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The Relationship Between Depression Symptoms Measured by The Patient Health Questionnaire-9 and Blood Sugar Levels in Type 2 Diabetes Mellitus Outpatient Patients at Raden Achmad Basoeni General Hospital, Mojokerto, East Java, 2025

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ABSTRACT

The purpose of this research was to determine the correlation of depressive symptoms in patients with T2DM on 2-hour postprandial (PP) blood sugar levels. This research was an analytical observational (quantitative) study with a cross-sectional design and a simple random sampling technique. This study was conducted at R.A Basoeni Regional General Hospital, Mojokerto, East Java. Depressive symptoms were measured using the Patient Health Questionnaire-9 (PHQ-9), while 2-hour PP blood sugar levels were measured using a glucometer conducted in July-August 2025 with 101 respondents. The data obtained were analyzed using the Chi-Square test to determine the correlation between the two variables. The results of this study indicate a significant correlation with $p = 0.010$ and $\alpha = 0.05$, which mean $p < \alpha$. Therefore, it can be concluded that there is a statistically significant relationship between depressive symptoms and 2-hour postprandial blood sugar levels in patients with T2DM. This finding confirms that depressive symptoms play a significant role in influencing blood sugar stability in patients with T2DM.

Keywords: Type 2 Diabetes Mellitus; Depression; PHQ-9; Blood Sugar Levels.

INTRODUCTION

Hyperglycemia is a condition in which blood glucose levels rise above normal values, and this condition becomes one of the main characteristics of various health disorders, especially diabetes mellitus (DM). Diabetes mellitus is now one of the main problems in the global health sector. Based on its cause, DM is classified into four types, namely type 1 DM, type 2 DM, gestational DM, and other types of DM. A number of epidemiological studies show that the incidence and prevalence of type 2 DM have increased in various parts of the world. The World Health Organization (WHO) predicts that there will be a sharp increase in the number of people with type 2 diabetes in the coming years. The number of people with type 2 diabetes in Indonesia is projected to rise dramatically from 8.4 million people in 2000 to about 21.3 million people in 2030, according to WHO estimates. The International Diabetes Federation (IDF) also predicts an increase in the number of DM patients, from 10.7 million in 2019 to 13.7 million by 2030 (Anggita Dianti & Noviyanti, 2021; Endokrinologi Indonesia, 2021).

Indonesia's population aged over 20 years is estimated to reach 133 million people, according to data from Indonesia's Central Statistics Agency. The prevalence of type 2 diabetes mellitus (DMT2) in urban areas was recorded at 14.7 million people, while in rural areas it was recorded at 7.2 million people. Considering the adult population is expected to increase to 194 million by 2030, if the prevalence of DMT2 in urban and rural areas remains stable, it is estimated that the number of DMT2 sufferers will reach around 28 million in

urban areas and 13.9 million in rural areas by that year. Data from the Ministry of Health indicate that the prevalence of DMT2 will continue to increase, reaching 8.5.

As many as 15% to 30% of patients with DMT2 are estimated to meet the criteria for a diagnosis of depression. This condition suggests that depression is quite common among individuals with DMT2. Recent studies show that about 43.5% of DMT2 patients who come to the clinic have depressive disorders. People with DMT2 tend to have higher rates of depression compared to individuals who do not have DMT2 (Kroenke et al., 2021; Tiksnadi et al., 2023; Tomokawa et al., 2020). This condition is directly related to the hyperglycemia experienced by DMT2 sufferers. Persistent hyperglycemia over a long period of time can cause damage to various organs of the body. High blood sugar levels and the potential for complications due to DMT2 can trigger the onset of depressive symptoms in sufferers (Pujiningsih, 2021; Faiq Mujabi & Yuniartika, 2018).

Depression in DMT2 patients often goes undetected, making it a major obstacle to optimal DMT2 management. Depressive conditions in DMT2 sufferers increase the likelihood of complications (Eliza et al., 2023). Depression in DMT2 patients also contributes to changes in the neurohormonal and neurotransmitter systems, which can impact glucose metabolism regulation (Abuhegazy et al., 2022; Pashaki et al., 2019; Kautzky-Willer et al., 2023). Blood sugar level control, which refers to the extent to which glucose levels can be maintained within the normal range, remains the main indicator for assessing sugar regulation. To date, blood sugar control examinations are considered the most effective method for evaluating a person's blood sugar stability (Pujiningsih, 2021).

