Original Research Paper

Volume-9 | Issue-3 | March-2019 | PRINT ISSN - 2249-555X

Biochemistry

A STUDY OF INSULIN RESISTANCE, B -CELL FUNCTION AND LIPID PROFILE IN TYPE II DIABETES MELLITUS

Dr Mohini Rathore* Resident Doctor, Third Year Department of Biochemistry, Government Medical College, Government Medical College, Kota-324010.*Corresponding Author

Dr.Gulab Kanwar Senior Professor and Head, Department of Biochemistry, Government Medical College, Kota-324010

ABSTRACT Type 2 diabetes is associated with a cluster of interrelated plasma lipid and lipoprotein abnormalities, including reduced HDL cholesterol, a predominance of small dense LDL particles, and elevated triglycerides. This study was conducted to demonstrate the effect of altered lipid profiles of the established cases of diabetes mellitus two patients on their insulin resistance states as depicted by their HOMA scores. This study is a cross-sectional analysis of the samples collected at New Medical College, Kota. One hundred four subjects ≥40 years were selected from the elderly population, which were established cases of type 2 DM. The same number of healthy non-diabetic subjects were evaluated. When the diabetic group and the control group were compared, significant statistical differences were observed in age, fasting blood sugar, serum cholesterol, serum triglycerides, serum VLDL, HB1AC, serum insulin, HOMA2-IR and HOMA Beta scores. No significant statistical difference was observed between diabetic and control group in regards to serum HDL levels. The findings reflect that altered lipid profile, serum insulin, Hb1AC, HOMA-IR, HOMA-B and fasting insulin are independent predictors of type 2 diabetes mellitus.

KEYWORDS : HOMA scores, type 2 diabetes mellitus, lipid profile, serum insulin, Hb1AC

INTRODUCTION

Diabetes is a metabolic illness that affects 422 million people worldwide, and it is the underlying cause of morbidity and mortality for many other chronic diseases . Diabetes mellitus type 2 (also known as type 2 diabetes) is a long-term metabolic disorder that is characterised by high blood sugar, insulin resistance, and relative lack of insulin. Type 2 diabetes mellitus is the most common form of diabetes and is currently a major worldwide cause of morbidity and mortality.

Type 2 diabetes is known to be linked with a constellation of interrelated lipoprotein and plasma lipid and abnormalities, including reduced HDL cholesterol, a predominance of small dense LDL particles, and elevated triglycerides. This study was conducted to demonstrate the effect of altered lipid profiles of the established cases of diabetes mellitus two patients on their insulin resistance states as depicted by their HOMA scores. The motto of our study is to make aware of the prediabetic population about regular screening so that preventive measures can be initiated in due time to lessen the atherogenic risk and manifestations of diabetes.

The objectives of the present study are:
1. To study the serum insulin level in type 2 DM
2. To calculate the HOMA index and B- cell function in type 2 DM
3. To study the serum lipid profile in type 2 DM

MATERIALS AND METHODS

The Ethical Committee of our college approved the study. This study is a cross-sectional analysis in the samples collected in time duration from January 2017 to January 2018 at New Medical College, Kota. The study highlights the risk factors found in the literature such as age, gender, lipid profiles, insulin resistance, and others. Data about glycemic levels were gained from the examinations and laboratories files, which displayed glycemic measures using the Fasting blood sugar, Serum insulin and HbA1c method. One hundred four subjects ≥40years were selected as a sample population. These are the definitively diagnosed patients of diabetes mellitus type 2 and were regularly visiting the outdoor department for follow-ups. Same numbers of patients were taken as the control population. Lifestyle factors and clinical conditions were collected, physical examinations were conducted, and laboratory variables related to Fasting Plasma Glucose test (FPG), haemoglobin A1C (HbA1c), insulin and HOMA indices were measured.

