Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/17100
DOI URL: http://dx.doi.org/10.21474/IJAR01/17100

RESEARCH ARTICLE

A CORRELATIVE STUDY OF FASTING BLOOD SUGAR, BODY MASS INDEX AND DURATION OF DIABETES WITH FASTING C-PEPTIDE LEVEL IN TYPE 2 DIABETES MELLITUS PATIENTS

Dr. Vinayshree R. Harsoor and Dr. Basavaraj Mangshetty

Manuscript Info

Manuscript History
Received: 15 April 2023
Final Accepted: 19 May 2023
Published: June 2023

Abstract

Background: Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. It occurs either due to insulin deficiency or insulin resistance. It is an ongoing progressive disorder. The long term complications can be prevented by early screening of diabetes and initiating treatment. Progression of the disease is depicted in the form of worsening hyperglycemia, which may either be due to decreasing secretory activity of beta cells of pancreas or increasing insulin resistance, or in the form of progression of complications. The worldwide prevalence of diabetes mellitus has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 415 million in 2017. Adding to this burden is the increasing incidence of type 2 diabetes mellitus. Hence, there is a need to understand the pathophysiology of diabetes, insulin secretion and insulin resistance and overcome them. One such way is to measure beta cell secretory activity. Measurement of C-peptide, which is secreted along with Insulin, provides a better index of endogenous insulin production and pancreatic beta cell function.

Materials And Methods: It is a prospective interventional study done by simple random procedure, over a period of 18 months (1st March 2021 to 31st August 2022) with 200 cases.

Results: Study reveals that there is no statistically significant difference of mean FBS with Quantile C-peptide levels. But there is statistically significant negative correlation between duration of diabetes and C-peptide levels in the study population ($p<0.05$). As duration of diabetes increases, C-peptide value decreases. And, there was statistically highly significant positive correlation between BMI and C-peptide levels in the study population ($p<0.001$). As BMI value increases, C-peptide level also increases.

Conclusion: This study suggests that BMI and duration of diabetes are major factors in ß cell function in people with diabetes.

Introduction:-

Diabetes mellitus refers to a group of commom metabolic disorders that share the phenotype of hyperglycemia.[1] It occurs either due to insulin deficiency or insulin resistance. It is an ongoing progressive disorder.

Corresponding Author:- Dr. Vinayshree R. Harsoor

Type 1 DM is caused by pancreatic β cell destruction by auto antibodies, leading to defect in insulin synthesis and secretion.[2] Type 2 DM results from a combination of impaired β cell function[3] and marked increase in peripheral insulin resistance at receptor/ post receptor levels. Their circulatory levels of insulin may be variable from hyper to normo-insulinemic levels in majority of patients.

Type 2 DM is a major health problem worldwide[4]. The worldwide prevalence of diabetes mellitus has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 415 million in 2017.[5] According to IDF Diabetes Atlas 2021, in 2021, it is estimated that 537 million people have diabetes and type 2 diabetes is the most common type of diabetes, according for over 90% of all diabetes worldwide. India accounts for 1 in 7 all adults living with diabetes worldwide.

Treatment is based on underlying pathophysiology of diabetes mellitus and not on symptoms, taking into account the insulin secretory capacity of pancreatic β cell and peripheral resistance to insulin action occurring primarily in liver, muscle and adipose tissue. Measurement of C-peptide, which is co-secreted with insulin from ß cells of pancreas (as proinsulin) provides an index of endogenous insulin production and pancreatic ß cell function. Once diabetes is diagnosed, assay for C-peptide can be used to differentiate type 1 and type 2 behavior and to distinguish those who require insulin treatment from others.

Objectives:-

1. To study and C-peptide level with Fasting Blood Sugar in patients of type 2 diabetes mellitus.
2. To correlate Body Mass Index and duration of type 2 diabetes mellitus with fasting C-peptide level.

Materials And Methods:-

It is a prospective interventional study done by simple random procedure, over a period of 18 months (1st March 2021 to 31st August 2022) with 200 cases.

Inclusion criteria:

1. Patients attending OPD with type 2 diabetes mellitus (on Oral Hypoglycaemic Agents or Oral Hypoglycaemic Agents+Insulin).
2. Age more than 18 years.
3. Patients of either gender.

