Original Research Article

A correlational study to assess predictability of diabetes on the basis of different anthropometric and biochemical indicators

Vivek Sharma[1], Neeraj Gour[2]*, Poornima Dey Sarkar[3], Sana Tafseer[4]

[1]Department of Biochemistry, SHKM Government Medical College, Nuh, Haryana, India
[2]Department of Community Medicine, SHKM Government Medical College, Nuh, Haryana, India
[3]Department of Biochemistry, MGM Medical College, Indore, Madhya Pradesh, India
[4]Department of Pharmacology, UCMS, New Delhi, India

*Correspondence:
Dr. Neeraj Gour,
E-mail: drneerajg04@gmail.com

ABSTRACT

Background: Obesity is a complex disorder that involves some degree of over-consumption1 coupled with a metabolic derangement. There are some direct and indirect anthropometric and bio chemical indicators which if measured can provide some clue about development of diabetes among vulnerable group of population.
Methods: This observational cross sectional study was conducted in the Department of Biochemistry at MGM Medical College and MY Hospital. All the patients and controls were clinically examined, and routine biochemical tests were analyzed for all subjects.
Results: Positive and significant correlation was found between BMI and FBS, HBA1C, Leptin, HOMA IR respectively, whereas negative correlation was found between BMI and adiponectin. Same way positive correlation was found between W/H ratio and Leptin, HOMA IR respectively and negative correlation was found with adiponectin.
Conclusions: This is very much evident through this study that various anthropometric and biochemical indicators may be treated as prognostic predictor of diabetes either linked to obesity or not.

Keywords: Anthropometric and biochemical indicators, Diabetes, Obesity

INTRODUCTION

Obesity is a complex disorder that involves some degree of over-consumption coupled with a metabolic derangement.[1] Adipose tissue previously was considered a passive storage depot for fat but is now known to play an active role in metabolism.[2]

In India, the second most populous country in the world and where under-nutrition has been the major public health concern over the past several decades, little attention has been paid to obesity until recently.

Obesity plays a central role in the insulin resistance syndrome, which includes hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and an increased risk of atherosclerotic cardiovascular disease.

An association between obesity and insulin resistance has been reported in adults and children. Weight loss is associated with a decrease in insulin concentration and an increase in insulin sensitivity in adults and adolescents. The intimate relationship between diabetes and obesity has given rise to the term "diabesity" to characterize the

close association of these two disorders and one study showed that overweight/obesity and central obesity were significantly associated with diabetes.[3] In India, the prevalence of diabetes is expected to increase from 31.7 million in2000 to 79.4 million in 2030.[4,5]

There are some direct and indirect anthropometric and bio chemical indicators which if measured can provide some clue about development of diabetes among vulnerable group of population.

This study has attempted to assess some of biochemical and anthropometric predictors of diabetes and obesity and at the same time also tried to find out their correlation with each other.

METHODS

This observational cross sectional study was conducted in the Department of Biochemistry at MGM Medical College and MY Hospital.

Cases were divided into three groups namely, Group 1: normal, healthy adults as control group, Group 2: obese subjects, without diabetes, Group 3: obese subjects, with diabetes. 100 cases were selected in each group.

Convenient sampling method has been adopted for the recruitment of subjects.

The obese diabetic subjects and obese nondiabetic subjects were taken from the outpatient department of Endocrinology, MGM Medical College and MY Hospital while the control subjects were recruited from the subjects coming to the department for a routine health check-up.

A written informed consent from the patient and control was obtained after complete explanation of the study. All the patients and controls were clinically examined and routine biochemical tests were analyzed for all subjects prior to selection.

The BMI and other anthropometric measurement of all subjects were done. The patients on insulin treatment, obesity, hypertension, ischemic heart disease, neurological disorders, renal failure, chronic liver disease, cancer, and immunological disorders were excluded from this study. The study was approved by the institutional ethics committee.

Biochemical assays

3 mL venous blood samples were obtained from the patients as well as controls after 8-10 hours of fasting. All the routine biochemical parameters were analyzed by automated clinical analyzers (Roch P 800 and ELISA). The serum ADA level was measured using a spectrophotometer based on the method by Giusti and Galanti. ADA activity is described as U/L.