LDL levels were calculated using Friedewald's equation:
LDL = Total cholesterol - HDL - Triglycerides/5
VLDL has been traditionally defined as the total cholesterol that is neither HDL nor LDL. Then Friedewald's equation mentioned above yields:

VLDL = Triglycerides/5

Updated HOMA models (HOMA2 IR and HOMA-B) were calculated using fasting glucose and fasting insulin in a steady-state condition [fasting glucose: 3–25 mmol/L and fasting insulin: 2.88–43.16 lU/mL (20–300-pmol/L)] by HOMA calculator for specific insulin version 2.2.3 available from http://www.dtu.ox.ac.uk/homacalculator which takes inputs as shown below in figure 1:

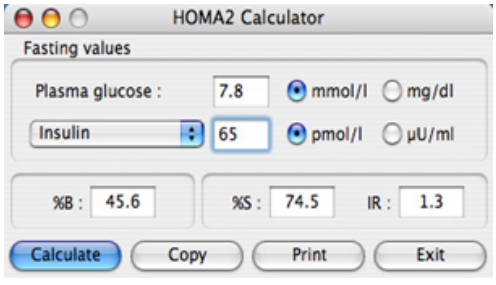

Figure 1: Layout of HOMA calculator software

Quantitative data were summarised in the form of MEAN ± SD and comparison of various parameters was done by Student's t-test. The level of significance was kept 95% for all statistical analysis. Quantitative data were summarised in the form of MEAN ± SD and comparison of various parameters was done by Student's t-test. The level of significance was kept 95% for all statistical analysis.

OBSERVATIONS AND RESULTS

Detailed descriptive statistics of the variables showing their minimum and maximum values, mean, standard deviation and standard error mean for both the diabetic group and the control of the study is depicted in table number 1.

Table 1: Descriptive statistics of variables considered in the study

Variable	Groups (n=104)	Min	Max	Mean	SD	SE Mean
AGE (Years)	Control	40	62	54.68	4.48	0.44
	Case	45	65	59.93	3.93	0.39
FBS (mg/dL)	Control	65	110	88.19	10.77	1.06
	Case	127	266	156.87	24.91	2.44

S. Cholesterol (mg/dL)	Control	170	199	184.70	9.17	0.90
	Case	36	467	202.50	58.70	5.76
S. Triglyceride (mg/dL)	Control	101	140	122.56	11.64	1.14
	Case	22	796	202.53	124.82	12.24
S.VLDL (mg/dL)	Control	08	42	25.38	8.67	0.85
	Case	09	709	48.98	69.25	6.79
S.HDL (mg/dL)	Control	41	64	57.19	16.71	0.62
	Case	15	118	54.83	6.33	1.64
Hb1AC (%)	Control	04	06	4.93	0.61	0.06
	Case	06	09	7.02	0.76	0.07
S.INSULIN (µU/mL)	Control	05	20	10.92	3.37	0.33
	Case	25	55	33.09	5.79	0.57
HOMA-IR	Control	1	3	1.39	0.42	0.04
	Case	3	8	4.65	0.81	0.08
HOMA-β	Control	60	290	129.39	44.78	4.39
	Case	36	144	98.90	21.62	2.12

Statistical difference between cases and controls has been shown in table 2.

Table 2: Statistical difference between cases and controls

Variable	p-Value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
				Lower	Upper
AGE (Years)	<.001	2.25	.58429	3.40	1.10
FBS (mg/dL)	<.001	68.68	2.661	73.92	63.43
S. Cholesterol (mg/dL)	.003	17.80	5.826	29.28	6.31
S. Triglyceride (mg/dL)	<.001	79.97	12.293	104.21	55.74
S.VLDL (mg/dL)	<.001	23.61	6.843	37.10	10.11
S.HDL (mg/dL)	.179	2.37	1.752	5.82	1.09
Hb1AC (%)	<.001	2.09	.095	2.28	1.90
S.INSULIN (µU/mL)	<.001	22.16	.657	23.46	20.87
HOMA-IR	<.001	3.26	.090	3.43	3.08
HOMA-β	<.001	30.49	4.876	20.88	40.10

