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Research Article

Comparative analysis of anthropometric parameters and lipid profile of type 2 diabetic patients in south west Punjab.

Arun Kumar Maria[1], Khushboo Verma[2], Satwant Kumar[3], Vitull K Gupta [4], Mohnish Kumar [5]
[1] Professor, Department of Medicine, Adesh Institute of Medical Sciences and Research (AIMSR) Bathinda 151101, India.
[2]Ex Intern, Rabindra Nath Tagore Medical College and Hospital, Udaipur 313001, India
[3]Ex Intern AIMSR, Bathinda(presently Lab of Neuro- and Psychophysiology, KU Leuven, Belgium
[4]Associate Professor (Department of Medicine), AIMSR, Bathinda
[5]Ex Intern, AIMSR, Bathinda India.

***Corresponding author**
Arun Kumar Maria
Email: cooldoctor5@yahoo.co.in

Abstract: The objective of present study is to investigate the effectiveness of multiple adiposity indices to predict the hypertension, dyslipidemia and hyperuricemia in the north Indian type-2 diabetic patients. In this study 128 women and 269 men type-2 diabetic patients were recruited. Data was collected through clinical evaluation and laboratory investigations. Body weight and height, waist circumference (WC), and hip circumference (HC) were measured. Whereas, body mass index (BMI), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) were calculated. Blood pressure (BP), fasting lipid profiles, and glucose and urine acid levels were evaluated. It is found that the Mean BMI for females was 28.62 (SD 5.57) kg/m2 and for males was 28.50 (SD 5.27) kg/m2. Whereas, mean WHR for females was 0.96 (SD 0.09) kg/m2 and for males was 1.05 (SD 0.06) kg/m2 and mean WHtR for females was 0.60 (SD 0.10) kg/m2 and for males was 0.58 (SD 0.12) kg/m2. Receiver operating characteristic (ROC) curve analysis showed that WHtR is the best predictor for the classifying hypertension and dyslipidemia. Whereas, BMI is effective in predicting hyperuricemia in type-2 diabetic patients. Amongst type-2 diabetic patients of north Indian region WHtR is found to be the best predictor of dyslipidemia and hypertension.
Keywords: Metabolic Syndrome, Waist to height ratio, hyperuricemia, dyslipidemia, diabetes.

INTRODUCTION

The latest data on global burden of non-communicable diseases points towards rising trends of obesity in all age groups as well as across both sexes [1]. There is preponderance of metabolic and cardiovascular diseases increasing morbidity and mortality. The metabolic syndrome (MetS) is the co-existence of statistically significant “metabolic” risk factors, such as visceral obesity, dyslipidemia, hyperglycemia and hypertension. These factors appear to advance the development of atherosclerotic cardiovascular diseases (ASCVD) [2]. Several terms have been used to describe these constellation of features such as- Syndrome X (3), deadly quartet (4), insulin resistance syndrome [5,6] and the hypertriglyceraemic waist [7]. Reaven was the first to put forward the concept of 'syndrome X', (which he later renamed MetS) [6] In our study, we examined the above mentioned risk factors in the patients who were already diagnosed with type 2 DM.