Exclusion criteria:

1. Admitted patients.
2. Patients with Type 1 diabetes mellitus or Type 3C diabetes mellitus or newly diagnosed diabetes or pre-diabetic.
3. Patients with duration of diagnosed diabetes mellitus less than 1 year.
4. Patients with acute illness like acute pancreatitis, acute hepatitis, chronic liver disease, acute kidney injury, coronary artery disease, cerebrovascular accident.
5. Patients with chronic kidney disease.

Method of Collection of Data:-

The study was performed on patients attending out-patient services at tertiary care center. A detailed history was obtained from qualifying patients using a pre-designed, structured proforma. Further, a detailed systemic examination, followed by relevant investigations was conducted and the results were noted. Anthropometric data including height, weight, waist circumference and hip circumference were measured by trained personnel obeying the standard procedure of measurement as described below. Height was measured (to ±1cm) in all included patients at baseline using a wall-mounted stadiometer. Body weight was measured (to ±0.1kg) with the individuals wearing light clothing and without shoes, using an electronic calibrated scale. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). Clinical examination including blood pressure recording was done. Blood pressure was measured using standard methods in right arm sitting posture by an aneroid manometer.

Blood samples were collected for biochemical tests in overnight fasting state. Fasting is defined as no calorie intake for atleast 8 hours. Two hours after meals is taken as postprandial. Part of the sample was allowed to clot and serum was separated by centrifuging on site and samples were immediately sent for biochemical examination at a

NABL accredited laboratory for measurement of creatinine, lipid profile, uric acid, alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP). Rest of the blood sample collected were anticoagulated with EDTA for fasting blood sugar (FBS), glycated hemoglobin (HbA1c). The samples were analyzed using standard laboratory procedure. Quantitative measurement of C-peptide in serum was done using a two-site immunoezymometric assay.

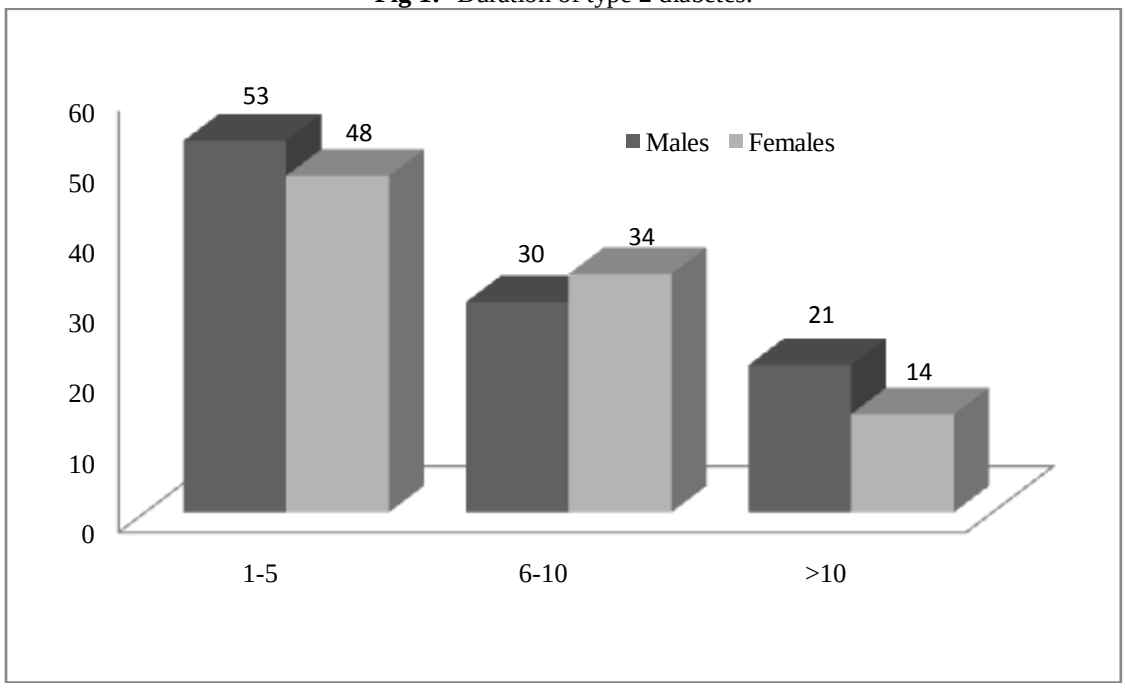
Results:-

Duration of type 2 diabetes

Table 1:- Duration of type 2 diabetes.