In diabetics, the mean age was 59.93 years with a standard deviation of 3.93, while in the non-diabetics the mean age was 54.68 with a standard deviation of 4.48. Out of the 104 cases in the control group, about 40 % were females, and 60 % were males whereas in the diabetic group 32 % were females and 68 % were males. In diabetics serum fasting blood sugar mean was 156.87 mg/dl with a standard deviation of 24.913 and in control, the mean was 88.19 mg/dl and a standard deviation of 10.767. The mean fasting blood sugar was higher in people with diabetes as compared to non-diabetics. In the sample population serum triglycerides mean was 202.53 mg/dl with a standard deviation of 124.822 and in control, the mean was 122.56 mg/dl and a standard deviation of 11.637. The mean serum triglycerides were higher in

diabetics as compared to non-diabetics. One case showed serum cholesterol level to be 796 mg/dl indicating the possibility of lipid metabolism disorder. In the sample population serum cholesterol mean was 202.50 mg/dl with a standard deviation of 58.699 and in control, the mean was 184.7 mg/dl and a standard deviation of 9.165. The mean serum cholesterol was higher in diabetics as compared to non-diabetics. One case showed serum cholesterol level to be 467 mg/dl indicating the possibility of lipid metabolism disorder. In the sample population serum VLDL mean was 48.98 mg/dl with a standard deviation of 69.25 and in control, the mean was 25.38 mg/dl and a standard deviation of 8.667. The mean serum cholesterol was higher in diabetics as compared to non-diabetics. In the sample population serum HDL mean was 54.83 mg/dl with a standard deviation of 6.328 and in control, the mean was 57.19 mg/dl and a standard deviation of 16.711. The mean serum HDL was lower in diabetics as compared to non-diabetics. P value between the diabetic and non-diabetic was .179 and thus insignificant statistically.

In people with diabetes serum Hb1AC mean was 7.02 % with a standard deviation of 0.756 and in control, the mean was 4.93 % and standard deviation of 0.605. The mean Hb1AC was higher in diabetics as compared to non-diabetics.In the sample population serum insulin mean was 33.09 µU/mL with a standard deviation of 5.788 and in control, the mean was 10.92 µU/mL and a standard deviation of 3.367. The mean serum insulin was higher in diabetics as compared to non-diabetics. P value between the diabetic and non-diabetic was <0.001.

In diabetics serum HOMA2-IR mean was 4.65 with a standard deviation of 0.814 and in control, the mean was 1.39 and a standard deviation of 0.423. The mean HOMA2-IR was higher in diabetics as compared to non-diabetics. In the sample population HOMA2-β mean was 98.90 with a standard deviation of 21.620 and in control, the mean was 129.39 and standard deviation of 44.775. The mean HOMA2-β was lower in diabetics as compared to non-diabetics. P value between the diabetic and non-diabetic was <0.001.

DISCUSSION

Our study revealed that fasting blood sugar, serum cholesterol, serum triglycerides, serum VLDL, HB1AC and serum insulin levels were significantly higher in the established cases of diabetes mellitus type 2 cases taking P<0.001* which was statistically significant. It was also observed that there was no significant statistical difference was found between diabetic and control group in regards to serum HDL levels.

The clinical study by Ozder A [2], showed the mean age of diabetics to be 55.3 ± 10.5, mean Glucose (FBG) among males to be 217.1 ± 57.5 mg/dl, mean Glucose (FBG) among females 196.7 ± 61.2 mg/dl, mean HbA1c among males to be 8.84 ± 1.53 mg/dl, mean HbA1c among females to be 8.46 ± 1.49

mg/dl. The same study showed mean values of lipid profile variables to be, TC to be 219.1 ± 34.7 mg/dl, TG to be 250.0 ± 100.7mg/dl, HDL to be 30.2 ± 7.4 mg/dl and LDL to be 125.7 ± 21.4 mg/dl. Similar to our study, Elnasri HA and Ahmed AM[3] in their research found that there was a statistically significant association of triglycerides with poor glycaemic control of diabetes. The same study found a substantial difference in the values of HDL, contrary to the present study. Identical results were shown in a study done by Lal, S.[4] which revealed that total serum cholesterol, LDL cholesterol and triglycerides were significantly raised (p<0.0001) whereas the level of HDL cholesterol was significantly lower (p<0.0001) in diabetic subjects as compared to control.

Our study gives similar results to a study which showed that at ≥1.7 cut off values the HOMA2-IR values were 2.10–8.55 in patients of metabolic syndrome at 95% confidence intervals. A study by Geloneze, B. et al. [5] showed similar values of HOMA2-IR in patients of insulin resistance (IR) and metabolic syndrome (MS). The cut-off values for IR were: HOMA2-IR > 1.8; and, for MS were: HOMA2-IR > 1.4 (sensitivity: 79.2%; specificity: 61.2%). In a recent study conducted by Basukala, P. et al. [6]on 60 newly diagnosed cases of type two diabetes mellitus similar results regarding HOMA indices were observed. The mean IR and beta-cell function were HOMA2IR=2.61 ± 1.06 and; HOMA2%B=47.10 ± 24.67 respectively. This is in coherence with the findings of our study although the authors have given lower mean values of HOMA2-IR and HOMA2-β scores.