The metabolic syndrome has become the foremost public health threat in the contemporary times[8].The escalating burden of obesity is the impelling force behind its pervasiveness [9,10]. However, the more intriguing factor is the ethnic variation in the pathogenesis, disease presentation and treatment strategies. The first formal definition was proposed by a consultation group of WHO in 1999 and had insulin resistance, impaired glucose tolerance or diabetes as essential components.[11]. Owing to insufficient evidence and the ethnic variations, the definition of metabolic syndrome has still remained debatable ever since [12]. Another major criteria emerged from the National Cholesterol Education Program (NCEP) Expert Panel in 2001. Unlike the WHO criteria, according to the US National Cholestrol Education programme : Adult Treatment panel III (NCPE : ATPIII) criteria, the demonstration of insulin resistance was not necessary, rather the presence of any three out five factors i.e. abdominal obesity, elevated triglyceride, reduced HDL, elevated fasting glucose and elevated blood pressure.. In 2005, the International Diabetes Federation (IDF) [13] and American Heart Association / National Heart Lung and Blood Institute (AHA/ NHLBI) endeavored to resolve the differences in the clinical definitions. The IDF introduced abdominal obesity as a prerequisite of the diagnosis of MetS, with particular emphasis on waist measurement as a simple screening tool that was also adopted by AHA/NHLBI [6]. The remaining four components of MetS w remained same as in the AHA/NHLBI, although abdominal obesity was defined differently. Currently, the two most widely used definitions are those of the NCEP: ATP III and IDF specifically focusing on waist circumference as a surrogate measure of central obesity. In contrast, the other definitions from WHO ; the European Group for the study of Insulin Resistance (EGIR), and the National Cholesterol Education Program Adult Treatment Panel III (NCEP:ATPIII), the American Association of Clinical Endocrinology (AACE) definitions are all largely focused on insulin resistance are all largely focused on insulin resistance.

The physique of a patient with metabolic syndrome has constantly been a debatable theme for the healthcare researchers as well as the physicians. The Lancet expressed the build of a diabetic patient as “a roundedness of the body contour, a tendency to obesity, a smooth skin with fine hair and short tapering limbs with small hands and feet” [14].

This implies that not only adiposity, but also the pattern of fat distribution is significant. Upper body obesity has been held responsible for insulin resistance. Excess upper body fat is distributed either as extra peritoneal (visceral) or subcutaneous deposits. There are contradictory views regarding which of the two is linked with insulin resistance [15-17]. However, both can be collectively estimated clinically, by documenting the waist circumference as done in our study. Additionally, we included parameters like waist to hip ratio and waist to height ratio in our study. These parameters are of particular concern in a population group like in our study since the Asians exhibit the metabolic syndrome even with moderate degree of abdominal obesity [18, 19]. Thus, the Asians are proposed to be inherently insulin resistant [20]. Hence, as mentioned earlier, the inclusion of different cut-off points for abdominal obesity by IDF holds good and has been considered in the study.

We hereby intend to investigate the effectiveness of multiple adiposity indices to predict the presence of various components of metabolic syndrome namely - hypertension, dyslipidemia and hyperuricemia.

Variations in the adiposity are associated with changes in lipoproteins –high triglycerides (TG), low high density lipoprotein (HDL), increased coronary heart disease and non-insulin dependent diabetes mellitus (NIDDM) [21, 22]. Hence, fasting lipid profiles, glucose and urine acid levels were evaluated during the study period.

The Joint Statement of the IDF and NHLBI mentioned that, it is a key concern to consider the applicability of the criteria amongst the different ethnic groups [11]. Thus, it is essential to conduct studies in specific ethnic groups and record the findings of the particular geographical and ethnic groups. Our study focused over the north Indian diabetic patients.

The Joint Statement also calls attention to the compilation of evidence based cross-sectional and longitudinal data regarding degree of predisposition to CVD and type 2 diabetes mellitus with those showing above cut-off values of waist circumference. Additionally, it also promotes the studies exploring the relation of waist circumference thresholds to the metabolic risks and cardiovascular outcomes [11, 23]. Our study is an attempt to depict the extent of the disease in the specific geographical niche with the demonstration of various adiposity and metabolic indicators. Moreover, we aim to contribute to the ethnic specific information in the same regard.

MATERIAL AND METHODS

Three hundred and ninety seven (397) men (mean age 53.94 yrs) and women (mean age 51.05 yrs), all known patients of type 2 diabetes were recruited for the study. The patients with previously confirmed severe medical diseases, such as cancer, stroke and heart failure were excluded. All the participants gave written informed consent. The study was approved by the institute ethics committee

The patients, who were attending the Diabetes Clinic of the hospital between January 2012 and July 2013 were examined for this study. The patient confidentiality was assured by coding the patients' information and removing the identifiable personal data before data compilation. All the data was part of routine base line and follow up measurements of these patients. The anthropometric measurements, physical examination findings and blood pressure measurements were recorded at the same time. The blood sample (venous) were taken after overnight fasting (≥10 h) along with the urine for biochemical analysis.

