Journal of Applied Chemistry and Biomedical Laboratory Research
https://doi.org/00.0000/0000-000-000
eISSN 3125-1404

Open Access

Analysis of Fasting and 2-Hour Postprandial Blood Glucose Levels among Patients with Type II Diabetes Mellitus

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Received: May 26, 2026
Accepted: June 29, 2026
Published online: June 30, 2026

ABSTRACT

Type II Diabetes Mellitus (T2DM) is a metabolic disorder characterized by elevated blood glucose levels (hyperglycemia) caused by impaired insulin secretion, impaired insulin action, or both. T2DM has become a major global health problem due to its continuously increasing prevalence. This study aimed to evaluate the increase in fasting blood glucose levels compared with 2-hour postprandial blood glucose levels in patients with Type II Diabetes Mellitus. This study used a descriptive method with a cross-sectional design approach. The study involved 30 patients diagnosed with T2DM. Based on gender characteristics, 16 participants were female (53%) and 14 were male (47%). Based on age group, 10 patients (33%) were over 65 years old, while 20 patients (67%) were under 65 years old. The results showed that fasting blood glucose levels were normal in 9 patients (30%) and elevated in 21 patients (70%). Meanwhile, normal 2-hour postprandial blood glucose levels were found in 4 patients (13%), whereas elevated levels were observed in 26 patients (87%). Statistical analysis demonstrated a significant increase between fasting blood glucose levels and 2-hour postprandial blood glucose levels in 73% of patients, with a Sig. (2-tailed) value of 0.001 < 0.05.

Keywords: Fasting Blood Glucose, 2-Hour Postprandial Blood Glucose, Type II Diabetes Mellitus

Citation:
Riyani A, Susilawati, Fadhilah F, Rustiana T. Analysis of Fasting and 2-Hour Postprandial Blood Glucose Levels among Patients with Type II Diabetes Mellitus. J Appl Chem Biomed Lab Res (JACBioLab). 2026;2(1):32-38. https://doi

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycemia resulting from impaired insulin secretion, impaired insulin action, or both. Currently, diabetes mellitus has become a major global health problem due to its continuously increasing prevalence worldwide. The International Diabetes Federation (IDF) estimated that approximately 463 million people aged 20–79 years were living with diabetes in 2019, equivalent to a prevalence of 9.3% of the total population within the same age group. Based on gender, the prevalence of diabetes in 2019 was estimated at 9% in women and 9.65% in men. The prevalence of diabetes also increases with age, reaching 19.9% or approximately 111.2 million individuals among those aged 65–79 years. This number is projected to rise to 578 million by 2030 and 700 million by 2045 [1,2].

According to the International Diabetes Federation (IDF) report in 2021, approximately 537 million adults aged 20–79 years were living with diabetes worldwide. Diabetes was also responsible for 6.7 million deaths, equivalent to one death every five seconds. China ranked first globally in the number of adults with diabetes, reaching 140.87 million people in 2021, followed by India with 74.19 million, Pakistan with 32.96 million, and the United States with 32.22 million cases. Indonesia ranked fifth, with 19.47 million people living with diabetes out of a total population

of 273.8 million. The IDF also reported that four out of five people with diabetes (81%) live in low- and middle-income countries. Furthermore, approximately 44% of adults with diabetes remain undiagnosed [3].

Based on the 2018 Basic Health Research (Riskesdas) data, the prevalence of diabetes mellitus in Indonesia exceeded one million diagnosed cases across all provinces. The highest number of cases was reported in West Java Province, with 186,809 cases, followed by East Java Province with 151,878 cases, while the lowest number was found in North Kalimantan Province, with 2,733 cases.

In Bandung City, the target number of diabetes mellitus patients in 2021 was 43,761 individuals. Of this number, 40,601 patients (92.78%) had received healthcare services according to the standard of care for diabetes mellitus patients. Among them, 17,825 individuals were treated in clinics or hospitals, and their residential areas could not be identified. The Minimum Service Standards (SPM) in healthcare mandate that all citizens should receive essential healthcare services, including healthcare services for diabetes mellitus patients. The healthcare service coverage target established by the government is 100%. However, the achievement of healthcare services for diabetes mellitus patients in Bandung City in 2021 was only 92.78%, indicating that the target had not yet been fully achieved [4].

The diagnosis of Type II Diabetes Mellitus (T2DM) is generally established through blood glucose testing. To evaluate increased blood glucose levels, fasting blood glucose examination is performed after patients fast for 8–10 hours prior to testing. In addition, 2-hour postprandial blood glucose examination is conducted after patients consume a complete meal, followed by blood glucose measurement two hours later. The evaluation of increased blood glucose levels is determined based on the comparison between fasting blood glucose and 2-hour postprandial blood glucose results [5–7].

