

A correlational study to assess the relation between stress and blood glucose among type 2 diabetes patients

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Abstract

Type 2 Diabetes Mellitus (T2DM) is a major global health concern, and psychological stress is increasingly recognized as a significant factor influencing glycemic control. Chronic stress activates hormonal responses, particularly the release of cortisol and catecholamines, which can impair glucose metabolism and contribute to hyperglycemia. Understanding this relationship is essential for improving diabetes management outcomes. This study aims to assess stress levels among patients with T2DM, evaluate their blood glucose status, determine the correlation between stress and blood glucose levels, and examine associations with selected demographic and clinical variables such as age, duration of illness, and regular blood glucose monitoring practices. A cross-sectional correlational research design will be employed among T2DM patients in selected hospitals of Lucknow, Uttar Pradesh. Data will be collected using a structured stress assessment questionnaire along with fasting blood sugar and postprandial blood sugar measurements. Statistical analysis, including Pearson correlation and multiple regression, will be used to examine the relationship between variables. The study is expected to identify a significant association between elevated stress levels and poor glycemic control. The findings will provide valuable evidence for integrating stress management interventions into diabetes care programs. Such interventions may enhance glycemic regulation, improve self-management practices, and ultimately contribute to better health outcomes and quality of life among individuals living with T2DM.

Keywords: Stress, Blood Glucose, Type 2 Diabetes Mellitus, Glycemic Control, Psychological Stress, Diabetes Management.

Introduction

Type 2 Diabetes Mellitus (T2DM) has emerged as one of the most challenging public health problems worldwide, particularly in developing countries like India, where changing lifestyles, urbanization, unhealthy dietary patterns, and reduced physical activity have significantly contributed to its increasing prevalence. Diabetes is not merely a metabolic disorder characterized by elevated blood glucose levels but is also influenced by multiple physiological, psychological, and environmental factors. Among these, psychological stress has gained increasing recognition as an important determinant affecting glycemic control. Stress is an unavoidable component of modern life, and its impact on individuals with diabetes is particularly significant because of its ability to alter hormonal balance and disrupt glucose metabolism. The release of stress hormones such as cortisol, adrenaline, catecholamines, and growth hormone during stressful situations activates the fight-or-flight response, resulting in elevated blood glucose levels. In individuals with T2DM, where insulin resistance already exists, this stress-induced hyperglycemia further complicates diabetes management and increases the risk of long-term complications (Brunner and Suddarth's, 2015). The need for this study arises from the growing evidence that stress significantly influences diabetes progression and glycemic control, yet remains an underexplored factor in routine diabetes care. While pharmacological management, dietary modification, and exercise are widely emphasized in diabetes treatment protocols,

psychological factors such as stress are often neglected despite their substantial impact on metabolic regulation. Stress can impair self-care practices among diabetic patients by affecting medication adherence, dietary compliance, physical activity levels, and regular blood glucose monitoring. Patients experiencing chronic stress may find it difficult to maintain the discipline required for effective diabetes management, thereby worsening their clinical outcomes (International Diabetes Federation, 2013). Another important reason for conducting this study is the inconsistent findings reported in previous research regarding the relationship between stress and blood glucose levels. Some studies have demonstrated a strong positive association between high stress levels and elevated blood glucose, while others have reported variable responses depending on individual coping mechanisms, duration of diabetes, and the presence of comorbidities. Such inconsistencies indicate the need for more focused research to clarify this relationship. Moreover, much of the existing evidence has been derived from Western populations, and there is limited research examining this relationship within the Indian context, where sociocultural, economic, and lifestyle factors may uniquely influence stress perception and diabetes outcomes (Kalra S, 2013). India has one of the highest burdens of diabetes globally, and the prevalence of T2DM continues to rise at an alarming rate. Indian patients often face additional stressors such as financial instability, work-related pressures, family responsibilities, and limited access to quality healthcare, all of which may contribute to poor glycemic control. These contextual factors highlight the need for region-specific studies to understand how stress affects blood glucose regulation among Indian diabetic patients. Investigating this relationship in selected hospitals in Lucknow, Uttar Pradesh, will provide locally relevant evidence that can inform healthcare strategies and intervention planning (Koopmanschap M, 2002). The study is also needed because stress-induced hyperglycemia contributes significantly to the development of diabetes-related complications, including cardiovascular diseases, neuropathy, nephropathy, and retinopathy. Early identification of stress as a modifiable risk factor can enable healthcare professionals to implement preventive strategies aimed at reducing these complications. Integrating stress assessment into routine diabetes care may facilitate early interventions such as counseling, relaxation therapies, mindfulness practices, and psychological support programs, which can improve overall diabetes outcomes (Lustman PJ, Clouse RE, 2005). Furthermore, there is an increasing recognition of the importance of holistic and patient-centered approaches in chronic disease management. Diabetes care should not be limited to biochemical monitoring and medication administration alone but should also address the psychological and emotional wellbeing of patients. Understanding the correlation between stress and blood glucose levels can guide nurses and other healthcare professionals in developing comprehensive care plans that include stress management interventions. Such approaches have the potential to enhance self-management behaviors, improve quality of life, and reduce healthcare costs associated with diabetes complications (Gonzalez JS, 2016). The findings of this study will contribute valuable evidence to nursing practice, clinical management, and public health policy by emphasizing the importance of psychological health in diabetes care. It will also help bridge the existing research gap in the Indian setting and provide a scientific basis for designing targeted interventions for stress reduction among T2DM patients. Therefore, this study is essential to better understand the relationship between stress and blood glucose levels and to promote integrated diabetes management strategies that address both physical and psychological dimensions of health (Abu Hassan H, 2016).

Purpose of the Study

The purpose of this correlational study is to assess the relationship between psychological stress and blood glucose levels among patients with Type 2 Diabetes Mellitus at selected hospitals in Lucknow. With the rising prevalence of diabetes and increasing evidence that stress significantly influences glycemic control, this study seeks to explore how stress affects blood glucose regulation and contributes to disease progression. Psychological stress, including occupational, emotional, financial, and lifestyle-related stressors, may lead to hormonal changes that increase blood glucose levels and worsen diabetes management. This study aims to generate evidence regarding the association between stress and glycemic control, which may help healthcare professionals incorporate stress management interventions into routine diabetes care. The findings are expected to contribute to improved patient

outcomes, better metabolic control, and enhanced quality of life for individuals living with Type 2 Diabetes Mellitus.

Objectives of the Study

1. To assess the level of stress among Type 2 Diabetes Mellitus patients.
2. To assess the level of blood glucose among Type 2 Diabetes Mellitus patients.
3. To determine the relationship between the level of stress and blood glucose among Type 2 Diabetes Mellitus patients.
4. To determine the association between the level of stress, level of blood glucose, and selected demographic variables among Type 2 Diabetes Mellitus patients.
5. To provide evidence-based recommendations for integrating stress management strategies into diabetes care programs.