Statistical analysis

Appropriate statistical test were applied for the statistical analysis of data. ANOVA has been applied to assess the variance and correlation coefficients have been calculated to find out correlation between two quantitative variables. Significance level has been set as $P < 0.05$ with 95 % confidence level.

RESULTS

This study was conducted in the Department of Biochemistry at MGM Medical College and MY Hospital.

Table 1: Distribution of subjects on the basis of gender.

Groups	Male		Female	
	Number	%	Number	%
Controls (n=100)	81	81	19	19
Obesity with diabetes (n=100)	67	67	33	33
Obesity without diabetes (n=100)	63	63	37	37

Among all three groups maximum males (81%) were in control group whereas majority of females were in other obesity with (33%) and without diabetes (37%) groups (Table 1).

Table 2: Distribution of subjects on the basis of age.

Groups	Age (Years) Mean±SD
Controls (n=100)	56.91±9.37
Obesity with diabetes (n=100)	40.91±8.34
Obesity without diabetes (n=100)	48.10±10.71

Mean age of controls was 56.91 years where as mean age in the group of subjects with obesity with diabetes was 40.91 years and with obesity without diabetes was 48.10 years (Table 2).

Mean BMI of controls was 23.26. Mean BMI in the group of subjects with obesity with diabetes was 32.43 and of subjects with obesity without diabetes were 32.06.

Mean W/H ratio was 1.02 among subjects having obesity with diabetes followed by 1.01 among subjects having obesity without diabetes.

Mean HbA1C was also high (9.15) among obesity with diabetes subjects where as it was more or less same among other two groups.

On contrary when we compared adiponectin level among three groups it was lowest (9.15) among subjects suffering with diabetes and obesity both.

Level of HOMA IR was also very high among subjects having obesity with diabetes and ADA activity (22.71)

has also been found very high in same group (Table 3).

Table 3: Distribution of different anthropometric and biochemical parameters among subjects.

Parameters	Controls (n=100)	Obesity with diabetes (n=100)	Obesity without diabetes (n=100)	ANOVA F Value (p value)
	Mean+SD	Mean+SD	Mean+SD	
BMI (Kg/m^2)	23.26±3.60	32.43±2.27	32.06±2.59	325.6 ((<0.005)
Waist/hip	0.95±.03	1.02±0.08	1.01±0.06	33.81 (<0.005)
FBS (mg/dl)	101.72±9.14	188.09±55.69	103.93±10.56	220.57 (<0.005)
HbA1C (%)	5.68±0.466	9.15±1.65	5.58±0.33	400.81 (<0.005)
Adiponectin (µg/ml)	13.41±5.33	9.15±2.13	12.67±5.13	26.20 (<0.005)
HOMA IR	3.61±1.03	9.76±4.6	4.27±2.0	129.83 (<0.005)
ADA	17.40±1.97	22.71±4.66	21.79±5.05	47.14 (< 0.005)

Table 4: Correlations of anthropometric parameters (BMI) with different biochemical predictor of obesity and diabetes.

Anthropometric parameter		FBS	HBA1C	LEPTIN	Adiponectin	HOMA IR
BMI	Pearson Correlation	0.344	0.341	0.682	-0.180	0.332
	P value	0.005	0.005	0.005	0.002	0.004
	N	300	300	300	300	300

Positive and significant correlation was found between BMI and FBS, HBA1C, Leptin, HOMA IR respectively, whereas negative correlation was found between BMI and adiponectin. Same way positive correlation was found between W/H ratio and Leptin, HOMA IR respectively and negative correlation was found with adiponectin (Table 4 and 5).

Table 5: Correlations of anthropometric parameters (W/H Ratio) with different biochemical predictor of obesity and diabetes.

Anthropometric parameter		Leptin	Adiponectin	HOMA IR
W/H ratio	Pearson correlation	0.341	-0.176	0.123
	P value	0.003	0.002	0.033
	N	300	300	300