Blood glucose testing can be performed using several methods. The most commonly used methods are Point-of-Care Testing (POCT), the hexokinase enzymatic method, and the glucose oxidase (GOD-PAP) method (8).

For field examinations, the POCT method is generally preferred because it is practical and portable. Several studies have reported that blood glucose measurement using the POCT method demonstrates relatively good accuracy, with a sensitivity of 70% and specificity of 90% [1,9,10].

MATERIALS AND METHODS

This study employed a descriptive research design with a cross-sectional approach to determine the increase in fasting blood glucose levels and 2-hour postprandial blood glucose levels in patients with Type II Diabetes Mellitus (T2DM).

The study population consisted of all participants enrolled in the diabetes mellitus Prolanis program at Mitra Sehati Primary Clinic, totaling 76 individuals. The sample used in this study consisted of 30 patients who had been diagnosed with Type II Diabetes Mellitus.

The sample size was determined using the Slovin formula:

$$n = \frac{N}{1 + Ne^2}$$

The method used for fasting blood glucose and 2-hour postprandial blood glucose examination was Point-of-Care Testing (POCT).

The POCT method is based on an electrochemical biosensor test strip principle. Blood samples are drawn through capillary action into the reaction zone on the strip until a stable sample volume is achieved automatically. When glucose in the whole blood sample reacts with the reagent on the electrode, it is detected by the autocheck meter system through the application of a constant electrical potential at the electrode. The resulting electrical current is then converted into a glucose concentration reading.

The blood glucose examination procedure was performed by first disinfecting the ring finger and allowing it to dry. The fingertip was then punctured using a sterile lancet. The blood sample was absorbed by the glucose strip that had been inserted into the glucometer until a beep sound was heard. After approximately 10 seconds, the blood glucose level appeared on the monitor screen, and the result was recorded.

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RESULTS AND DISCUSSION

The results of this study are presented as follows.

Patient characteristics based on gender are presented in Figure 1. The results showed that 14 patients (47%) were male and 16 patients (53%) were female.