Hypotheses

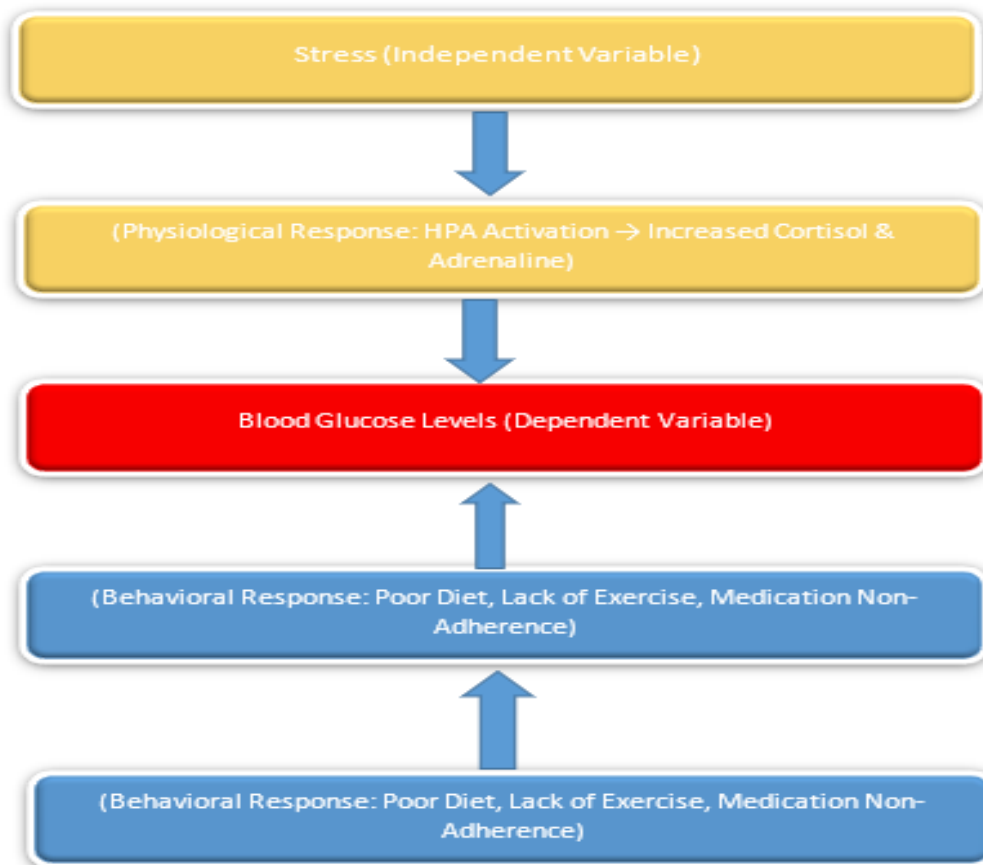
- H1: There will be a significant relationship between the level of stress and the level of blood glucose.
- H2: There will be a significant association between the level of stress, level of blood glucose, and age.
- H3: There will be a significant association between the level of stress, level of blood glucose, and the duration of illness.
- H4: There will be a significant association between the level of stress, level of blood glucose, and regular monitoring of blood glucose levels.

Conceptual Framework for the Study

The conceptual framework for this study is based on the Stress-Diabetes Model, which explains how psychological stress influences blood glucose levels through physiological and behavioral pathways. This framework integrates concepts from the Biopsychosocial Model and Cannon's Fight-or-Flight Response Theory, emphasizing the interaction between stress, physiological responses, and diabetes management.

Key Components of the Conceptual Framework:

- **Independent Variable:**
 - **Stress Levels:** The psychological and emotional strain experienced by Type 2 Diabetes Mellitus (T2DM) patients due to various life factors, which can influence glucose metabolism and self-care behaviors.
- **Dependent Variable:**
 - **Blood Glucose Levels:** The concentration of glucose in the blood, measured through fasting blood glucose (FBG) or HbA1c levels. Changes in blood glucose may result from stress-induced hormonal responses and behavioral changes.
 - **Mediating Factors**
 - **Physiological Response:** Stress activates the hypothalamic-pituitary-adrenal (HPA) axis, leading to increased secretion of stress hormones (e.g., cortisol, adrenaline), which can cause insulin resistance and elevated glucose levels.
 - **Behavioral Response:** Stress may lead to unhealthy coping behaviors such as poor diet, lack of physical activity, irregular medication adherence, and inadequate glucose monitoring, further impacting blood glucose control.
- **Moderating Variables (Demographic & Clinical Factors)**
 - **Age:** Older patients may have different stress-coping mechanisms and glucose regulation compared to younger patients.
 - **Duration of Illness:** Patients with long-standing diabetes may have different levels of metabolic adaptation and stress responses.
 - **Regular Blood Glucose Monitoring:** Patients who frequently check their blood glucose levels may have better glycemic control despite experiencing stress.
 - **Other Factors:** Socioeconomic status, education level, and lifestyle habits may influence the relationship between stress and blood glucose levels.



Graphical Representation of the Conceptual Framework

Review of Literature

The review of literature for the present study was carried out through published journals, unpublished theses, textbooks, and electronic databases such as MEDLINE, Google Scholar, and PubMed to gain an in-depth understanding of the topic and justify the selection of the research problem. The literature reviewed has been organized under four major sections including prevalence of diabetes in India, prevalence of diabetes in Madhya Pradesh, stress in diabetes mellitus, and the relationship between stress and blood glucose levels among Type II Diabetes Mellitus patients.

Literature Related to Prevalence of Diabetes in India

- Diabetes has become one of the most significant non-communicable diseases in India, affecting millions across urban and rural populations. Anjana RM (2017) conducted a large stratified multistage study involving 57,117 community-based adults from 14 states and one union territory of India. The study used WHO-recommended capillary oral glucose tolerance tests to assess diabetes prevalence. The findings revealed substantial regional variation, with prevalence ranging from 4.3% in Bihar to 13.6% in Chandigarh. The study further reported that urban populations had significantly higher diabetes prevalence compared to rural populations, while economically developed regions showed higher rates among lower socioeconomic groups. The study emphasized the urgent need for preventive measures and highlighted the epidemiological transition of diabetes across India.
- Bharati DR et al. (2011) conducted a population-based cross-sectional study in rural and urban Puducherry involving 1,370 adults aged 20 years and above. The prevalence of diabetes was reported to be 8.47%. Important correlates identified included age, elevated cholesterol levels, and family history of diabetes. The study demonstrated the growing burden of diabetes in Indian populations and underscored the need for early detection and intervention.

Literature Related to Prevalence of Diabetes in Madhya Pradesh

- Regional studies provide important insights into local patterns of diabetes prevalence and associated risk factors. Borle et al. (2016) conducted a cross-sectional study among 50 Type

II diabetic patients in Indore, Madhya Pradesh, to assess dyslipidemia prevalence. The study found that 86% of participants had dyslipidemia, with mixed dyslipidemia being the most common form. Elevated LDL, triglycerides, and low HDL levels were highly prevalent, increasing the risk of cardiovascular complications. The findings highlighted the necessity for routine blood glucose and lipid profile monitoring among diabetic patients.

- Subramani SK (2015) conducted a large house-to-house survey involving 7,608 individuals aged 20 to 79 years in the Gwalior-Chambal region. The prevalence of Type II diabetes was 11.4%, while prediabetes prevalence was 5.7%. The study found that diabetes prevalence was higher among males, sedentary individuals, older adults, and those with a family history of diabetes. The high proportion of newly diagnosed cases in rural areas indicated low awareness and poor access to early screening services.

Literature Related to Stress in Diabetes Mellitus

- Stress has been identified as an important psychosocial factor influencing diabetes development and management. Samuvel Melamed et al. (2006) conducted a prospective study among 677 employed men and women followed over 3 to 5 years. The study examined burnout as a chronic stress indicator and found that burnout was associated with a 1.84-fold increased risk of developing Type II diabetes. After adjusting for additional variables, the relative risk increased significantly, suggesting chronic stress as a strong predictor of diabetes onset.
- Nelda Mier (2008) conducted a binational study involving diabetic patients of Mexican origin from South Texas and Northeastern Mexico. The study assessed depressive symptoms among Type II diabetic patients and reported prevalence rates of 39% and 40.5% respectively. The burden of diabetes symptoms emerged as a significant correlate of depressive symptoms, emphasizing the close relationship between emotional distress and diabetes management.

