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ORIGINAL RESEARCH

Comparative study of blood sugar and vaspin in type II obese and non obese diabetic population in Western Rajasthan

Dr. Sapna Sihag[1], Dr. Jairam Rawtani[2] , Dr. Madhu Shekhar Bissa[3], Dr. Jayashree Bhawani[4]

[1]Senior Resident, [2]Senior Professor, Department of Biochemistry, Dr. S.N Medical College, Jodhpur.

[3]Senior Resident, Department of Biochemistry, Dr. B.R Ambedkar Government Medical College, Sirohi.

[4]Junior Resident. M.D. (Pathology) Department of Pathology,Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, Maharastra, India**.**

Corresponding Author:Dr. Sapna Sihag,
Email: sapnasihag81@gmail.com

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Abstract

Introduction:

Diabetes mellitus is associated with multiple diseases and results in various complications. Obesity is known to worsen diabetic complications. Vaspin is expressed in both visceral and subcutaneous adipose tissue depots of obesehumans.

Material and methods:

50 known cases of non-obese type–2 diabetes mellitus (BMI < 30 kg/m^2) and 50 known cases of obese type-2 diabetes mellitus (BMI > 30 kg/m^2) and 25 healthy controls of the age group 30-70 years were included in this study. Anthropometric parameters, plasma glucose concentration, vaspin and HbA1c level were measured in each participant. Student's unpaired t-test (parametric measures) and the Mann–Whitney U test (nonparametric measures) were used to determine statistical significance.

Result:

A statistically highly significant elevated serum vaspin level($t = 11.03$, $p<0.0001$) and blood sugar levels ($t = 13.55$, $p<0.0001$) were observed in Obese subjects when results were compared with healthy controls and non-obese subjects

Conclusion:

The present study concludes that the serum blood sugar and vaspin are related to type II diabetes and obesity.

Introduction:

Diabetes mellitus is a combination of heterogeneous disorders commonly presenting with episodes of hyperglycaemia and glucose intolerance, as a result of lack of insulin , defective insulin action, or both.(1) It is a common disease which is considered epidemic by World Health Organization (WHO). Estimative for world prevalence is around 4.0%and, in Brazil,

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around 7.6%, as shown in the last evaluation. Its incidence in adults and adolescents have been alarmingly rising in developed countries with estimatives for an increase of 60% in the adult population with more than 30 years old in 2025, as the higher prevalence would be present in 45 to 64 years-old adults.(2)

Symptoms of marked hyperglycemia include polyuria, polydipsia, weight loss, sometimes with polyphagia, and blurred vision. Long-term complications of diabetes include retinopathy with potential loss of vision; nephropathy leading to renal failure; peripheral neuropathy with risk of foot ulcers, amputations, and Charcot joints; and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms and sexual dysfunction.(2)(3)

According to the current classification there are two major types: type 1 diabetes (T1DM) and type 2 diabetes (T2DM). The distinction between the two types has historically been based on age at onset, degree of loss of β cell function, degree of insulin resistance, presence of diabetes-associated autoantibodies, and requirement for insulin treatment for survival.(4)

The blood sugar level, blood sugar concentration, or blood glucose level is the concentration of glucose present in the blood of humans and other animals. A persistently high level is referred to as hyperglycemia; low levels are referred to as hypoglycemia.(5)The association of obesity with type 2 diabetes has been recognized for decades, and the major basis for this link is the ability of obesity to engender insulin resistance.(6)

Hemoglobin is the principal carrier of oxygen in the body.(7) Glycated haemoglobin is produced by a ketoamine reaction between glucose and the N-terminal valine of both β-chains of the haemoglobin molecule. The major form of glycated haemoglobin is haemoglobin A1c. When plasma glucose is consistently elevated, the nonenzymatic glycation of haemoglobin increases; this alteration reflects the glycaemic history over the previous 2–3 months(i.e life span of RBC).(7,8)HbA1c is not only a useful biomarker of long-term glycemic control but also a good predictor of lipid profile.There was a linear relationship between HbA1c and dyslipidemia as the levels of serum cholesterol and triglycerides were significantly higher and that of high-density lipoprotein cholesterol were significantly lower in patients with worse glycemic control as compared to patients with good glycemic control.(9)