Raden Achmad Basoeni Hospital, Mojokerto, is a regional general hospital located in Mojokerto Regency, East Java. R.A. Basoeni Hospital is a type C hospital that provides healthcare services for the community in Mojokerto and its surroundings. This hospital continues to innovate in delivering high-quality patient care. R.A. Basoeni Hospital plans to establish a Neuro-Psychiatric Center as part of its strategic development program, which will become one of its key advantages. This service aims to provide holistic therapy for neurological and psychiatric conditions (Armansyah et al., 2025; Suratman et al., 2023; Vina et al., 2021).

Visits by DMT2 patients at R.A. Basoeni Hospital have increased each year. Outpatient visits for DMT2 patients were recorded at 8,967 in 2022, 11,993 in 2023, and 12,190 in 2024. Outpatient visits increased by 33% in 2023 and by 1% in 2024. The average number of outpatient DM visits is projected to reach 900 patients per month by 2025.

In identifying depressive symptoms in DMT2 patients, one of the most widely used instruments in healthcare facilities is the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 is a standardized questionnaire consisting of nine questions corresponding to the diagnostic criteria for depression according to the DSM-IV/DSM-5. The instrument has high sensitivity and specificity, is easy to administer, does not require much time, and has been widely validated across various clinical populations, including patients with chronic diseases such as DMT2. The PHQ-9 is highly relevant for use in hospitals and clinics because it can detect depressive symptoms ranging from mild to severe, facilitating the screening and early detection process.

The researcher's interest in studying this topic prompted further investigation into the relationship between depressive symptoms measured using the PHQ-9 and 2-hour

postprandial (PP) blood sugar levels in DMT2 patients in the outpatient unit of R.A. Basoeni Hospital, Mojokerto, East Java, in 2025. The purpose of this study is to analyze the relationship between depressive symptoms, measured using the PHQ-9, and 2-hour postprandial blood sugar levels in outpatients with type 2 diabetes mellitus at Raden Achmad Basoeni Regional General Hospital, Mojokerto. This research is expected to provide empirical evidence regarding the link between mental health and glycemic control in diabetic populations. The benefits of this study include scientific, clinical, and institutional contributions. From a scientific perspective, it aims to enrich research evidence concerning psychoneuroendocrine interactions in T2DM. From a clinical standpoint, it may serve as a basis for healthcare providers to consider routine depression screening among T2DM patients to optimize integrated management. From an institutional viewpoint, it can provide input for the hospital in developing holistic services that integrate psychiatric and endocrinological aspects, in line with the planned establishment of the Neuro-Psychiatric Center.

METHOD

Research design

The research design is an observational analytical study that aims to determine the relationship between depression symptoms measured using the PHQ-9 instrument, and blood sugar levels in DMT2 patients who have been diagnosed by a doctor. The approach used is quantitative, data collected in the form of numbers and analyzed using statistical techniques to see the relationship between variables. This study is explanatory in nature which explains the relationship between two variables based on theory and data obtained in the field. The data collection method was carried out through direct observation and filling out questionnaires. This study applied a cross-sectional time approach, with data collection and analysis carried out at one time during the 2025 research period.

Research methods

This research method applies a quantitative approach by utilizing primary data collected and analyzed in a structured manner. The collection method is carried out by checking the blood sugar levels of DMT2 patients who have been diagnosed by a doctor and then continuing by providing a PHQ-9 questionnaire to find out whether there are symptoms of depression or not.

Population, Sample, Sample Size and Sampling Techniques

A. Research population

The population in this study consisted of all patients who had been diagnosed with DMT2 who visited the outpatient polyclinic at Raden Achmad Basoeni Hospital.

The study sample was patients with DMT2 who visited the outpatient polyclinic of RA Basoeni Hospital Mojokerto in 2025, which was selected based on the inclusion criteria that had been set, with the data collection process carried out through the distribution of PHQ-9 questionnaires given to patients after blood glucose level checks were carried out using a Glucometer

B. Research sample

Criteria included:

- DMT2 patients who have been diagnosed with an anamnesis, physical examination and laboratory.
- Able to communicate effectively.
- Have a willingness to participate as a respondent in the research.