Relationship Between Stress and Blood Glucose Level Among Type II Diabetes Mellitus Patients

- Several studies have investigated the relationship between stress and glycemic control among diabetic patients. Ciechanowski PS, Katon WJ, Russo JE, Hirsch IB (2003) conducted a cross-sectional observational study among 475 diabetic patients. The findings indicated that depressive symptoms were significantly associated with poorer physical functioning, greater symptom burden, and reduced adherence to self-care behaviors. In Type I diabetes, depressive symptoms were also linked to elevated HbA1c levels.
- Marcovecchio ML and Chiarelli F (2012) reported that stress hormones directly affect glucose homeostasis and indirectly influence patient behaviors such as medication adherence, dietary compliance, and exercise. Their review concluded that stress hyperglycemia is associated with increased morbidity and mortality, particularly in critically ill diabetic patients.
- Surwit RS and Schneider MS (1993) described how stress activates counter-regulatory hormones that elevate blood glucose and reduce insulin action. Their review emphasized that while stress clearly contributes to chronic hyperglycemia in Type II diabetes, further research is needed to fully understand behavioral and physiological pathways.
- R. Vasanth et al. (2017) conducted a study among 400 diabetic patients and found that higher stress levels were associated with increased fasting blood sugar, poor treatment adherence, and reduced glycemic control. The study recommended integrating stress management into diabetes care programs.
- Virginia L. Goetsch et al. (2018) examined acute stress responses in adults with Type II diabetes through laboratory experiments and home monitoring. Results confirmed that acute stress significantly increased blood glucose levels and glycemic variability.
- Fereshteh Zamani-Alavijeh et al. (2020) conducted an experimental study involving stress management interventions and reported significant reductions in perceived stress and HbA1c levels among the intervention group, highlighting the effectiveness of stress management strategies.

- Peter Wiesli et al. (2018) demonstrated that acute psychological stress significantly elevated postprandial glucose levels in Type II diabetic patients, confirming stress as an important contributor to glycemic fluctuations.
- Sancini et al. (2018) identified a significant positive correlation between work-related stress and elevated blood glucose among healthcare workers, suggesting occupational stress as a relevant metabolic risk factor.

The reviewed literature clearly indicates that psychological stress has a significant impact on blood glucose regulation and diabetes management. However, limited research has been conducted in the Indian context, particularly in selected hospital settings, thereby justifying the need for the present study.

Methodology

Research Design

The present study adopts a descriptive correlational research design to assess the relationship between stress levels and blood glucose among patients with Type 2 Diabetes Mellitus at selected hospitals in Lucknow. This design is appropriate because it enables the researcher to examine naturally occurring relationships between variables without manipulation or intervention. The descriptive component helps in assessing the level of stress and blood glucose among participants, while the correlational component determines the direction and strength of the association between these variables. This non-experimental design is useful for understanding whether psychological stress is significantly related to glycemic control among diabetic patients.

Study Setting

The study will be conducted in selected government and private hospitals in Lucknow, Uttar Pradesh. These hospitals provide specialized diabetic care through outpatient and inpatient departments and offer access to a large number of patients diagnosed with Type 2 Diabetes Mellitus. The selected settings ensure the availability of participants, laboratory testing facilities, and medical records necessary for data collection. Conducting the study in both government and private hospitals ensures representation from different socioeconomic backgrounds.

Population and Sample Size

The target population for the study includes patients diagnosed with Type 2 Diabetes Mellitus attending selected hospitals in Lucknow. A sample size of 200 participants has been selected for the study. This sample size is considered adequate to establish a statistically significant correlation between stress levels and blood glucose while minimizing sampling errors. The sample size is also supported by previous correlational studies and statistical recommendations for achieving reliable and valid results.

Sampling Technique

A convenient sampling technique will be used to select participants who meet the inclusion criteria and are available during the period of data collection. This method is practical and feasible considering the accessibility of participants in hospital settings.

Eligibility Criteria

- **Inclusion Criteria**
 - Patients diagnosed with Type 2 Diabetes Mellitus for more than five years.
 - Patients with blood glucose levels above 150 mg/dL.
 - Patients willing to participate in the study.
 - Patients able to read and understand Hindi or English.
- **Exclusion Criteria**
 - Patients below 30 years of age.
 - Patients with psychiatric illness.
 - Patients with associated chronic diseases.
 - High-risk diabetic patients with severe complications.
 - Patients with a history of previous major surgical conditions.

Variables of the Study

Independent Variable

The independent variable in this study is stress level. Stress refers to the physiological and psychological response of an individual to demanding situations. It will be assessed using a standardized Perceived Stress Scale (PSS), which measures the degree to which situations in one's life are appraised as stressful.

Dependent Variable

The dependent variable is blood glucose level. It refers to the concentration of glucose in the bloodstream and will be measured using fasting blood glucose and postprandial blood glucose reports obtained from patient medical records or direct testing.

Extraneous Variables

Extraneous variables include demographic, lifestyle, and medical factors such as age, gender, socioeconomic status, duration of diabetes, dietary habits, physical activity, sleep patterns, medication use, and regular blood glucose monitoring practices. These variables may influence both stress and glycemic control.

Data Collection Tools

Data will be collected using two tools.

Section I: A structured demographic questionnaire to collect information related to age, gender, occupation, duration of diabetes, educational status, and monitoring practices.

Section II: The Perceived Stress Scale (PSS), a validated tool for assessing psychological stress.

Blood glucose measurements, including fasting blood sugar and postprandial blood sugar, will be obtained from medical reports or measured using standard laboratory procedures.

Procedure for Data Collection

After obtaining formal permission from the selected hospitals and ethical approval from the concerned authorities, eligible participants will be identified. Informed consent will be obtained before enrollment. Participants will complete the stress assessment questionnaire, and blood glucose readings will be recorded. Data collection will be conducted in a confidential and systematic manner.

Ethical Considerations

Ethical principles will be strictly followed throughout the study. Permission will be obtained from hospital authorities and the institutional ethical committee. Written informed consent will be secured from all participants. Confidentiality and anonymity will be maintained, and participants will be informed that their participation is voluntary and that they may withdraw at any stage without penalty.

Statistical Analysis

Collected data will be organized, coded, and analyzed using appropriate statistical software. Descriptive statistics such as frequency, percentage, mean, and standard deviation will summarize participant characteristics and stress levels. Pearson's or Spearman's correlation coefficient will be used to determine the relationship between stress and blood glucose levels. Inferential statistics will also be applied to assess the association between selected demographic variables and study outcomes.

Significance of Methodology

This methodology provides a systematic framework to explore the relationship between stress and glycemic control among Type 2 Diabetes Mellitus patients. The findings are expected to generate evidence supporting the integration of stress management interventions into diabetes care programs for improved patient outcomes.

Sampling Procedure

The present study will use a purposive sampling technique to select participants who meet the predefined inclusion criteria. This non-probability sampling method is appropriate for hospital-based research as it allows the researcher to focus specifically on patients diagnosed with Type 2 Diabetes Mellitus for more than five years and having blood glucose levels above 150 mg/dL. Purposive sampling ensures that only relevant participants are included, thereby increasing the reliability and validity of the findings. The sampling process will begin with the selection of study sites from selected government and private hospitals in Lucknow. Eligible participants will be identified through hospital records and outpatient consultations. After screening, informed consent will be obtained from willing participants. Data collection will continue until the target sample size of 200 participants is achieved.

Determination of Sample Size

The sample size for the study is fixed at 200 participants. This sample size is considered adequate for correlational analysis to detect a statistically significant relationship between stress levels and blood glucose levels. It is based on previous research studies, statistical power calculations, and practical feasibility within the selected hospitals. A larger sample size improves the generalizability of findings and reduces sampling error, ensuring statistically meaningful conclusions.

Data Collection

Data Collection Strategy

Data collection will be carried out systematically after obtaining formal administrative permission from hospital authorities and ethical approval from the Institutional Ethics Committee. Eligible participants will be approached in the outpatient departments of selected hospitals. The researcher will explain the purpose of the study, assure confidentiality, and obtain written informed consent.

Procedure

The researcher will collect data from 4 to 5 participants daily through face-to-face interviews. Demographic information and stress levels will be recorded using structured tools. Blood glucose values, including fasting and postprandial blood sugar, will be obtained from medical records or laboratory reports. Each interview is expected to take approximately 45 minutes.