Vaspin (visceral adipose tissue-derived serine protease inhibitor); also known as Serpin A12) is a 47-kDa protein of 415 amino acids that belongs to the serine protease inhibitor (serpin) family. (10) Vaspin is expressed in both visceral and subcutaneous adipose tissue depots of obesehumans and that its expression may be regulated in an adipose tissue depot-specific manner associated with parameters of obesity, glucose metabolism, and insulin resistance. In human beings, vaspin mRNA or serum concentration was reported to be associated with blood glucose concentration,(11)(12) insulin sensitivity, and body mass index (BMI) or percent body fat(13)in very few studies.

Therefore this study was conducted to evaluate the status of serum blood glucose and serum vaspin levels in Non-Insulin Dependent Diabetes Mellitus and obese Non-Insulin Dependent Diabetes Mellitus patients with an aim to find out the utility of serum vaspin in early diagnosis and better management of type2 Diabetes Mellitus and its complications.

Material and methods:

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The study was conducted in the Department of Biochemistry, in collaboration with Department of General Medicine of Dr. S. N. Medical College and its associated group of Hospitals, Jodhpur. The study period was around 1year from 25-8-2020 to 25-8-2021. The study population was recruited from the Type-2 diabetic patients attending the diabetes clinics at M.D.M. Hospital, Jodhpur during the data collection period and fulfilling the inclusion criteria. An ethical clearance was obtained from the ethical committee of Dr. S. N. Medical College, Jodhpur and an informed consent was taken from all the Type-2 diabetic patients and non-diabetic subjects who participated in the study

50 known cases of non-obese type–2 diabetes mellitus (BMI < 30 kg/m^2) and 50 known cases of obese type-2 diabetes mellitus(BMI > 30 kg/m^2) and 25 healthy controls of the age group 30-70 years were included in this study. Type 1 diabetes mellitus patients, patient suffering from liver disease/cardiovascular disease/any other metabolic disease or disorder other than type–2 diabetes mellitus and patient who did not agree to give the informed consent were excluded from the study.

Height was measured to the last millimeter using a portable stadiometer, and weight was recorded to the nearest 0.11 kg using a standardized electronic digital scale. Using the measurements, BMI (weight in kilograms divided by the square of the height in meters: kg/m2) was then computed.

Fasting (12 h) venous blood samples were collected by venipuncture into vacutainer tubes. Once centrifuged, the fractions were separated. Plasma glucose levels were measured by the glucose oxidase method with an RA-1000 auto analyzer. The HbA1c analysis was performed using highpressure liquid chromatography on a Bio-Rad Variant II instrument.Serum vaspin level was measured with a commercial ELISA kit according to the manufacturers' instructions.

The statistical analysis was performed using SPSS/5. Student’s unpaired t-test (parametric measures) and the Mann–Whitney U test (nonparametric measures) were used to determine statistical significance. To compare means across different glycemic categories, one-way ANOVA analysis was utilized. P values <0.01 were considered statistically significant.

Results

In the present study, the mean age for Healthy controls, Non-obese and Obese NIDDM subjects was 52.66±4.12 years, 55.12±3.95 years and 57.67±5.10 years respectively. The mean body weight was 60.32±3.83 kg, 63.93±6.74 kg and 77.32±10.59 kg in healthy controls, non-obese and obese subjects NIDDM respectively. The mean height was 1.58±0.03 meters, 1.62±0.04 meters and 1.68±0.06 meters in healthy controls, non-obese and obese NIDDM subjects respectively. The mean BMI was 20.22±2.62 kg/m^2, 23.34±2.36 kg/m^2 and 31.38±4.68 kg/m^2 in healthy controls, non-obese and obese NIDDM subjects respectively.