Body weight and height were recorded with the subjects dressed in minimal light clothing and without wearing the shoes. The waist circumference was measured from the center point of the distance between iliac crest and the lower most margins of the ribs. The hip circumference was measured between the maximum girths of the buttocks. The mean of three recording was taken from each site for the further calculations. The BMI was calculated as weight (in kilograms)/ height (in meters) squared. Similarly, WHR and WHtR were calculated as ratio of waist to hip and waist to height respectively.

Hypertension was defined by the ongoing use of antihypertensive treatment with systolic blood pressure of ≥140 mm Hg, or diastolic blood pressure of ≥90 mm Hg (24). As per NCEP ATP III criteria (2), the subjects were classified dyslipidemia when presented with one or more of the following including: plasma cholesterol (TC) ≥6.22 mmol/L (240 mg/dl), triglycerides (TG) ≥2.26 mmol/L (200 mg/dl), LDLc ≥4.14 mmol/L (160 mg/dl), or HDLc <1.03 mmol/L (40 mg/dl). Hyperuricemia was diagnosed by serum uric acid ≥420 µmol/l (7.0 mg/dl) in men, or ≥350 µmol/l (6.0 mg/dl) in women [25].

The venous blood samples collected from subjects were centrifuged; the plasma was separated and used for further analysis. The serum total cholesterol (TC), triglycerides (TG) and HDL were measured by enzymatic calorimetric method and serum LDL were calculated by using Friedewald's formula i.e. LDL = TC –HDL –TG/5.0 (mg/dL) [26]. The glucose oxidase method was used to detect glucose and the serum uric acid (UA) was measured by the enzymatic colorimetric method.

The data analysis was performed using R, an open source statistical programming environment for linear regression analysis and to generate logistic regression models, as described in detail previously [27]. The area under the receiver's operating characteristic curve (AUC) was used to compare the predictive ability of anthropometric and biochemical measurements of metabolic abnormalities. The AUC is a measure of the degree of separation between case and control subjects [28, 29]. We used Student's t-test or -chi-square test for comparing the characteristics in the study population and the anthropometric parameters, and P-values less than 0.05 (two-tailed) were considered to be significant.

RESULTS

Table 1 summarizes the characteristics of the subjects. The average age of the men in the study was 53.94 yrs which was higher than the average age of the women included in the study that is 51.05yrs. During the study, it was observed that the men have higher WHR and WC in comparison to the fairer sex.

The women patients with type-2 diabetes tend to have more incidence of hyperuricemia (18.7% vs. 12.2%). Conversely, men are more prone to both dyslipidemia (71.2% vs. 62.0%) and hypertension (56.6% vs. 39.6%).

WHtR is the best predictor for forecasting the development of dyslipidemia (as depicted in Receiver Operating Characteristic (ROC) curve analysis in Figure 1.

In comparison to BMI, the WHR was found to be more effective in predicting dyslipidemia in type-2 diabetic patients (shown in Figure 2 and 3). WHtR is overall best suited for predicting hypertension and dyslipidemia. While, BMI predicted hyperuricemia effectively as shown in Table 2.