In the study conducted by Song, S.K.[7] among the diabetic population in Korea it was concluded that HOMA2-β was also a stronger predictor of diabetes and its values were significantly correlated with the diabetic population.

In the Tehran Lipid and Glucose Study[8], after 9.2 year follow-up, 346 (7.0 %) incident cases of type 2 diabetes mellitus were identified, and this was observed that optimal cut-off points for HOMA2-IR, HOMA2-B, and insulin were 1.41, 72.5 and 11.13 lU/ ml in women and 1.18, 74.6 , and 9.16 lU/ml in men, respectively. The HOMA2-IR and HOMA2-β values of this study are lower than the present study since in our study results are displayed in the mean±SD format, while

in the Tehran Lipid and Glucose Study the results have been viewed as cut-offs.

These findings reflect that altered lipid profile, serum insulin, Hb1AC, HOMA-IR, HOMA-B and fasting insulin are independent predictors of type 2 diabetes mellitus.

CONCLUSION

The present study suggested that common lipid abnormalities during diabetes-induced dyslipidemia are hypercholesterolemia, hypertriglyceridemia and elevated LDL cholesterol. The HOMA analysis allows assessment of primary β-cell function and insulin sensitivity and can characterise the pathophysiology in those with abnormal glucose tolerance. In our study, HOMA2-IR and HOMA Beta scores showed a significant statistical difference in the sample and control population. Results suggest a high prevalence of dyslipidemia, which might be playing a substantial role in the development of cardiovascular diseases and cerebrovascular accidents among diabetic patients. The optimal care for diabetic patients should include routine monitoring of blood glucose and serum lipid profile. Thus lipid profile, serum insulin levels, serum Hb1AC levels along with the HOMA scores are simple investigations which helps to estimate future cardiovascular morbidity and mortality among diabetes mellitus type 2 subjects.

Patient education on diabetes management and lifestyle modifications is the cornerstone of effective diabetes control and management and prevention of complications.

REFERENCES

1. Kharroubi AT, Darwish HM. Diabetes mellitus: The epidemic of the century. World journal of diabetes. 2015;6(6):850-67.
2. Ozder A. Lipid profile abnormalities seen in T2DM patients in primary healthcare in Turkey: a cross-sectional study. Lipids in health and disease. 2014;13:183-.
3. Elnasri H, Ahmed A. Patterns of lipid changes among type 2 diabetes patients in Sudan2008. 314-24 p.
4. Smith S, Lall AM. A study on lipid profile levels amoung diabetics and non diabetics in naini India2009; 33(4):[138–41 pp.].
5. Geloneze B, Vasques AC, Stabe CF, Pareja JC, Rosado LE, Queiroz EC, et al. HOMA1-IR and HOMA2-IR indexes in identifying insulin resistance and metabolic syndrome: Brazilian Metabolic Syndrome Study (BRAMS). Arquivos brasileiros de endocrinologia e metabologia. 2009;53(2):281-7.
6. Basukala P, Jha B, Yadav DB, Krishna Shrestha P. Determination of Insulin Resistance and Beta-Cell Function Using Homeostatic Model Assessment in Type 2 Diabetic Patients at Diagnosis2018; 09(3):[790 p.].
7. Song YS, Hwang YC, Ahn HY, Park CY. Comparison of the Usefulness of the Updated Homeostasis Model Assessment (HOMA2) with the Original HOMA1 in the Prediction of Type 2 Diabetes Mellitus in Koreans. Diabetes & metabolism journal. 2016;40(4):318-25.
8. Ghasemi A, Tohidi M, Derakhshan A, Hasheminia M, Azizi F, Hadaegh F. Cut-off points of homeostasis model assessment of insulin resistance, beta-cell function, and fasting serum insulin to identify future type 2 diabetes: Tehran Lipid and Glucose Study. Acta diabetologica. 2015;52(5):905-15.