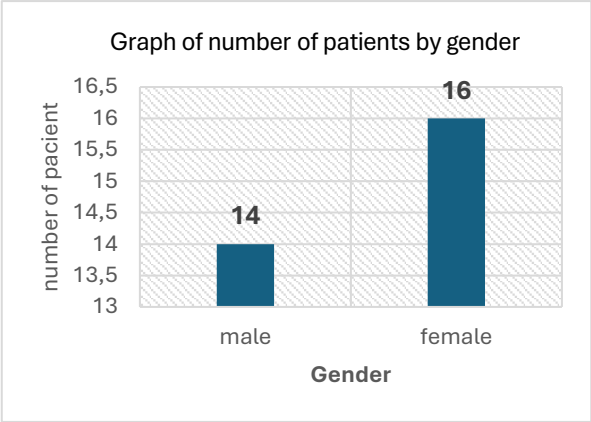

Figure 1. Patient characteristics by gender

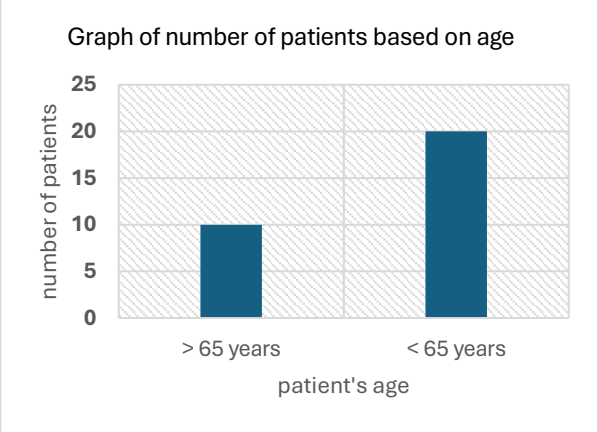

Figure 2. Patient characteristics by age

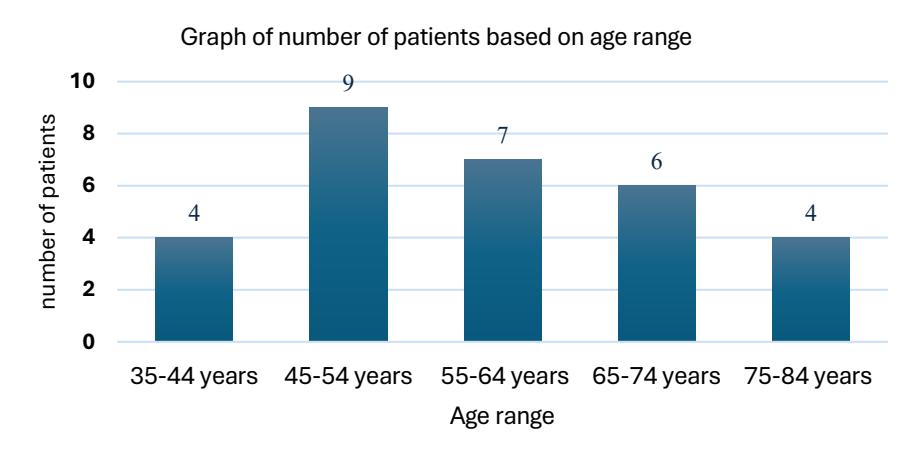

Figure 3. Patient characteristics based on age range

Patient characteristics based on age are presented in Figures 2 and 3. The 30 patients included in this study ranged in age from 38 to 82 years. Based on age group distribution, the highest number of patients was found in the 46–55 years age group, consisting of 9 patients, followed by the 56–65 years age group with 7 patients. Meanwhile, 4 patients were in the 36–45 years age group, which is considered a vulnerable age range for diabetes mellitus.

When classified according to elderly age categories, 10 patients were over 65 years old, while 20 patients were under 65 years old.

The results of fasting blood glucose and 2-hour postprandial blood glucose examinations are shown in Table 1.

Table 1. Results of Fasting Blood Glucose and 2-Hour Postprandial Blood Glucose Examinations in Type II DM Patients

No	FBG (mg/dL)	2PPBG (mg/dL)	Increase (mg/dL)	Percentage increase
1	93	136	43	46
2	299	335	36	12
3	116	145	29	25
4	373	378	5	1
5	114	161	47	41
6	159	254	95	60
7	132	165	33	25
8	106	154	48	45
9	160	191	31	19
10	155	206	51	33
11	108	175	67	62
12	90	98	8	9
13	108	161	53	49
14	142	204	62	44
15	114	154	40	35
16	125	188	63	50
17	133	136	3	2
18	98	164	66	67
19	98	180	82	84
20	93	168	75	81
21	142	180	38	27
22	168	221	53	32
23	116	181	65	56
24	187	247	60	32
25	136	144	8	6
26	116	154	38	33
27	125	129	4	3
28	122	144	22	18
29	212	339	127	60
30	104	248	144	138

Based on the study data obtained from Type II Diabetes Mellitus patients at Mitra Sehati Primary Clinic, the mean fasting blood glucose level was 141 ± 61 mg/dL, while the mean 2-hour postprandial blood glucose level was 191 ± 65 mg/dL. A significant increase was observed in 22 samples (73%), as shown in Table 2.

Table 2. Descriptive Statistical Analysis of Fasting Blood Glucose and 2-Hour Postprandial Blood Glucose Levels in Type II DM Patients

Descriptive Analysis					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	FBG	141,46	30	60,91	11,12
	2HPP	191,33	30	65,06	11,87

The descriptive statistical analysis showed that the mean fasting blood glucose level was 141.46 mg/dL with a standard deviation of 60.91, whereas the mean 2-hour postprandial blood glucose level was 191.33 mg/dL with a standard deviation of 65.06. Statistical analysis using the paired t-test demonstrated a significant increase, with a 2-tailed significance value of < 0.05, indicating an increasing trend in blood glucose levels in 73% of patients. Figure 4 illustrates the trend of increasing blood glucose levels from fasting conditions to 2 hours after meal consumption.

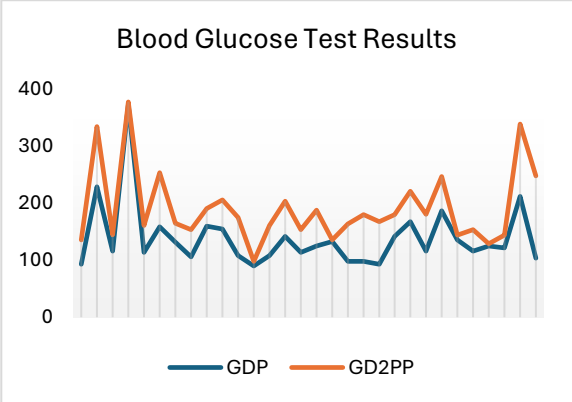

Figure 4. Graph of increase in fasting blood glucose levels 2 hours after eating

Table 3. Distribution of Fasting Blood Glucose Levels in T2DM Patients

FBG level	Frekuensi	%	Avg (mg/dL)
Normal 70-110 mg/dL	9	30	100
Ab Normal >110 mg/dL	21	70	166
Total	**30**	**100**	

The results presented in Table 3 indicate that 9 patients (30%) had normal fasting blood glucose levels, with an average value of 100 mg/dL, while 21 patients (70%) had elevated fasting blood glucose levels, with an average value of 166 mg/dL.