Duration in years	Males		Females		Total	
	No	%	No	%	No	%
1-5	53	51.0	48	50.0	101	50.5
6-10	30	28.8	34	35.4	64	32.0
>10	21	20.2	14	14.6	35	17.5
Total	104	100	96	100	200	100
Mean±SD	7.06±5.28		6.85±5.12		6.93±5.23	

Fig 1:- Duration of type 2 diabetes.

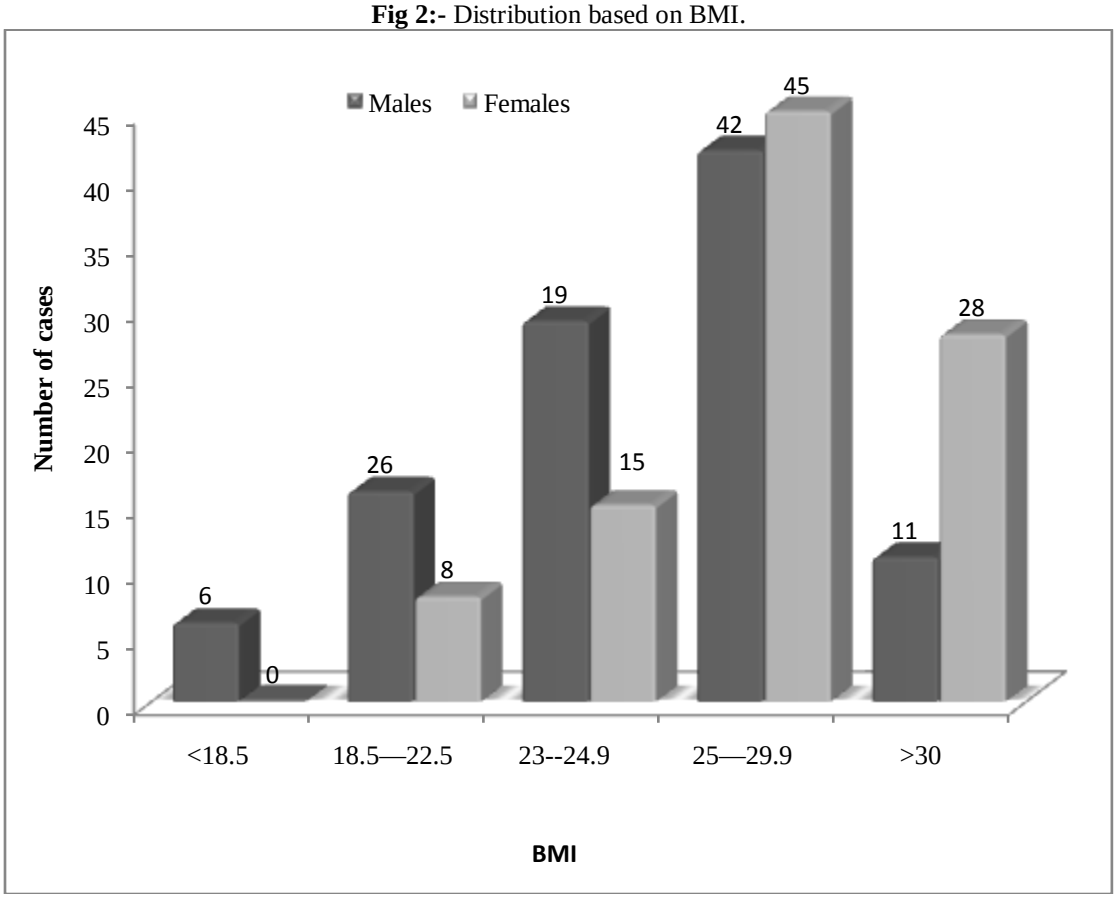


1. Distribution based on BMI

Table 2:- Distribution based on BMI.

BMI (kg/m²)	Males		Females		Total	
	No.	%	No.	%	No.	%
<18.5	6	5.7	0	0.0	6	3.0
18.5-22.5	16	15.4	8	8.3	24	12.0
23-24.9	29	27.9	15	15.6	44	22.0
25-29.9	42	40.4	45	46.9	87	43.5
>30	11	10.6	28	29.2	39	19.5
Total	104	100.0	96	100.0	200	100.0
Mean ± SD	25.41± 4.06		28.01± 4.20		26.70± 4.13	

Fig 2:- Distribution based on BMI.