Fasting Serum Glucose:

Mean fasting serum glucose in the Healthy controls, Non-obese and Obese NIDDM subjects was 87.54±11.19, 154.59±15.96 and 197.38±32.66 mg/dl, which varies from 70-104, 140-175 and 165-240 mg/dl, respectively (table 1)

A statistically highly significant elevated fasting serum glucose level was observed in Obese NIDDM subjects ($t = 8.95$, $p<0.001$) when results were compared with Healthy subjects. A statistically significant elevated fasting serum glucose level was observed in Non-obese NIDDM subjects ($t = 2.03$, $p=0.48$) when results were compared with Healthy subjects. A statistically very significant elevated fasting serum glucose level was observed in Obese NIDDM subjects ($t = 5.65$, $p<0.01$) when results were compared with Non-obese NIDDM

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subjects.(Table 2)

Table 1: Mean Fasting Serum Glucose (mg/dl) of the subjects studied.

Group Studied (n)	Fasting Serum Glucose (mg/dl) (Mean ± S.D.)		
	Male	Female	Total
Healthy Controls (25)	90.23±12.25 (80-104)	84.86±10.14 (70-90)	87.54±11.19
NIDDM Patients Without obesity (50)	160.54±16.41 (160-175)	148.65±15.52 (140-165)	154.59±15.96
NIDDM Patients with obesity (50)	204.37±32.04 (175-240)	190.38±29.28 (165-225)	197.38±32.66

Table No.-2 : Statistical analysis of Fasting Serum Glucose (mg/dl) among the groups studied.

Groups Compared	t-value	p-value	Statistical Significance

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Healthy Controls V/S NIDDM Patients without Obesity	2.03	0.48	**Significant**
Healthy Controls V/S NIDDM Patients with Obesity	8.95	<0.001	**Highly Significant**
NIDDM Patients without Obesity V/S NIDDM Patients with Obesity	5.65	<0.01	**Very Significant**

Mean HbA1C level in the Healthy controls, Non-obese and Obese NIDDM subjects was5.04±0.62%, 6.37±0.53% and 6.79±1.91 %, which varies from 4.4-5.6%, 6-6.8% and 6.2-7.2 %, respectively. (table 3)

A statistically highly significant elevated HbA1C level was observed in Obese NIDDM subjects ($t = 13.55$, $p<0.001$) when results were compared with Healthy subjects. A statistically significant elevated HbA1C level was observed in Non-obese NIDDM subjects ($t = 3.12$, $p=0.59$) when results were compared with Healthy subjects. A statistically significant elevated HbA1C level was observed in Obese NIDDM- subjects ($t = 4.23$, $p=0.89$) when results were compared with Non-obese NIDDM subjects. (Table 4)

Table-3:MeanHbA1C Level (%) of the subjects studied.

Group Studied (n)	**HbA1C (%)(Mean ± S.D.)**		
	Male	**Female**	**Total**
Healthy Controls (25)	5.28±0.64 (4.9-5.6)	4.81±0.61 (4.4-5.0)	5.04±0.62
NIDDM Patients Without obesity	6.49±0.55 (6.2-6.8)	6.26±0.52 (6.1-6.4)	6.37±0.53

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(50)			
NIDDM Patients with obesity (50)	7.06±2.36 (6.8-7.2)	6.53±1.46 (6.2-6.8)	6.79±1.91

Table No.-4: Statistical analysis ofHbA1C (%) Level among the groups studied.

Groups Compared	t-value	p-value	Statistical Significance
Healthy Controls V/S NIDDM Patients without Obesity	3.12	0.59	**Significant**
Healthy Controls V/S NIDDM Patients with Obesity	13.55	<0.0001	**Highly Significant**
NIDDM Patients without Obesity V/S NIDDM Patients with Obesity	4.23	0.89	**Significant**

Mean serum vaspin in the Healthy controls, Non-obese and Obese subjects was 309.78±49.34pg/ml, 494.56±184.37pg/mland 1121.52±432.94 pg/ml, which varies from 170-350pg/ml, 170-745pg/mland 165-2000 pg/ml, respectively.(table 5)

A statistically highly significant elevated serum vaspin level was observed in Obese subjects ($t = 13.07$, $p<0.0001$) when results were compared with Healthy subjects. A

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statistically highly significant elevated serum vaspin level was observed in Non-obese subjects ($t = 10.66$, $p<0.0001$) when results were compared with Healthy subjects. A statistically highly significant elevated serum vaspin level was observed in Obese subjects ($t = 11.03$, $p<0.0001$) when results were compared with Non-obese subjects.(table 6)