Table 4. Distribution of 2-Hour Postprandial Blood Glucose Levels in T2DM Patients

2HPP Level	Frekuensi	%	Avg (mg/dL)
Normal 70-140 mg/dL	4	13	125
Ab Normal >140 mg/dL	26	87	201
Total	**30**	**100**	

The results in Table 4 showed that 4 patients (13%) had normal 2-hour postprandial blood glucose levels, with an average value of 125 mg/dL, whereas 26 patients (87%) had elevated postprandial blood glucose levels, with an average value of 201 mg/dL.

Tables 3 and 4 demonstrate an increase in blood glucose levels two hours after food intake.

Discussion

Normal fasting blood glucose levels, measured after a patient has not consumed any food for at least 8 hours, range from 70–110 mg/dL. Meanwhile, normal 2-hour postprandial blood glucose levels should not exceed 140 mg/dL. A patient is diagnosed with diabetes mellitus if blood glucose levels are greater than or equal to 200 mg/dL. Blood glucose levels between 140 mg/dL and 199 mg/dL are categorized as prediabetes.

In this study, fasting blood glucose levels in T2DM patients were measured after 8–10 hours of fasting, while 2-hour postprandial blood glucose levels were measured after patients consumed a complete meal consisting of rice, side dishes, vegetables, and fruits. The results demonstrated a significant increase in blood glucose levels, where the mean fasting blood glucose level was 141 mg/dL and the mean postprandial blood glucose level reached 191 mg/dL.

Fasting blood glucose levels varied among patients. Of the 30 patients examined, 9 patients (30%) had blood glucose levels within the normal range, while 21 patients (70%) showed elevated fasting blood glucose levels. Variations were also observed in postprandial blood glucose levels after meal intake. Among the 30 patients

examined, 4 patients (13%) had normal postprandial blood glucose levels, whereas 26 patients (87%) had elevated levels above the normal range.

These findings indicate that food intake can trigger an increase in blood glucose levels from normal to elevated levels. Therefore, dietary patterns and food portions should be properly regulated to prevent excessive increases in blood glucose levels. This condition may also be influenced by several factors, including body metabolism, oral antidiabetic medication consumption, and insulin injections, particularly regarding dosage and administration timing.

Based on gender distribution, among the 30 T2DM patients included in this study, 16 patients (53%) were female and 14 patients (47%) were male. Women are considered to have a higher risk of developing T2DM than men, often associated with hormonal factors and metabolic changes in the body. These findings are consistent with previous studies which reported that blood glucose levels are influenced by patient gender.

Based on age classification according to the Indonesian Ministry of Health, which categorizes stages of human development, 4 patients (13%) were in late adulthood (36–45 years), 9 patients (30%) were in the early elderly stage (46–55 years), 7 patients (23%) were in the late elderly stage (56–65 years), 6 patients (20%) were aged 66–75 years, and 4 patients (13%) were aged 76–85 years. When grouped into two categories, patients aged >65 years accounted for 33%, while those aged <65 years accounted for 67%.

The majority of patients were within the age range of 46–65 years. The risk of T2DM is known to increase significantly after the age of 40 due to declining body function and reduced muscle mass. Patients aged >65 years showed a higher prevalence of T2DM because of decreased organ function, particularly reduced β-pancreatic cell function in insulin production, combined with unhealthy lifestyle and dietary habits.

However, 20 patients (67%) were younger than 65 years old, which may be associated with unhealthy lifestyles, irregular eating patterns, stress, lack of exercise, and reduced physical activity, accompanied by gradual organ function decline. Lack of physical activity is considered one of the major risk factors. Moderate-intensity exercise, such as brisk walking for 30 minutes per day, can help the body utilize insulin more effectively [11].

Another study demonstrated a significant relationship between physical activity and blood glucose levels. Physical exercise increases cellular sensitivity to insulin, thereby helping reduce blood glucose levels more effectively. During physical activity, muscles utilize stored glucose as an energy source, directly lowering blood glucose levels. Regular physical activity can improve glycemic control, which is reflected in more stable blood glucose levels among patients with Type II Diabetes Mellitus.

The results of this study demonstrated an increasing trend in fasting blood glucose levels and 2-hour postprandial blood glucose levels following the consumption of white rice, fried eggs, cucumber, stir-fried long beans, and tempeh among T2DM patients. Statistical analysis showed a Sig. (2-tailed) value of <0.05, indicating a significant increase in blood glucose levels in 73% of patients.

According to the American Diabetes Association (ADA), variations in blood glucose levels are influenced not only by food intake but also by patient age, gender, medications, insulin therapy, diabetes status, and other physiological conditions that may affect blood glucose regulation.

CONCLUSIONS

The results of this study involving 30 patients with Type II Diabetes Mellitus showed that 73% of patients demonstrated an increasing pattern from fasting blood glucose levels to 2-hour postprandial blood glucose levels after consuming a complete meal.

It is recommended that the community maintain a healthy and balanced diet, adopt a healthy lifestyle, and engage in regular physical activity and exercise to help control blood glucose levels.

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