Exclusion criteria:

- Patients who do not show a cooperative attitude.
- Patients who refuse or refuse to participate as respondents.
- DMT2 patients with complications of other diseases.

C. Sample size

The Slovin formula is applied to calculate the number of respondents.

$$\mathbf{n = N / (1 + (N \times e^2)).}$$

Description:

n = total samples taken

N = total population of 135 patients

e = Acceptable margin of error in evaluation, e = 0.05 (5%)

So the sample size was obtained by 101 patients

D. Sampling techniques

The sampling technique used is a simple random sampling technique, where every individual in the patient population has an equal and unbiased opportunity to be selected as a sample. This method was chosen because it was simple, easy to apply, and effective in reducing selection bias, so that the samples taken could accurately represent the population and the results of the study could be generalized well. In this approach, the researcher selects the participants who are considered most relevant and appropriate to the research objectives, taking into account their professional knowledge and considerations. The total sample involved was 101 people, who were DMT2 patients who visited the outpatient polyclinic at Raden Achmad Basoeni Hospital, Mojokerto.

Data Analysis

The study aims to analyze the relationship between depression symptoms measured with PHQ-9 and blood sugar levels of 2 hours PP in outpatient DMT2 patients at the Raden Achmad Basoeni Regional General Hospital, Mojokerto, East Java in 2025.

Data processing in this study will be carried out using the SPSS (Statistical Product and Service Solutions) program.

1. Univariate analysis:

This study used univariate analysis which aims to identify the distribution of population frequencies and explain the nature of each study variable, namely the relationship between depression symptoms measured by the PHQ-9 instrument and blood sugar levels in DMT2 patients.

2. Bivariate analysis:

This study uses bivariate analysis which aims to answer the formulation of the problem, namely the relationship between depression symptoms measured by the PHQ-9 instrument and the blood sugar level level of 2 hours PP in DMT2 patients.

RESULTS AND DISCUSSION

Distribution of sample data based on length of exposure to DMT2

In this subchapter, the distribution of respondents based on DMT2 duration is presented. Information about the duration of the disease is an important aspect because the longer a person has DMT2, the more likely it is to develop complications, changes in metabolic patterns, and psychological disorders such as depression. The length of illness can also affect medication adherence, patients' clinical experiences, and their ability to control blood sugar levels.

Table 1. Distribution of sample data based on length of exposure to DMT2

Long Suffering from DMT2 (Years)	Frequency	Percentage (%)
Short Duration < 5 years	44	43,6
Medium Duration 5-10 years	39	38,6
Long-Term/Chronic Duration > 10 years	18	17,8
Total	**101**	**100**

Source: Primary data, 2025

The results of the distribution of sample data showed that respondents were aware of the length of time they were exposed to DMT2 according to table 1, as many as 43.6% had been diagnosed since a period of <5 years, 38.6% had been diagnosed since a period between 5-10 years, and 17.8% had been diagnosed since a period of >10 years. These results show that the majority of respondents have been diagnosed for <5 years (43,6%).

Distribution of sample data based on the regularity of treatment

In this subchapter, the distribution of respondents is presented based on their level of regularity in undergoing treatment. Regularity of treatment is a very important aspect of DMT2 management, because adherence to medical therapy, routine control, and monitoring of blood sugar levels have a direct effect on the success of disease control. Patients who do not regularly receive treatment are at risk of blood sugar fluctuations and chronic complications.

Table 2. Distribution Sample data based on Regularity of treatment

No	Regularity of Treatment	Frequency	Presentase (%)
1.	Teratur	87	86.1
2.	Irregular	14	13.9
	Total	**101**	**100.0**

Source: Primary data, 2025

The results of the distribution of sample data based on the regularity of treatment according to table 2, as many as 86.1% were declared to be regular for treatment and 13.9%

were declared irregular for treatment. These results show that the majority of DMT2 respondents at RUD R.A. Basoeni Mojokerto, have a good level of compliance in undergoing treatment.