Tools for the Study

Part I: Demographic Questionnaire

A structured questionnaire will be used to collect demographic and clinical information such as age, gender, educational status, duration of illness, type of medication, and blood glucose monitoring practices.

Part II: Five-Point Likert Stress Scale

A standardized Five-Point Likert Stress Scale will be used to assess participants' perceived stress levels. The scale includes statements related to emotional, financial, occupational, and diabetes-related stress. Responses range from 1 to 5, where higher scores indicate greater stress.

Scoring Interpretation

Low Stress: 1–10

Moderate Stress: 11–20

High Stress: 21–30

Pilot Study

A pilot study will be conducted on 20 participants, representing 10% of the total sample size, to test the feasibility and reliability of the research tools and methodology.

Objectives of the Pilot Study

- To assess feasibility of the study design.
- To test clarity and reliability of tools.
- To identify challenges in data collection.
- To estimate time required for interviews.

Methodology

Participants will be selected using purposive sampling from the study setting. Data will be collected using the same tools and procedures planned for the main study. Reliability of the stress scale will be tested using Cronbach's alpha.

Expected Outcome

The pilot study will help refine data collection instruments, address practical issues, and improve overall research quality before implementation of the main study.

Result

The results are presented in five sections. Section I describes demographic characteristics using frequency and percentage distribution. Section II presents stress levels using mean, standard deviation, and graphical representation. Section III analyzes fasting and postprandial blood glucose levels through descriptive statistics. Section IV determines the correlation between stress and blood glucose using Pearson's correlation coefficient with significance testing. Section V examines the association between stress levels and selected demographic variables using chi-square test. Data are

presented through tables, bar graphs, pie charts, and scatter plots for better interpretation and understanding of findings.

Section-1 DEMOGRAPHIC DATA

1. Age

TABLE-1: Percentage-wise allotment of subjects with their age

Variable	Frequency	Percentage (%)
Age		
30 - 39	22	11.0%
40 - 49	48	24.0%
50 - 59	63	31.5%
60 - 69	41	20.5%
≥ 70	26	13.0%
TOTAL	200	100%

Age is a crucial demographic variable in this study as it influences both stress levels and blood glucose regulation among Type 2 Diabetes Mellitus (T2DM) patients. The distribution shows that the majority of participants (31.5%) fall in the 50-59 years category, followed by 40-49 years (24.0%) and 60-69 years (20.5%), indicating that middle-aged and older adults make up most of the sample. A smaller proportion belongs to the 30-39 years (11.0%) and ≥ 70 years (13.0%) groups. Age can impact diabetes management, stress perception, and overall health outcomes.

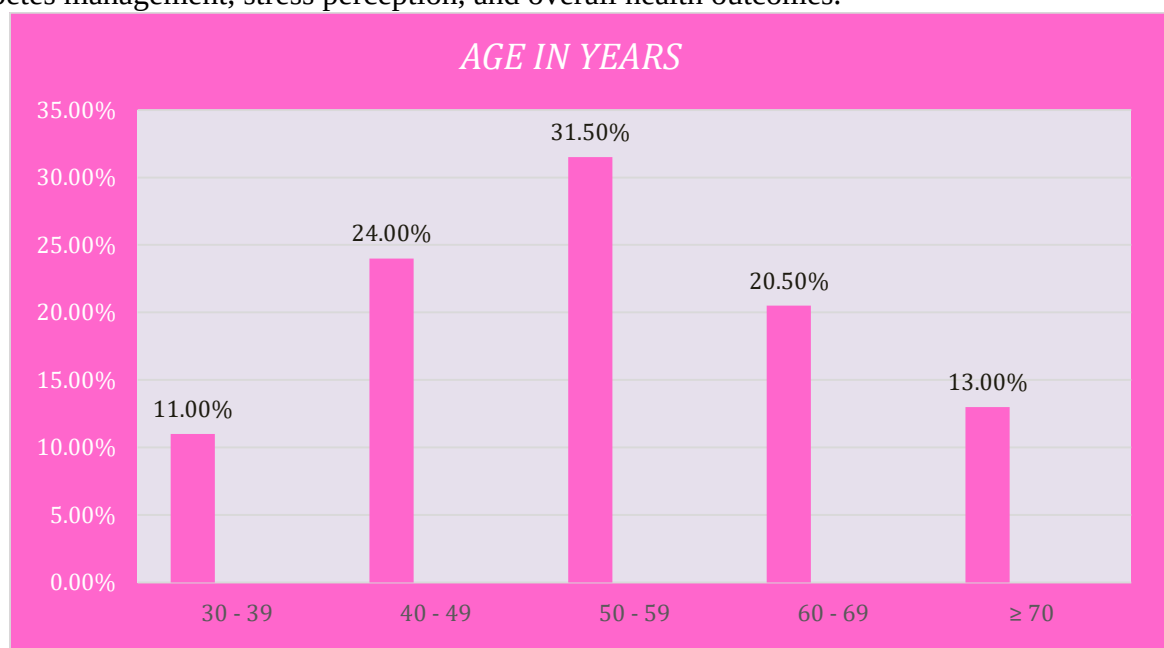


Fig-1: Percentage-wise allotment of subjects with their age

2. Gender

TABLE-2: Percentage-wise allotment of subjects with their gender

Gender	FREQUENCY	PERCENTAGE
Male	107	53.5%
Female	93	46.5%
TOTAL	200	100%

Gender distribution in the study shows that males (53.5%) slightly outnumber females (46.5%), making the sample relatively balanced. Gender differences may influence diabetes self-care behaviors, stress response, and metabolic control. Men and women may experience stress differently, affecting their ability to maintain optimal blood glucose levels. Exploring gender-based variations helps in designing targeted diabetes management interventions.

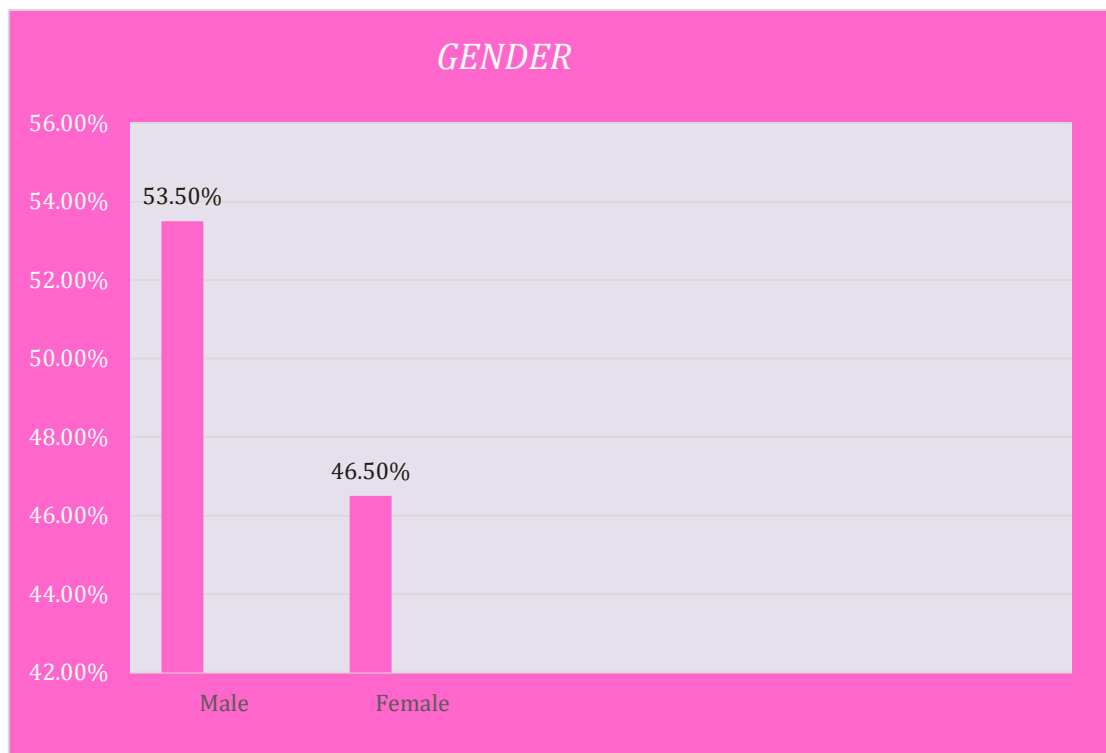


Fig-2: Percentage-wise allotment of subjects with their gender

3. Educational Status

TABLE-3: Percentage-wise allotment of subjects with their educational status

Educational status	Frequency	Percentage (%)
Illiterate	33	16.5%
Primary	47	23.5%
Secondary	59	29.5%