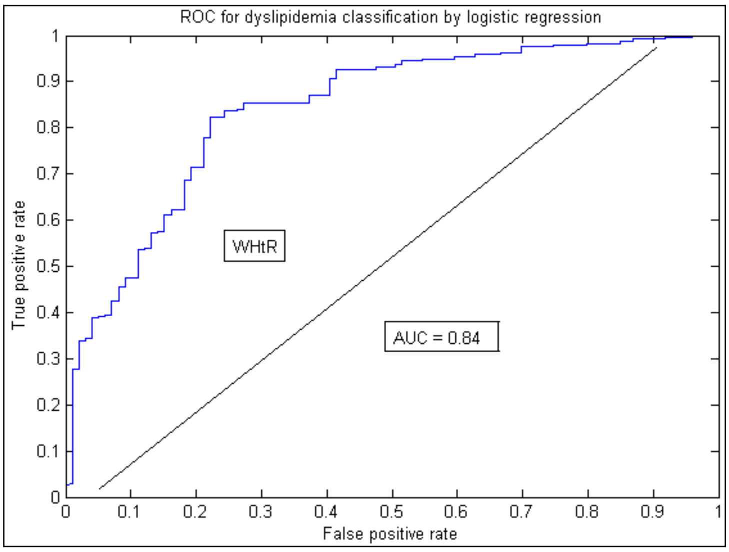

Fig- 1: Receiver operating characteristic (ROC) curve showing area under the curve for waist to height ratio (WHtR) for dyslipidemia

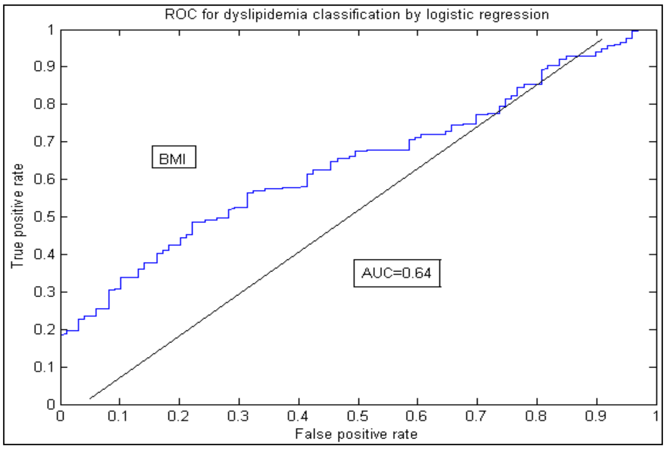

Fig- 2: Receiver operating characteristic (ROC) curve showing area under the curve for body mass index (BMI) for dyslipidemia.

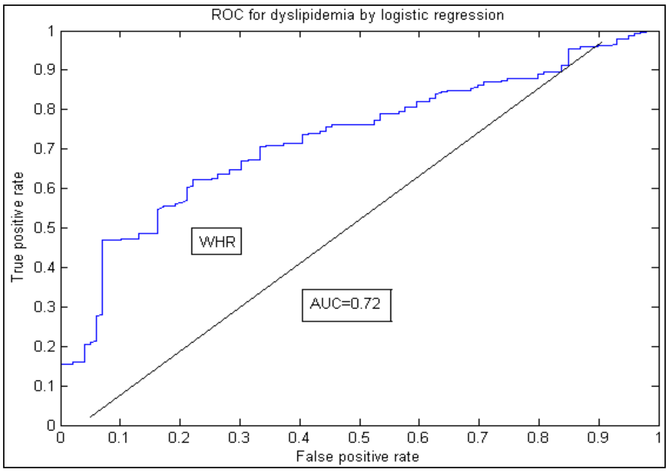

Fig- 3: Receiver operating characteristic (ROC) curve showing area under the curve for waist to hip ratio (WHR) for dyslipidemia.

