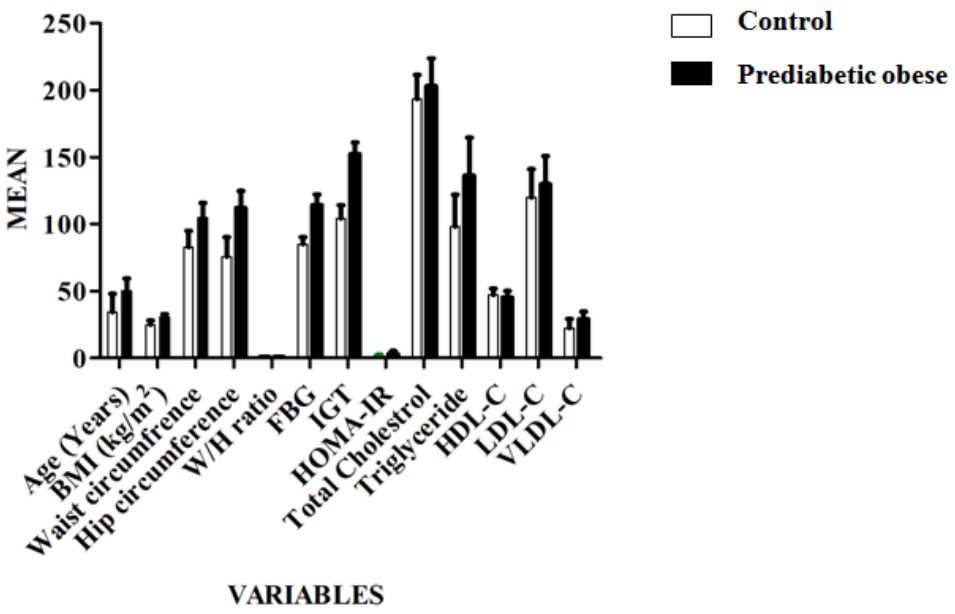
Data: means ± SD.

Table 2. Pearson's correlation of IGT with BMI, W/H ratio, HOMA-IR and lipid profile

Parameters	IGT (r value)	Parameters	IGT (r value)
Age	0.284**	Total cholesterol	0.864**
BMI	0.385**	Triglyceride	0.887**
Waist circumference	0.354**	HDL-C	-0.543**
Hip circumference	0.193**	LDL-C	0.687**
Waist/Hip ratio	0.341**	VLDL-C	0.887**
Fasting Blood Sugar	0.897**	HOMA-IR	0.437**

****** Correlation is significant at the 0.01 level (2-tailed).

Graph no.1: Showing the overall status of anthropometric indices and biochemical parameter in control and prediabetic obese subjects-



IV. Discussion

Prediabetes is a metabolic state between normal glucose tolerance and diabetes mellitus. It includes IFG and/or IGT subjects [2]. Many previous studies described about pathophysiology of prediabetes in which IGT is a state of more pronounced insulin resistance especially at the level of the muscle metabolism while IFG is associated to a greater extent with impaired β-cell function and insulin secretion [16]. In this study we have demonstrated that age, BMI and W/H ratio were positively correlated with increasing incidence of insulin resistance in obese prediabetic subjects. Moreover, the prediabetic obese subjects demonstrate significant changes in the lipid profile in comparison to control subjects. Significantly higher levels of total cholesterol, triglycerides, LDL-C, VLDL-C and lower level of HDL-C were found in prediabetic obese subjects compared to control subjects (($p<0.001$)). Previous other studies on this topic, which supports our results and have found decreased HDL-C ($p<0.001$) and increased triglycerides ($p<0.001$) and total cholesterol ($p<0.001$) is to be the main differences between prediabetic obese and control subjects [17–20]. The number of previous studies about lipid profile in prediabetic obese subjects are very limited. Our results support the concept for higher insulin resistance in the state of prediabetes. Fasting blood sugar, IGT (2-h post–75-g glucose load plasma glucose) level and HOMA-IR between prediabetic obese and control subjects are found be highly significant ($p<0.001$). Another characteristic alteration in serum lipids in the state of insulin resistance concerns LDL-C. It is well known that qualitative rather than quantitative changes in LDL-C are typical for the athrogenic dyslipidemia in type 2 diabetes. Small, dense LDL particles, highly susceptible to oxidation are characteristic of the proatherogenic changes in diabetes but such changes are also found in prediabetic subjects as part of the insulin resistance state [21].

V. Conclusion

Our study supports the assumption that anthropometric indices and lipid profile may play an important role in the development of insulin resistance. From the above results, it may conclude that prediabetic obese subjects have decreased levels of HDL-C and increased levels of age, BMI, W/H ratio, fasting glucose, IGT (Impaired glucose tolerance), total cholesterol, triglyceride, LDL-C and VLDL-C. Thus deranged anthropometric indices and lipid profile is responsible for the production of insulin resistance in prediabetic obese subjects.

DECLARATIONS
Funding: No funding.
Conflict of interest: There are no conflicts of interest.
Ethical approval: Institutional Ethical Committee, G.R. Medical College Gwalior.

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Dr. Y. S. Chandel. "Status of Anthropometric Indices and Lipid Profile in Prediabetic Obese Subjects." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 6, 2019, pp 07-10.