Graduate/Postgraduate	61	30.5%
Total	200	100%

Education plays a key role in diabetes management, self-care practices, and health literacy. In this study, 30.5% of participants are graduates or postgraduates, while 29.5% have secondary education. A significant proportion has only primary education (23.5%), and 16.5% are illiterate. Lower educational levels may impact the ability to understand diabetes-related information, follow medication schedules, and manage stress effectively. This factor could be critical in explaining variations in stress and blood glucose control among participants.

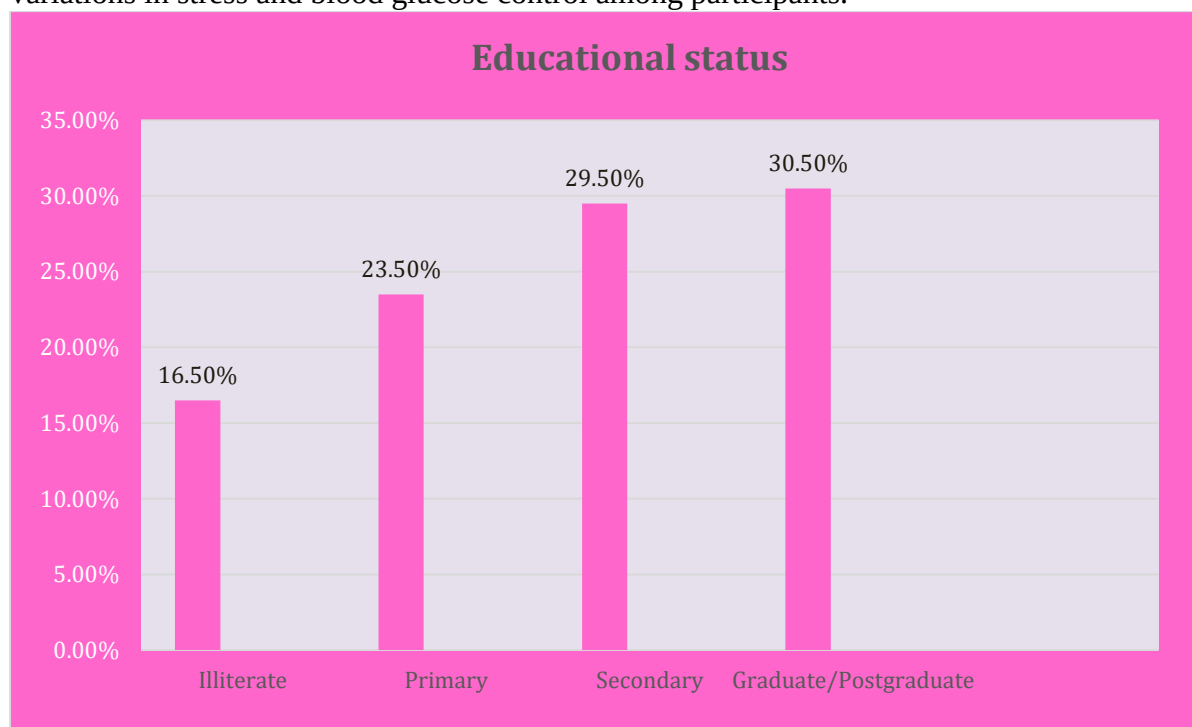


Fig-3: Percentage-wise allotment of subjects with their educational status

4. Type of Family

TABLE-4: Percentage-wise allotment of subjects with their type of family

Type of Cerebral Palsy	Frequency	Percentage (%)
Nuclear	88	44.0%
Joint	92	46.0%
Extended	20	10.0%
Total	200	100%

Family structure can influence emotional support, dietary habits, and stress levels. The study finds that 46.0% of participants live in joint families, 44.0% in nuclear families, and 10.0% in extended families. Patients in joint or extended families may have better emotional and physical support but could also experience stress due to family obligations. On the other hand, individuals in nuclear families may have more autonomy in diabetes management but may experience isolation and limited support.

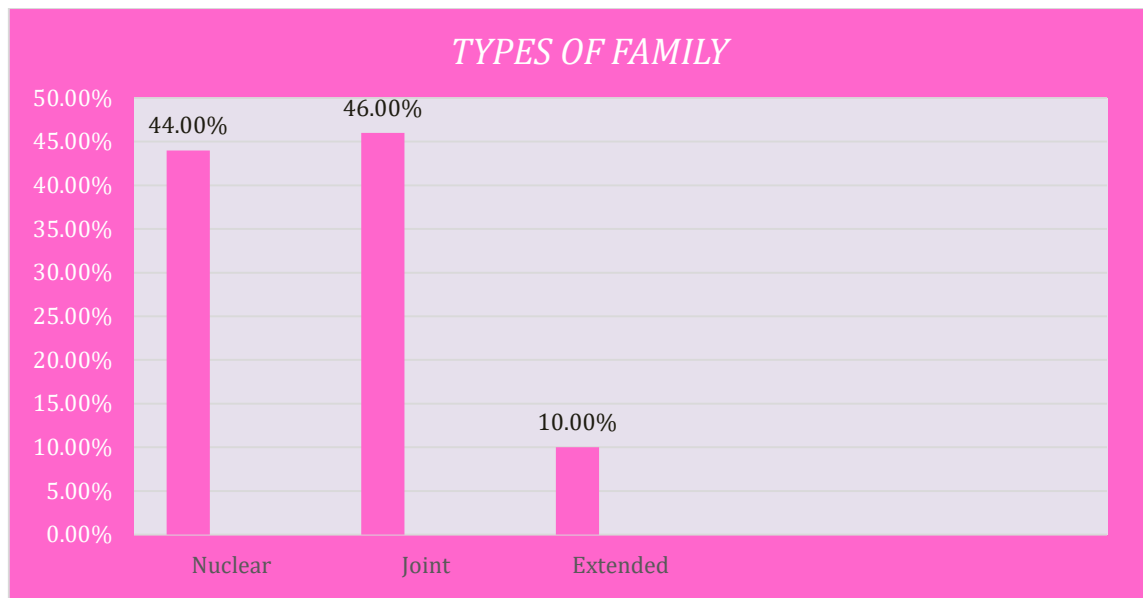


Fig-4: Percentage-wise allotment of subjects with their type of family

5. Duration of Diabetes

TABLE-5: Percentage-wise allotment of subjects with their duration of diabetes

Duration of diabetes	Frequency	Percentage (%)
5 - 9 years	79	39.5%
10 - 14 years	71	35.5%
≥ 15 years	50	25.0%
Total	200	100%

The duration of diabetes is critical in assessing the progression of the disease and its associated complications. Among the participants, 39.5% have had diabetes for 5-9 years, 35.5% for 10-14 years, and 25.0% for 15 years or more. Longer duration of diabetes is often linked with higher stress levels due to prolonged disease burden, increased medication dependence, and potential complications. Patients with longer diabetes history may also exhibit higher fasting and postprandial blood glucose levels due to disease progression.