Table 1: Characteristics of subjects in type-2 diabetes patients

	Female		Male	
	Mean	SD	Mean	SD
Age, year	51.05	(14.17)	53.94	(13.3)
Anthropometric measurements				
BMI, kg/m^2	28.62	(5.57)	28.50	(5.27)
Waist circumference(cm)	95.60	(17.55)	97.61	(18.17)
Hip circumference, cm	99.43	(17.95)	97.0	(16.56)
Waist to hip ratio	0.96	(0.09)	1.05	(0.06)
Waist to height ratio	0.60	(0.10)	0.58	(0.12)
Biochemical indicators				
Total cholesterol (mg/dL)	236.50	(54.68)	223.08	(57.28)
LDLc (mg/dL)	151.74	(45.03)	135.48	(45.82)
HDLc (mg/dL)	39.98	(19.69)	39.25	(18.20)
Triglycerides (mg/dL)	205.12	(105.15)	176.97	(58.46)
BUN (mg/dL)	11.40	(5.77)	12.05	(5.16)
Hemoglobin (mg/dL)	11.37	(1.59)	12.35	(2.07)
HbA1c levels	8.34	(1.10)	7.8	(2.0)
Fasting Blood Glucose (mg/dL)	156.27	(43.55)	157.21	(46.45)
Random Blood Glucose (mg/dL)	176.47	(70.41)	159.29	(56.16)
Blood Pressure				
Systolic (mmHg)	126	(28)	128	(26)
Diastolic (mmHg)	86	(23)	84	(14)

Table 2: The area under the curves for each indices for the presence of the hyperuricemia, hypertension and dyslipidemia in type-2 diabetes patients.

	Hyperuricemia	Dyslipidemia	Hypertension
WC	0.56	0.63	0.62
HC	0.62	0.54	0.61
BMI	0.66	0.64	0.66

WC = Waist circumference (cm), HC = Hip circumference (cm), BMI = Body Mass Index

DISCUSSION

The primary aim while dealing with the people diagnosed with diabetes mellitus is to reduce the underlying risk factors which subsequently lead to the development of the metabolic syndrome. Furthermore, the morbidity risks arising due to both should be taken into consideration. Therefore, such individuals need to be categorized according to the 10 year risk [2].The Framingham Risk Scoring should be estimated to gauge 10 year risk of CAD development [2].

In our study, the men were found to have higher WHR and WC in comparison to the women. It is significant to understand the sex differences while examining the various parameters related to the metabolic syndrome. This is indicated as there are significant morbidity implications in terms of CAD risk. The current guidelines for primary prevention of CAD favor more insistent therapy for the men then the women [30-32]. Earlier studies in the general population indicate that CAD has onset in later ages in the women as compared to the men [33, 34]. Conversely, diabetes signifies greater risk of CAD in the women [35, 36]. Thus, we studied the two sexes, separately in terms of various risk factors and predictors of the severity of the disease.

The mean BMI were recorded as 28.62 and 28.50 in female and male subjects respectively. Though the Expert Consultation Group by WHO agreed that a portion of Asian population has a higher degree of predisposition of diabetes and cardiovascular disease even at the WHO cut-off point for overweight (>=25), yet the cutoff points shall remain the same for the international references [37]. Thus, by the WHO criteria both the sexes were overweight.

In our study it was found that the women with type-2 diabetes tend to have more incidence of hyperuricemia (18.7% vs. 12.2%). Hyperuricemia, besides being an element of metabolic syndrome, additionally worsens the insulin resistance by affecting the insulin stimulated glucose uptake [38]. Recently, meta-analyses expressed that elevated serum uric acid level is an independent risk factor for diabetes mellitus [39, 40]. Hyperuricemia by causing inhibition of nitric oxide leads to the advancement of the vascular lesions [38]. Thus, from the perspective of ascertaining the cardiovascular morbidity and mortality serum uric acid levels should be estimated in a diabetic patient.

On the other hand, our study concluded that the men were more prone to both dyslipidemia (71.2% vs. 62.0%) and hypertension (56.6% vs. 39.6%). Dyslipidemia is frequent in diabetes; and both insulin deficiency and insulin resistance are influenced by it. [41]. Hence, there occurs an atherogenic dyslipidemia which entails a summation of the lipoprotein abnormalities – elevated serum triglycerides, apo-B, increased small LDL particles and reduced HDL-C [2]. Elevated plasma glucose level additionally predisposes to atherosclerosis by various mechanisms [42]. It is a significant issue to consider the sex of the individual as the women suffering from type 2 DM is more likely to have higher levels of triglycerides [43]. This implies that the diabetic female is predisposed to more profound outcome risks.