2. Quantile distribution in C-peptide and diabetic parameters

Table 3:- Quantile distribution in C-peptide and diabetic parameters.

Quantile C-Peptide	FBS (ng/mL)	PPBS (ng/mL)
	Mean ± SD	Mean ± SD
≤ 1	155.25 ± 49.47	274.91 ± 81.48
1-2	157.53 ± 64.33	256.46 ± 87.50
2-3	159.58 ± 60.86	252.33 ± 82.38
> 3	147.35 ± 51.74	250.44 ± 67.20
Total	154.31 ± 57.59	254.52 ± 78.17
ANOVA test, p-value and significance	F = 0.598, p = 0.617, NS	F = 0.355, p = 0.785, S

Study reveals that there was no statistically significant difference of mean FBS and PPBS with Quantile C-peptide levels ($p>0.05$).

3. Correlation between serum C-peptide and duration of diabetes

Table 4:- Correlation between serum C-peptide and duration of diabetes.

Variables	Correlation coefficient (r)	p-value and significance
All cases: Duration v/s C-peptide	r = -0.153	P = 0.031, S
Males: Duration v/s C-peptide	r = -0.063	P = 0.623, NS
Females: Duration v/s C-peptide	r = -0.275	P = 0.012, S

This study shows that there is statistically significant negative correlation between duration of diabetes and C-peptide levels in the study population ($p<0.05$). As duration of diabetes increases, C-peptide value decreases. There was no statistically significant correlation between duration of diabetes and C-peptide levels in males ($p>0.05$). But, there was statistically significant negative correlation between duration of diabetes and C-peptide levels in females ($p<0.05$).

4. Correlation between serum C-peptide and BMI

Table 5:- Correlation between serum C-peptide and BMI.

Variables	Correlation coefficient (r)	p-value and significance
All cases: BMI v/s C-peptide	r = +0.491	P = 0.000, HS
Males: BMI v/s C-peptide	r = +0.624	P = 0.000, HS
Females: BMI v/s C-peptide	r = +0.321	P = 0.011, S

In this study, there was statistically highly significant positive correlation between BMI and C-peptide levels in the study population ($p<0.001$). As BMI value increases, C-peptide level also increases. Correlation between BMI and C-peptide levels in males was highly significant with a p-value<0.001, and with respect to females p-value was <0.05.

Discussion:-

A total of 200 people with type 2 diabetes mellitus were considered for the study, out of which 104 were males and 96 were females. Male to female ratio was 1.08. The mean age of the study population was 48.51±9.15 years. The age group in the range of 51-60 years had the maximum number of study subjects (44.5%).

Khatib et al.[6] in his study also showed that the 50-60 years age group constitute many type 2 DM cases.

By measuring C-peptide levels in the fasting state, insulin secretion from the β cell of pancreas was measured in this study. Because C-peptide is secreted from β cell of pancreas along with insulin in equal amounts and it undergoes only negligible liver extraction and its level in the peripheral blood equals to that of in the portal blood, C- peptide is used as a measure of insulin secretion in the body.

The normal range of fasting C-peptide in our laboratory was 1.1-3.3ng/ml. The mean C-peptide value of the study population was 2.68±1.15ng/ml.

Association between duration of diabetes and C-peptide

The mean duration of type 2 diabetes in the study population was 6.93±5.23 years. 50% of the study population had history of diabetes for duration of 1-5 years. In our study there was statistically significant negative correlation between duration of diabetes and C-peptide i.e., as duration of diabetes increases, C peptide value decreases.

A similar study by Bilal B. A. et al., in which 83% of the study population had diabetes for <5 years, showed that the insulin reserve decreases and hence the C-peptide level decreases with the duration of diabetes.[7] This occurs due to ongoing beta cell destruction or dysfunction as duration of diabetes increases.

Association between BMI and C-peptide

The mean BMI of the study population was 26.70±4.13 kg/m². 63% of the study population was either overweight or obese. In our study there was statistically highly significant positive correlation between BMI and C-peptide in the study population i.e., as BMI increases, C-peptide value also increases.