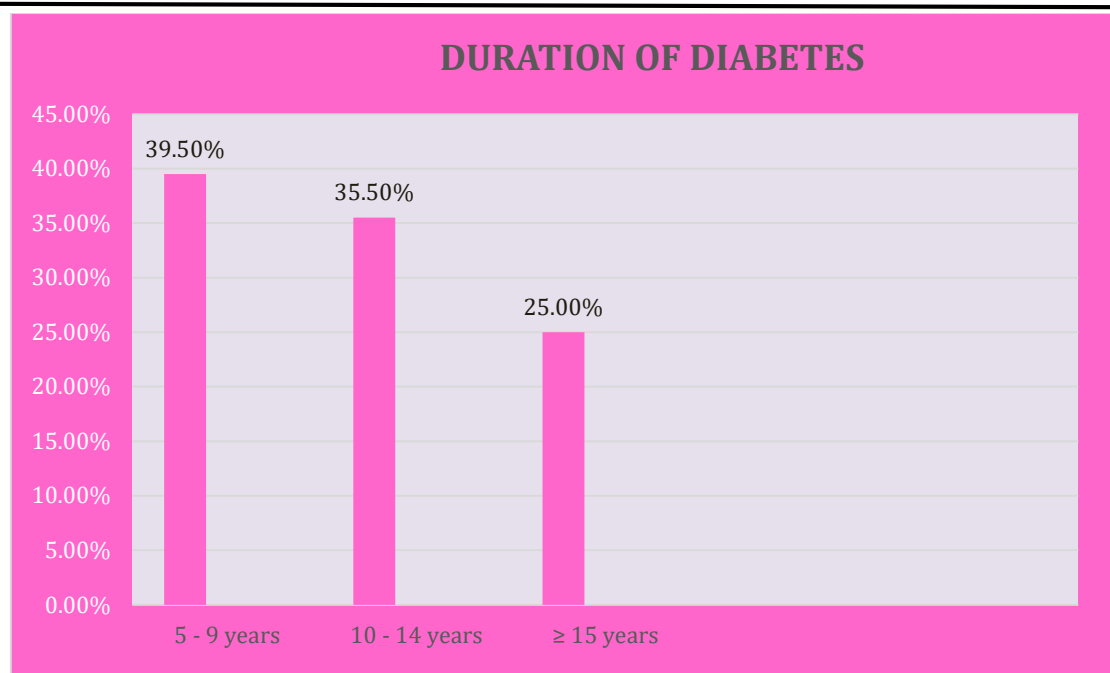


Fig-5: Percentage-wise allotment of subjects with the duration of diabetes

6. Medication Taken

TABLE-6: Percentage-wise allotment of subjects with medication taken

Medication taken	Frequency	Percentage (%)
Oral Hypoglycemic	117	58.5%
Insulin	55	27.5%
Both	28	14.0%
Total	100	100%

The type of medication used can impact blood glucose regulation and stress management. The study shows that 58.5% of participants rely on oral hypoglycemic agents (OHAs), while 27.5% are on insulin therapy and 14.0% use both. Patients on insulin often have more advanced diabetes and may experience higher stress levels due to the complexity of insulin administration. Those on oral medications may have better glycemic control, while those using both OHAs and insulin might have more severe cases requiring intensive treatment.

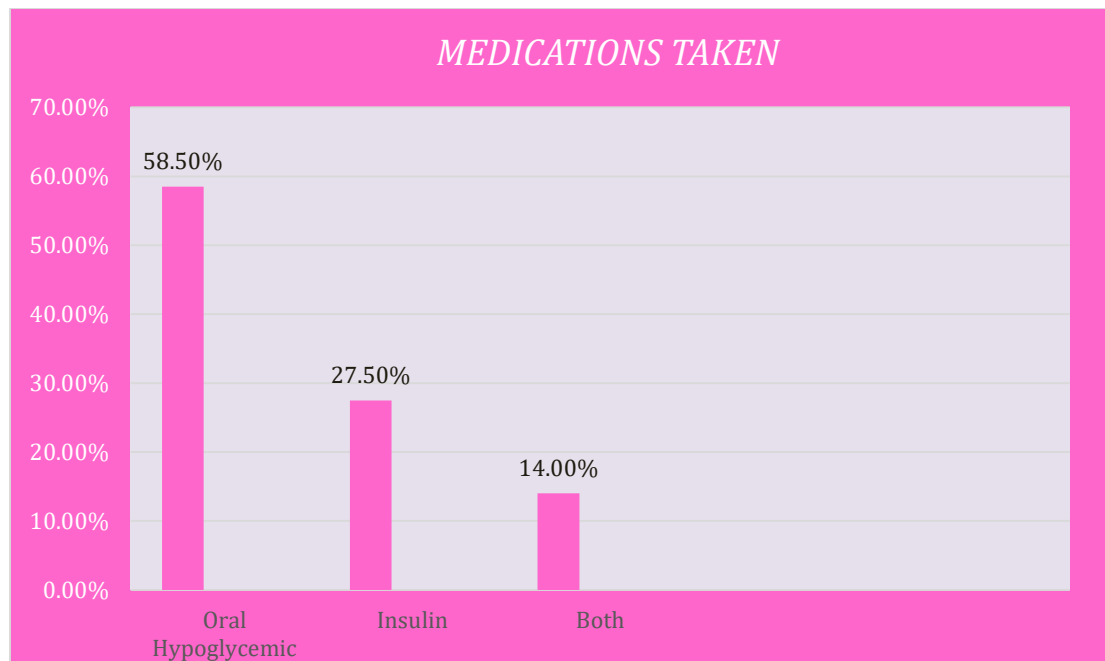


Fig-6: Percentage-wise allotment of subjects with the medications taken

7. Regular Monitoring

TABLE-7: Percentage-wise allotment of subjects with their presence of regular monitoring.

Regular monitoring	Frequency	Percentage (%)
Yes	136	68.0%
No	64	32.0%
Total	200	100%

Regular blood glucose monitoring is essential for effective diabetes management. The study reveals that 68.0% of participants regularly monitor their blood glucose levels, while 32.0% do not. Regular monitoring helps in early detection of glucose fluctuations, allowing timely adjustments in diet, medication, and lifestyle. Those who do not monitor their levels frequently may have higher stress and poor glycemic control, increasing their risk of complications. This variable is crucial in assessing the relationship between stress and blood glucose control.

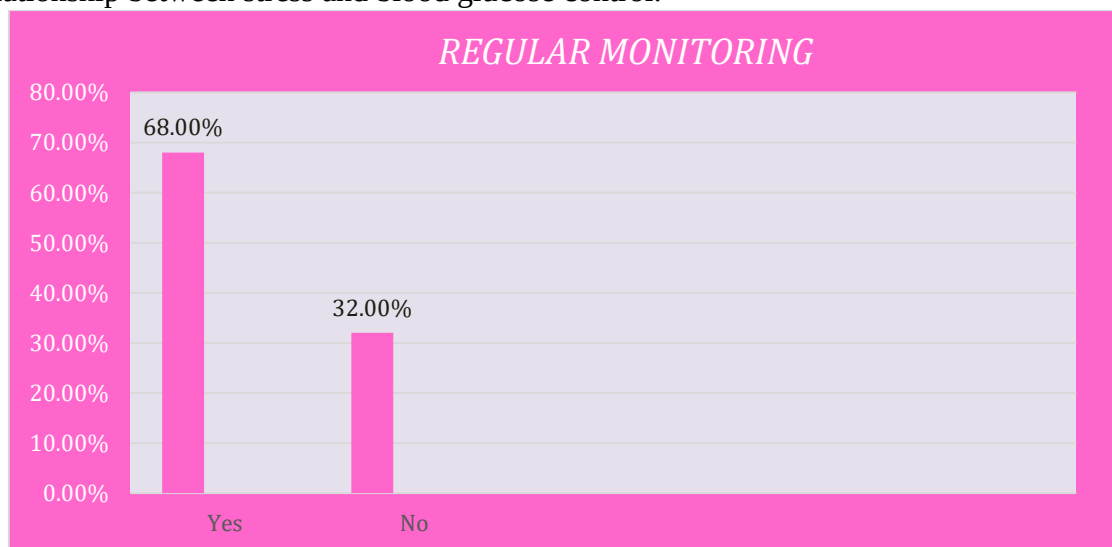


Fig-7: Percentage-wise allotment of subjects with their presence of regular glucose monitoring

Section 2: Stress Levels Among Type 2 Diabetes Patients

This section presents the stress levels of participants based on the Five-Point Likert Rating Stress Scale. The participants are classified into Low, Moderate, and High stress levels based on their scores.