The treatment strategies are affected by the pattern of dyslipidemia. In accordance with the ATP III guidelines [2], reduction of LDL-C is the primary focus. Furthermore, when the triglycerides>= 200mg/dl, then the subsequent focus of the therapy is the reduction of triglycerides [2]. Statins is the first line of treatment as it reduces LDL-C as well as non-HDL-Cs; with the combined benefit of reducing the risk of cardiovascular events in the presence of metabolic syndrome [44]. The treatment currently advocated is the combination of statins with the fibrates and nicotinic acid as they reduce the cardiovascular events significantly [45-47]. For hypertension, the goal of an antihypertensive therapy is a blood pressure of <140/90mmHg (48). Nonetheless, the target in case of a diabetic patient, is set to be the optimum level of <130/80mmHg (24).

Particularly, in Indian context since a sizeable risk exists at a moderate degree of overweight [37], hence it is prudent for the patients as well as the clinicians to keep a strict vigilance over these anthropometric and laboratory parameters, as were measured in our study. This cautious approach is a cost effective alternative to initiating antihypertensive, especially when a large population exists in the pre-hypertensive category with diabetes or other metabolic risk factors. Various lifestyle amendments are recommended like increasing physical activity, alcohol restraint, salt reduction and dietary modification popularly summated as –Dietary Approaches to Stop Hypertension (DASH) [49].

Amongst the various anthropometric parameters the WHtR was found to be the best predictor of dyslipidemia and hypertension. This is in agreement to the findings of previous studies [49-51]. It has been also regarded as the best predictor of undiagnosed diabetes, when compared to other anthropometric indicators such as BMI, waist circumference and waist to hip ratio [49]. In a comparative study with waist circumference, WHtR is better for predicting the cardiovascular and other outcomes [50]. It is proposed to be employed as a screening tool for those with high metabolic risks [50].

In a study, WHtR has even been proposed to be utilized as a global clinical tool; thereby suggesting a public health note " Keep your waist circumference to less than half of your height" [51].

It has been a fascinating quest to study the comparative predictive values of BMI and the other adiposity indicators. In the current study it was found that in comparison to BMI, WHR was more effective in predicting dyslipidemia in type-2 diabetic patients. On the other hand, BMI predicted hyperuricemia more effectively. These in disagreement to previous studies which indicate waist for height as a better indicator then BMI for various cardiovascular risk factors both in men and women [50-52].

Although, there is a universal understanding of plausible indicators, yet in the contemporary times it is imperative for clinicians to have a precise knowledge of the various anthropometric and laboratory parameters which are an early and unambiguous indicators. It is so since there is a rising incidence of diabetes and the metabolic syndrome. Another enthralling factor for early detection and management are the minimalistic interventions required in the initial stages of the disease. The health care professionals and clinicians play a major role in alerting and conveying this to the patient. The austere cost effective lifestyle measures that could be adopted should be suggested to the patients with high risk factors. It was experienced during the study that the general public awareness was not as appropriate as required for the enforcement of cumulative effort by both the patient and the clinician. As there is a massive upsurge in the incidence of obesity and metabolic syndrome, comprehensive approach for enhancing both the nutrition and physical activity targeting both the individual and the population are required [53].

Thus, by primary prevention the "bud can be nipped early", before it acquires gigantic implications. Given that the syndrome and its repercussions are reversible in the early stages, health care professionals play a crucial role [54]. In any case, if the syndrome proceeds to irreversibility, all efforts should be made to prevent its further progression. In the interim, further studies should be encouraged to document the relative accuracies of bedside parameters in predicting metabolic disorders. It is also recommended to formulate consultation groups and release region and ethnic specific guidelines to be uniformly adopted by the health care practitioners.

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