DISCUSSION

The study was conducted in the Department of Biochemistry at MGM Medical College and MY Hospital. Volunteer patients diagnosed with mentioned disorder were selected for the study. Complete care was taken in protecting the anonymity of patients and the privacy of patient medical records. Administration of any drug/medication or any surgical procedure to the patients was not involved in the study, only analysis was done. The samples were collected by standard procedures under aseptic conditions. Standard procedures were followed for the preservation and storage of samples before

analysis. There is a global obesity pandemic. However, the prevalence of overweight and obesity among men and women varies greatly within and between countries, and overall, more women are obese than men. These gender disparities in overweight and obesity are exacerbated among women in developing countries, particularly in the Middle East and North Africa. Yet, in developed countries, more men are overweight than women.[6] In present study Healthy subjects (controls) 81 cases are of males which were maximum in comparison of any group, 67 males subjects were in obesity with diabetes and 63 males were there in obesity without diabetes which is minimum in comparison to any group. Elderly obesity worldwide has become a growing public-health concern in developed countries with aging populations. The global epidemic of elderly obesity could be a major risk factor not only for resurgent chronic diseases, such as hypertension, cardiovascular disease, or diabetes, but also for impairing one's quality of life.[7] In present study Mean age of controls, diabetes with obesity and without obesity was 56.91 years, 40.91 years and 48.10 years respectively. Body weight, body mass index (BMI), waist and hip circumferences, waist/hip ratio (WHR), triceps and subscapular skinfolds were all positively predictive of NIDDM independent of age and sex.[8] In present study Mean BMI of controls, diabetes with obesity and without obesity was 23.26, 32.43 and 32.06 respectively. The body mass index (BMI) of subjects was calculated and adenosine deaminase activity was determined in their fasting blood sample. Serum adenosine deaminase activity was significantly increased in overweight and obese subjects and as well as in combined overweight and obese group as compared to control (P <0.0001).[9]

Present study also reported conforming findings i.e. ADA level was far more higher among obese and diabetic patients than normal so ADA measurement can become early predictor of Insulin resistance and in turn for diabetes linked with obesity either.

We investigated the relationship between adenosine deaminase with BMI and FBS and found that adenosine deaminase level has a positive correlation with BMI and FBS (P <0.0001). We also investigated the relationship between adenosine deaminase with insulin resistance (Homa IR) and found that adenosine deaminase level has a positive correlation with insulin resistance. As level of level of adenosine deaminase increases the insulin resistance also increases (P <0.0001). We measured ADA activity in serum of obese subjects and found that ADA activity was significantly increased in obese subjects compare to control and the increase is proportional to increase in BMI (P<0.0001).

Present study supports this mechanism as ADA is increased in obese subjects and the increase is directly proportional to the increase in BMI. By inactivating extracellular adenosine which is spontaneously released by adipocytes, ADA impairs the insulin sensitivity for glucose transport.[10] Although adenosine is endogenous anti-inflammatory agent and may limit cytokine production, various studies have proved that production of TNF-α is increased in obesity.[11] It has also been proved that inhibition of re-phosphorylation of adenosine by adenosine kinase or its degradation by ADA improves survival from sepsis in various models.[12,13]

It has already been proven that ADA is increased in patients with diabetes mellitus.[14] Hence we state that an increase in ADA activity is more than expected and insulin resistance develops in obesity and these obese persons then progress to develop NIDDM and with the background of a country like India, where people are more prone to diabetes, drugs used in the treatment of inflammatory disease such as adenosine kinase inhibitors methotrexate sulfasalazine or aspirin which exert their beneficial effects by releasing adenosine should be given to overweight and obese persons.[15-17]

BMI levels were associated with higher concentrations of leptin, fasting insulin, HOMA and lower concentrations of adiponectin. The physiologic function of leptin is to provide a signal to the brain to decrease appetite, increase fuel consumption and control stores of body fat in and humans. However, instead of leptin deficiency, the leptin concentration was positively associated with adiposity in our study. Positive correlation was found between W/H ratio and Leptin, HOMA IR respectively and negative correlation was found with adiponectin. Body weight, body mass index (BMI), waist and hip circumferences, waist/hip ratio (WHR), triceps and subscapular skinfolds were all positively predictive of NIDDM independent of age and sex. There were modest to strong correlations between these anthropometric variables, however, waist circumference was the strongest predictor of NIDDM. In multivariate analysis, waist circumference was the only significant predictor of NIDDM in models that included other anthropometric variables either separately or simultaneously.[8]

CONCLUSION

This is very much evident through this study that various anthropometric and biochemical indicators may be treated as prognostic predictor of diabetes either linked to obesity or not, though more studies are warranted in same direction to make this finding more conclusive and acceptable biochemical evidence.

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