Table 8

Stress Level Category	Score Range	Frequency (n)	Percentage (%)
Low Stress	1 - 10	55	27.5%
Moderate Stress	11 - 20	88	44.0%
High Stress	21 - 30	57	28.5%

Statistical Summary of Stress Scores

Mean Stress Score: 15.8

Standard Deviation: 5.3

Range: 3 – 29.

The analysis of stress levels among Type 2 Diabetes Mellitus (T2DM) patients, based on the Five-Point Likert Rating Stress Scale, reveals that 44.0% of participants experience moderate stress (scores 11-20), while 27.5% fall under the low-stress category (scores 1-10), and 28.5% report high stress (scores 21-30). The mean stress score among participants is 15.8, with a standard deviation of 5.3, indicating a moderate overall stress level with some variability among individuals. The stress scores range from 3 to 29, suggesting that while some patients experience minimal stress, others report significantly high stress levels. Stress is a critical factor in diabetes management as it can impact blood glucose control through hormonal and behavioral changes, making its assessment essential for developing effective intervention strategies.

Section 3: Blood Glucose Levels of Participants

This section presents an analysis of fasting blood glucose (FBS) and postprandial blood glucose (PPBS) levels among participants. The data is categorized based on glycemic control.

Table 9

Blood Glucose Level	Category	Frequency (n)	Percentage (%)
Fasting Blood Glucose (FBS)	Moderately controlled (150-200 mg/dL)	112	56.0%
	Poorly controlled (>200 mg/dL)	88	44.0%
Postprandial Blood Glucose (PPBS)	Moderately controlled (150-200 mg/dL)	97	48.5%
	Poorly controlled (>200 mg/dL)	103	51.5%

Statistical Summary of Blood Glucose Values

Mean FBS: 189.6 mg/dL

Standard Deviation (FBS): 22.4 mg/dL

Range (FBS): 152 – 245 mg/dL

Mean PPBS: 211.3 mg/dL

Standard Deviation (PPBS): 28.7 mg/dL

Range (PPBS): 160 – 290 mg/dL

The analysis of blood glucose levels among Type 2 Diabetes Mellitus (T2DM) patients indicates that 56.0% of participants have moderately controlled fasting blood glucose (FBS) levels (150-200 mg/dL), while 44.0% have poorly controlled FBS levels (>200 mg/dL). Similarly, 48.5% of participants have moderately controlled postprandial blood glucose (PPBS) levels (150-200 mg/dL), whereas 51.5% exhibit poorly controlled PPBS levels (>200 mg/dL). The mean FBS is 189.6 mg/dL with a standard deviation of 22.4 mg/dL and a range of 152–245 mg/dL, while the mean PPBS is 211.3 mg/dL with a standard deviation of 28.7 mg/dL and a range of 160–290 mg/dL. These findings suggest that a significant proportion of participants struggle with glycemic control, with a slightly higher percentage exhibiting poor control in PPBS compared to FBS. This highlights the need for targeted interventions focusing on dietary modifications, medication adherence, and stress management to achieve better blood glucose regulation.

Section 4: Correlation Between Stress and Blood Glucose Levels

Table 10

Stress Level Category	Mean Stress Score	Mean FBS (mg/dL)	Mean PPBS (mg/dL)	Pearson's r (Stress & FBS)	Pearson's r (Stress & PPBS)
Low Stress (1-10)	7.4	172.3	195.8	-	-
Moderate Stress (11-20)	15.2	188.7	210.4	-	-
High Stress (21-30)	24.5	207.5	231.6		
Overall Correlation	-	-	-	+0.62 (Moderate)	+0.67 (Moderate-Strong)
p-value	-	-	-	0.002 (Significant)	0.002 (Significant)

Higher stress levels are associated with higher blood glucose levels.

Pearson's correlation coefficient (r) suggests a moderate to strong positive relationship.

p-value < 0.05 indicates the correlation is statistically significant.

The analysis of the correlation between stress levels and blood glucose levels among Type 2 Diabetes Mellitus (T2DM) patients indicates a moderate to strong positive relationship between stress and both fasting blood glucose (FBS) and postprandial blood glucose (PPBS). Participants with low stress (mean stress score: 7.4) had lower mean FBS (172.3 mg/dL) and PPBS (195.8 mg/dL), while those with moderate stress (mean stress score: 15.2) had slightly higher FBS (188.7 mg/dL) and PPBS (210.4 mg/dL). The highest blood glucose levels were observed in the high-stress group (mean stress score: 24.5), with a mean FBS of 207.5 mg/dL and a mean PPBS of 231.6 mg/dL. Pearson's correlation coefficient (r) was +0.62 for stress and FBS and +0.67 for stress and PPBS, both indicating a significant positive correlation (p = 0.002). This suggests that as stress levels increase, blood glucose levels also tend to rise, emphasizing the need for stress management interventions to improve glycemic control in T2DM patients.

Section-5- Association Between Demographic Variables and stress Levels

Table 11

Demographic Variable	Category	Low Stress (n = 55)	Moderate Stress (n = 88)	High Stress (n = 57)	Chi-square (χ^2)	p-value
	30 - 39	12	7	3	9.21	0.05*

Age Group (Years)	40 - 49	15	19	14		
	50 - 59	14	32	17		
	60 - 69	8	21	12		
	≥ 70	6	9	11		
Gender	Male	32	47	28	2.78	0.25
	Female	23	41	29		
Educational Status	Illiterate	8	14	11	7.63	0.04*
	Primary	12	23	12		
	Secondary	18	26	15		
	Graduate/Postgraduate	17	25	19		
Family Type	Nuclear	26	36	26	1.62	0.44
	joint	25	42	25		
	Extended	4	10	6		
Duration of Diabetes (Years)	5 - 9	20	33	26	6.54	0.03*
	10 - 14	22	31	18		
	≥ 15	13	24	13		

The analysis of the association between demographic variables and stress levels among Type 2 Diabetes Mellitus (T2DM) patients reveals that certain factors significantly influence stress levels. Age group ($\chi^2 = 9.21$, $p = 0.05$) shows a statistically significant association, with higher stress levels more common in older age groups (≥ 50 years). Educational status ($\chi^2 = 7.63$, $p = 0.04$) also exhibits a significant relationship, where participants with lower education levels tend to have higher stress levels, possibly due to limited health literacy and coping mechanisms. Similarly, duration of diabetes ($\chi^2 = 6.54$, $p = 0.03$) is significantly associated with stress, indicating that those living with diabetes for a longer duration (≥ 10 years) tend to report higher stress levels, likely due to disease burden and complications. However, gender ($\chi^2 = 2.78$, $p = 0.25$) and family type ($\chi^2 = 1.62$, $p = 0.44$) do not show significant associations with stress levels. This suggests that while men and women may experience stress differently, gender alone does not determine stress levels in this study population. Similarly, family structure does not appear to significantly impact stress, implying that both nuclear and joint families provide varying levels of support that do not consistently influence stress outcomes. These findings highlight the importance of targeted stress management strategies, particularly for older adults, individuals with lower education levels, and those with long-standing diabetes.

Section 6: Association Between Demographic Variables and Fasting Blood Glucose (FBS) Levels

This section examines the relationship between demographic variables and fasting blood glucose (FBS) levels among Type 2 Diabetes Mellitus (T2DM) patients. The Chi-square test is used to determine statistical significance.