Frequency distribution of depression rates with PHQ-9

The level of depression in DMT2 patients was measured using the Patient Health Questionnaire – 9 (PHQ-9) which had 9 questions and answer options that had to be chosen based on the condition being perceived, in the form of scores with the category of no depressive symptoms (0-4), mild depression symptom level (5-9), mild depression level (10-14), moderate depression level (15-19), and severe depression level (≥ score of 20).

Table 3. Frequency distribution of depression rates with PHQ-9

Category: PHQ-9	Score Range	Frequency (n)	Percentage (%)
Symptoms of Mild Depression	5–9	99	98.0
Mild Depression	10–14	1	1.0
Major Depression	≥20	1	1.0
Total	-	**101**	**100**

Source: Primary data, 2025

Based on Table 3 of the results of the research that has been conducted at R.A. Basoeni Mojokerto Hospital, it was obtained from 101 respondents (100%), namely there were no respondents without symptoms of depression, 98.0% of respondents with mild depressive symptoms, 1.0% of respondents with mild depression, no respondents with depression, and 1.0% of respondents with severe depression. The results showed that the majority of respondents experienced mild depressive symptoms (98.0%,).

Frequency distribution of blood sugar levels

Blood sugar levels in DMT2 patients were measured using a glucometer, in the form of a normal category score of 2-hour blood sugar level PP < 140 mg/dL (7.8 mmol/L), pre-DM category: 2-hour blood sugar level PP 140 – 199 mg/d, and DM category: 2-hour PP blood sugar level ≥ 200 mg/dL (11.1 mmol/L) .

Table 4. Frequency distribution of blood sugar levels

Categories Blood Sugar 2 Hours PP	Frequency (n)	Percentage (%)
Normal (<140 mg/dL)	27	26,7
Pre-DM (140–199 mg/dL)	33	32,7
DM (≥200 mg/dL)	41	40,6
Total	**101**	**100**

Source: Primary data, 2025

Based on table 4, from all 101 respondents (100%), 26.7% had normal blood sugar (<140 mg/dL), 32.7% had pre-DM (140–199 mg/dL), and 40.6% had DM (≥200 mg/dL). These results show that the majority of respondents have a high level of sugar content.

The Relationship Between Depression Symptoms Measured with PHQ-9 and Blood Sugar Level

Table 5. The Relationship Between Depression Symptoms Measured with PHQ-9 and Blood Sugar Level

Statistical Test	Value	df	Asymptotic Significance (2-sided) / p value
Chi-Square	202,000a	158	0,010

Source: Primary data analysis using SPSS, 2025

Bivariate analysis was used in this study to determine the relationship between independent and dependent variables based on ordinal categorical data scales, using the Chi-square test and statistical processing with SPSS (Statistical Product and Service Solutions). Based on the scale of random blood sugar levels and depression levels (PHQ-9), which are ordinal categorical variables, the Chi-square test was conducted to determine whether there was a relationship between the two variables.

Based on Table 5.2, the results of the Chi-square test on 101 respondents showed a value of 202.000 with a degree of freedom (df) of 158 and a p-value of 0.010. A p-value smaller than 0.05 ($p < \alpha$) indicates a statistically significant association between depressive symptoms measured by PHQ-9 and blood sugar levels. These results confirm that the two variables have a statistically significant relationship.

Analysis of the relationship between depressive symptoms measured with PHQ-9 and blood sugar levels in DMT2 patients.

Based on Table 5.2, the results of the Chi-square test obtained from 101 (100%) respondents showed a value of 202.000 with a degree of freedom (df) of 158 and a significance value (Asymptotic Significance, 2-sided) of 0.010. The result ($p = 0.010$; $\alpha = 0.05$) indicates that there is a statistically significant relationship between blood sugar levels and the degree of depressive symptoms, confirming a significant association between the two categorical variables tested, namely the level of depressive symptoms measured by PHQ-9 and blood sugar levels.