A study conducted in Japanese population showed that BMI is positively associated with ß cell function in type 2 diabetes.[8] This result was compatible with autopsy findings of good correlation of ß cell mass with BMI.

Jin Ook Chung's study on 132 Korean people suggested BMI was positively associated with endogenous insulin secretion as assessed by serum C-peptide response in type 2 diabetes.[9] The author further adds that increase in BMI possibly contributes to further deterioration of ß cell function with associated increase in insulin resistance.

Study by Bilal B. A. et al. also showed that fasting C-peptide level in obese diabetics was elevated compared to non-obese diabetics, indicating insulin resistance.[7] Similar results were seen in a study conducted by Shaheena Banu et al.[10]

Association between FBS and C-peptide

57% of our study population had FBS <150mg/dL. There was no statistically significant correlation between FBS and C-peptide in this study.

A similar study by Shaheena Banu et al. also didn't show any significant correlation between FBS and fasting C-peptide levels.[10]

Hardeep Singh Deep et al. conducted a study in type 2 diabetics of Punjabi population and found that FBS levels were higher in patients with higher than normal C-peptide levels. They stated that increase in fasting C-peptide levels were associated with increased FBS due to insulin resistance.[11]

Clare N. et al.[12] in their study noticed that the obese patients had elevated serum insulin, C-peptide and blood glucose levels than non-obese patients.

Conclusion:-

1. Type 2 diabetics with higher BMI had higher fasting C-peptide levels, emphasizing that obese people have comparatively higher insulin resistance.
2. The insulin reserve decreased with the increase in duration of diabetes as seen by the decrease in fasting C-peptide levels. This indicates that the β cell dysfunction increases with the duration of diabetes.
3. This study suggests that BMI and duration of diabetes are major factors in ß cell function in people with diabetes.

References:-

1. Alvin C. Powers, Kevin D. Niswender, Carmella Evans-Molina, Diabetes Mellitus: Diagnosis, Classification, and Pathophysiology, Harrison's Principles of Internal Medicine, Vol. II, Ed. 21st, 396, 3094-3103.
2. Castano L, Eisenberth G. S. Type 1 diabetes, a chronic autoimmune disease of human, mouse and rat. Annu Rev Immunology 1990; 8: 647-679.
3. Sacks DB, Mc Donald JM. The pathogenesis of type 2 diabetes mellitus: a polygenic disease. Am J Clin pathol 1996; 105: 149-156.
4. King H, Aubert RE, Herman WH. Global Burden of diabetes 1995- 2025: prevalence, numerical estimates and projections. Diabetes care 1998; 21: 1414-31.
5. International Diabetes Federation Diabetes Atlas. 2021. 10th Edition.
6. American Diabetes Association. Screening for diabetes. Diabetes Care Jan 2002; vol 25 suppl (1):s21-s24.
7. Bilal Bin Abdullah, Basangouda S. Patil, A. Thaseen. Significance of C-peptide in Type 2 Diabetes – A study in the North Karnataka Population of India, Al Ameen Journal of Medical Sciences, 2010; 1, 3: 65-78.
8. Funakoshi S, Fujimoto S, Hamasaki A, et al. Analysis of factors influencing pancreatic beta-cell function in Japanese patients with type 2 diabetes: association with body mass index and duration of diabetic exposure. Diabetes Res Clin Pract 2008; 82: 353-358.
9. Jin Ook Chung, Dong Hyeok Cho, Dong Jin Chung. Associations among body mass index, insulin resistance, and pancreatic ß-cell function in Korean patients with new onset type 2 diabetes. Korean J Intern Med 2012; 27: 66-71
10. Shaheena Banu, Nasimudeen R. Jabir, C N Manjunath. C-peptide and its Correlation to Parameters of Insulin Resistance in the Metabolic Syndrome. CNS & Neurological Disorders – Drug Targets, 2011, Vol 10, No 8, pg 921-927.
11. Hardeep Singh Deep, Barjinder Pal Singh, Shalinder Pal Singh. Evaluation of serum C-peptide levels in type 2 diabetics in Punjabi population. International Jiurnal of Advances in Medcine. July-August 2017. Vol 4. Issue 4. Pg 1026-1030.
12. Clare N, Jones O, et al. Role of insulin resistance and obesity in regulation of plasma insulin concentrations. Am J Physiol Endocrinol Metab March 2000; 278: E501-508.