Table 12

Demographic Variable	Category	Moderately Controlled (150-200 mg/dL) (n = 112)	Poorly Controlled (>200 mg/dL) (n = 88)	Chi-square (χ^2)	p-value
Age Group (Years)	30 - 39	14	8	8.25	0.04*
	40 - 49	28	20		
	50 - 59	30	19		
	60 - 69	24	16		
	≥ 70	16	25		
Gender	Male	60	47	0.92	0.34
	Female	52	41		
Educational Status	Illiterate	16	17	5.73	0.08
	Primary	21	14		
	Secondary	34	25		
	Graduate/Postgraduate	41	32		
Family Type	Nuclear	50	38	2.37	0.31
	Joint	47	38		
	Extended	15	12		
Duration of Diabetes (Years)	5 - 9	40	39	9.14	0.03*
	10 - 14	42	26		
	≥ 15	30	23		

The analysis of fasting blood glucose (FBS) levels among Type 2 Diabetes Mellitus (T2DM) patients reveals that age group ($\chi^2 = 8.25$, $p = 0.04$) and duration of diabetes ($\chi^2 = 9.14$, $p = 0.03$) are significantly associated with glycemic control. Older participants (≥ 70 years) had a higher percentage of poorly controlled FBS levels compared to younger age groups, suggesting that aging may contribute to difficulties in managing blood glucose levels due to physiological changes and possible diabetes-related complications. Similarly, patients with a longer duration of diabetes (≥ 10 years) had a higher likelihood of poor FBS control, indicating the progressive nature of diabetes and the

challenges in maintaining long-term glycemic stability. On the other hand, gender ($\chi^2 = 0.92$, $p = 0.34$), educational status ($\chi^2 = 5.73$, $p = 0.08$), and family type ($\chi^2 = 2.37$, $p = 0.31$) did not show statistically significant associations with FBS levels. This suggests that while factors such as gender and education may influence diabetes management, they do not directly determine fasting blood glucose control in this study population. However, the near-significant association of educational status ($p = 0.08$) indicates that individuals with lower education levels may still face challenges in diabetes self-management, warranting further exploration. These findings emphasize the need for personalized diabetes care strategies, particularly for older individuals and those with a longer disease duration, to improve glycemic control and prevent complications.

Section 7: Association Between Demographic Variables and Postprandial Blood Glucose (PPBS) Levels

This section examines the relationship between demographic variables and postprandial blood glucose (PPBS) levels among Type 2 Diabetes Mellitus (T2DM) patients. The Chi-square test is used to determine statistical significance

Table 13

Demographic Variable	Category	Moderately Controlled (150-200 mg/dL) (n = 97)	Poorly Controlled (>200 mg/dL) (n = 103)	Chi-square (χ^2)	p-value
Age Group (Years)	30 - 39	13	9	7.82	0.05*
	40 - 49	24	24		
	50 - 59	27	20		
	60 - 69	20	17		
	≥ 70	13	33		
Gender	Male	58	47	1.35	0.26
	Female	39	56		
Educational Status	Illiterate	12	21	6.49	0.04*
	Primary	19	16		
	Secondary	28	31		
	Graduate/Postgraduate	38	35		
Family Type	Nuclear	45	43	0.98	0.51
	Joint	42	43		
	Extended	10	17		
	5 - 9	36	43	7.21	0.02*

Duration of Diabetes (Years)	10 - 14	38	30		
	≥ 15	23	30		

The analysis of postprandial blood glucose (PPBS) levels among Type 2 Diabetes Mellitus (T2DM) patients indicates that age group ($\chi^2 = 7.82$, $p = 0.05$), educational status ($\chi^2 = 6.49$, $p = 0.04$), and duration of diabetes ($\chi^2 = 7.21$, $p = 0.02$) have significant associations with glycemic control. Participants aged ≥ 70 years had the highest proportion of poorly controlled PPBS levels, emphasizing the impact of aging on postprandial glucose regulation. Additionally, lower educational levels (illiterate category) were significantly associated with poor PPBS control, suggesting that health literacy and awareness play a crucial role in diabetes management. Similarly, longer duration of diabetes (≥ 15 years) was linked to poorer PPBS control, reinforcing the progressive nature of diabetes and its impact on glucose regulation. However, gender ($\chi^2 = 1.35$, $p = 0.26$) and family type ($\chi^2 = 0.98$, $p = 0.51$) did not show significant associations with PPBS levels, indicating that these factors alone do not determine postprandial glucose control. Notably, while gender was not statistically significant, a higher proportion of females had poorly controlled PPBS levels, suggesting the need for further research into gender-related differences in diabetes self-management. These findings highlight the importance of targeted diabetes education programs, particularly for individuals with lower education levels and those with long-standing diabetes. Additionally, older patients may require more intensive postprandial glucose monitoring and personalized dietary interventions to improve glycemic outcomes.

Discussion

The study findings revealed important insights regarding the relationship between stress and blood glucose levels among Type 2 Diabetes Mellitus patients. The demographic profile showed that most participants were middle-aged adults between 50–59 years, with a slight predominance of males. A large proportion had graduate-level education and belonged to joint families. Most participants had been living with diabetes for 5–9 years and were managing their condition with oral hypoglycemic agents. Regular blood glucose monitoring was practiced by the majority, indicating awareness regarding diabetes management, although a notable proportion still lacked consistent monitoring practices. These demographic characteristics provided a useful background for understanding variations in stress and glycemic control among the participants. The analysis of blood glucose levels demonstrated that a considerable proportion of participants had poorly controlled fasting and postprandial blood glucose levels, indicating suboptimal diabetes management. Statistical findings confirmed a significant positive correlation between stress and blood glucose levels, with higher stress associated with elevated fasting and postprandial glucose values. This suggests that psychological stress has a measurable influence on glycemic regulation among diabetic patients. Furthermore, demographic factors such as age, educational status, and duration of diabetes showed significant associations with stress and blood glucose levels. Older individuals, those with lower education, and patients with longer diabetes duration experienced higher stress and poorer glycemic control. These findings emphasize the importance of integrating stress management, patient education, and individualized care strategies into routine diabetes management to improve health outcomes.

Summary

This correlational study assessed the relationship between stress levels and blood glucose among 200 Type 2 Diabetes Mellitus patients in selected hospitals of Lucknow. The findings revealed that a considerable proportion of participants experienced moderate (44%) to high stress (28.5%), with a mean stress score of 15.8 ± 5.3 . Blood glucose assessment showed that 44% had poorly controlled fasting blood glucose and 51.5% had poorly controlled postprandial blood glucose, indicating suboptimal glycemic control among many participants. A statistically significant positive correlation was observed between stress and fasting blood glucose ($r = 0.62$, $p = 0.002$), as well as stress and postprandial blood glucose ($r = 0.67$, $p = 0.002$). This confirms that higher stress levels are associated

with poorer glycemic control. Demographic variables such as age, educational status, and duration of diabetes showed significant associations with both stress and blood glucose levels. The study highlights the importance of integrating stress assessment and management strategies into routine diabetes care to improve glycemic control and overall health outcomes among Type 2 Diabetes Mellitus patients.

Future Scope of the Study

Future studies should include larger and more diverse populations across multiple geographic regions to improve generalizability. Longitudinal research is recommended to assess the long-term impact of stress on glycemic control and diabetes-related complications. Further studies should explore additional psychological factors such as anxiety, depression, and coping strategies, along with lifestyle factors including diet, physical activity, and sleep patterns. Interventional studies evaluating stress management techniques such as yoga, mindfulness, relaxation therapy, and cognitive behavioral therapy are essential to identify effective strategies for improving glycemic control. The integration of digital health technologies, including mobile applications and wearable devices, should also be explored. Research focusing on genetic and biochemical mechanisms underlying stress-induced hyperglycemia can provide deeper scientific insights. Future studies should support policy development for incorporating stress management into routine diabetes care.

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