The results of this study are consistent with previous research by Zheng et al., which showed that the severity of depression was significantly higher in the DMT2 group than in the non-diabetic group, with PHQ-9 scores also significantly higher in the DMT2 group ($p < 0.001$). The prevalence of DMT2 was also significantly higher among individuals with depression compared to those without depression ($p < 0.001$) (Zheng et al., 2024). This supports the current findings, which indicate that increasingly severe depressive symptoms tend to be associated with poorer metabolic conditions, including elevated blood sugar levels.

This study also aligns with the findings of Jhenitha Angel et al., (2025) who reported that 49.63% of DMT2 patients at Sorong Hospital exhibited depressive symptoms. The majority were categorized as mild depression (37.78%), followed by moderate depression (11.11%) and severe depression (0.74%). Similar findings were also reported by Khiro et al.,

who found a depression prevalence of 48.2% among DMT2 patients, dominated by mild (31.4%) and moderate (12.7%) depression. The study also revealed that psychological disorders are influenced by diabetic complications such as nephropathy and neuropathy, as well as patients' social and demographic factors (Khiro et al., 2024; Angel et al., 2025). These two studies reinforce the present research results, as the high number of depressive symptoms among DMT2 patients demonstrates that depression is an inseparable factor in glucose regulation, further confirming the relationship between depressive symptoms and blood sugar levels.

The research of Gupta and Adhikari further supports these findings, reporting a depression prevalence of 56.9% in DMT2 patients, with mild depression being the most dominant category. Factors such as marital status, lack of family support, and poor glycemic control were identified as major contributors to depression (Sarkar, Gupta, & Donation Officer, 2024). These findings further corroborate this study's results, showing that poor glycemic control not only worsens the condition of diabetes but is also closely related to the emergence of depressive symptoms, which in turn can contribute to elevated blood sugar levels.

These collective findings align with this study's results, which reveal a significant association between depressive symptoms and blood sugar levels in DMT2 patients. Physiologically, depressive symptoms can trigger increased blood sugar levels through several interconnected bodily mechanisms (Sri Yulianti & Kurniawati, 2018; Valerie Michaela et al., 2021). In individuals with depression, the body's stress system specifically the hypothalamic–pituitary adrenal (HPA) axis becomes overactive. This overactivation increases the production of stress hormones such as cortisol and catecholamines. Chronically elevated cortisol levels disrupt glucose metabolism by increasing hepatic gluconeogenesis and reducing insulin sensitivity. Consequently, the body becomes less able to utilize glucose effectively, leading to elevated blood sugar levels. Based on this theory and the present findings, it can be concluded that the relationship between depressive symptoms and blood sugar levels is bidirectional—each condition influences and exacerbates the other (Purwoningrum et al., 2020; Susilawati & Rahmawati, 2021).

This study has several limitations. First, data collection was conducted using the PHQ-9 questionnaire among outpatient DMT2 patients at Raden Achmad Basoeni Regional General Hospital in Mojokerto. Because the questionnaire was self-administered, some respondents required assistance to understand the questions, potentially leading to response bias, in which participants gave answers they believed the researchers expected rather than reflecting their actual psychological state. Additionally, data collection coincided with routine clinic visits, and the busy schedule of the polyclinic sometimes caused patients to rush or lose focus while completing the questionnaires, which may have affected response quality. Furthermore, the study only analyzed the relationship between blood sugar levels and depression using the PHQ-9, without controlling for other variables such as social support, antidepressant use, physical activity level, or history of complications. These limitations mean the results may not capture the full complexity of the condition. Lastly, the study did not include treatment regularity as an inclusion criterion, even though patient adherence to therapy can affect blood sugar stability. The lack of control over this factor may have influenced the results, leading to

an incomplete interpretation of the relationship between blood sugar levels and depressive symptoms.

CONCLUSION

Based on the research results and discussion, it can be concluded that there is a significant relationship between the symptoms of depression, measured using the PHQ-9, and the increase in blood sugar levels in DMT2 patients at Raden Achmad Basoeni Hospital in Mojokerto. To further enhance the understanding of factors affecting depression in DMT2 patients, researchers are encouraged to explore additional variables, such as socio-economic factors, family support, lifestyle, or comorbidities, for a more comprehensive picture. Additionally, using different research designs, such as longitudinal approaches or cohort studies, is recommended to more accurately observe the cause-and-effect relationship between blood sugar levels and depression over time.

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