Table-5:**Mean Serum Vaspin (pg/ml) of the subjects studied.**

Group Studied (n)	**Vaspin (Mean ± S.D.)**		
	Male	**Female**	**Total**
Healthy Controls (25)	322.33±52.39 (185-350)	297.23±46.29 (170-326)	309.78±49.34
NIDDM Patients Without obesity (50)	518.48±185.52 (180.2-745.4)	470.64±183.22 (170.0-702.5)	494.56±184.37
NIDDM Patients with obesity (50)	1230.91±452.35 (810.42-2000.1)	1013.79±413.53 (765.2-1895.71)	1121.52±432.94

Table No.-6: Statistical analysis of Serum Vaspin (pg/ml) among the groups studied.

Groups Compared	**t-value**	**p-value**	**Statistical Significance**

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Healthy Controls V/S NIDDM Patients without Obesity	10.66	<0.0001	**Highly Significant**
Healthy Controls V/S NIDDM Patients with Obesity	13.07	<0.0001	**Highly Significant**
NIDDM Patients without Obesity V/S NIDDM Patients with Obesity	11.03	<0.0001	**Highly Significant**

Discussion:

Type 2 diabetes is described as a combination of low amounts of insulin production from pancreatic β-cells and peripheral insulin resistance. Insulin resistance leads to elevated fatty acids in the plasma, causing decreased glucose transport into the muscle cells, as well as increased fat breakdown, subsequently leading to elevated hepatic glucose production. (14)

Obesity is considered the most important risk factor in the development of metabolic diseases. Adipose tissue affects metabolism by secreting hormones, glycerol, and other substances including leptin, cytokines, adiponectin, and proinflammatory substances. (15)

Expression of vaspin gene in visceral adipose tissue of humans and an increased circulating levels in the serum was found be positively associated with parameters of obesity, obesity related diseases, insulin resistance, and glucose metabolism.(16) Present study was aimed at estimating the serum vaspin levels in obese subjects and investigating the role of vaspin as a biomarker for insulin resistance and the obesity related metabolic alterations

Haslam and James quoted that that excessive body weight has strong link to many diseases and conditions, particularly cardiovascular, type 2 diabetes mellitus, obstructive sleep apnea and certain type of cancer.(17)

In this study a statistically highly significant elevated fasting serum glucose level was observed in Obese NIDDM subjects ($t = 8.95$, $p<0.001$) when results were compared with Healthy subjects. Keshab Raj Joshi and Harno K et al (2014) found similar results as the fasting blood glucose levels was found to be significantly ($p<0.02$) high in Type -2 diabetic mellitus patients, than control. (18)(19)

A statistically significant elevated HbA1C level was observed in Obese NIDDM-subjects ($t = 4.23$, $p=0.89$) when results were compared with Non-obese NIDDM subjects.

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Sisodia and Chouhan et al (2019) found that abnormal increase in BMI (Obesity) was associated with poor glycemic control (HbA1c).(20)Similarly Tomic Martina et al (2003) (199) conducted a similar study and found that there was a significant positive correlation between BMI and HbA1c.(21)

One of the most recently discovered adipokines is vaspin, a VAT-derived serine protease inhibitor with insulin-sensitizing effects, belonging to the serpin superfamily, clade A (Serpina12). Nakatsuka et al (2013) have indicated that changes in the vaspin gene are responsible for its compensatory effects on the metabolic abnormalities with regard to obesity. Several studies have shown a positive correlation between vaspin gene expression and the components of MetS(22) Kloting et al (2006) have investigated vaspin mRNA expression as an indicator for obesity and its association with anthropometric and metabolic parameters in VAT and subcutaneous adipose tissue (SAT) samples.(23)

A statistically highly significant elevated serum vaspin level was observed in Obese subjects ($t = 11.03$, $p<0.0001$) when results were compared with Non-obese subjects. (Table 6) The results of present study are in accordance to **Dai et al.** (24) and **Yang et al.** (25)

Conclusion:

Vaspin is expressed in both visceral and subcutaneous adipose tissue and is reported to be associated with blood glucose concentration. Thus the present study concludes that vaspin and blood glucose are related to type II diabetes and obesity.

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