Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

Assessment of Level of Stress and Glycemic Control among the Type 2 Diabetes Mellitus Patients: An Observational Study

Arindita Saha[1], Debasish Chakraborty[2], Satabdi Saha[3]

[1]Junior Resident, Department of Physiology, AGMC, Agartala, Tripura, India, [2]Professor, Department of Physiology, AGMC, Agartala, Tripura, India, [3]Senior Resident, Department of Physiology, AGMC, Agartala, Tripura, India

Abstract

Background: Type 2 diabetes is a chronic disease that is expanding at an alarming rate in the world. Several studies have shown that psychological distress plays an important role in the development, intensification, and chronicity of diabetes. Stress plays a dual role (cause and effect) in its relationship with diabetes. This elevation of blood glucose is seen not only in physical stress but also other form of stress such as psychosocial stress which is experienced in routine day lifestyle. The consequences of psychological stress on the endocrine system hamper the glucose metabolism processes. Hence, the assessment of stress was recommended in clinical practice. Timely assessment of stress and counseling the patients are highly essential in the management of diabetes.

Aims and Objectives: The aim of the study was to assess the stress level among the patients with type 2 diabetes mellitus (T2DM) and their glycemic control.

Materials and Methods: Assessment of stress level was done in 120 adult T2DM patients attending diabetes and nutritional clinic OPD of AGMC and GBP Hospital, Agartala, over a period of 3 months using perceived stress scale (PSS). Their hemoglobin A1C (HbA1C) level was noted. Statistical analysis was carried out using SPSS software 15.0, and results were analyzed and correlated. $P < 0.05$ was considered statistically significant.

Results: Out of the total sample size of 120, 56.7% were male and 43.3% were female. Estimation of HbA1C among the study participants showed 79.1% having poor glycemic control. Assessment of PSS showed 20.9% of the patients had low stress with score of 0–13, 40% of them had moderate level of stress with score of 14–26, and 39.1% had high perceived stress level with score of 27–40. The patients with moderate-to-high stress level had poor glycemic control.

Conclusion: Psychosocial stress hampers the normal physiology of the endocrine system bringing changes in the glucose metabolism processes. Excess stress among the type 2 diabetic patients deteriorates their glycemic control. Hence, regular assessment of stress and proper counseling of the patients are highly essential in the management of diabetes.

Key words: Type 2 diabetes mellitus, Hemoglobin A1C, Perceived stress scale, Stress

INTRODUCTION

Type 2 diabetes is a chronic disease that is expanding at an alarming rate in the world.[1] The International Diabetes Federation reports that the prevalence of diabetes has reached a global epidemic level. Stress is one of the main problems among patients with diabetes.[2] Stress is defined as the body response to any demand made on it. This response has two divisions that are specific response and non-specific response. Specific response is the one which is actual response to the particular stimulus that involves only a particular body system. However, non-specific response is the one which is common to any type of stress and involves different body systems and leads to fight or flight response.[3] Several studies have shown that psychological distress plays an important role in the development, intensification, and chronicity of diabetes. Stress plays a dual role (cause and effect) in its relationship with diabetes. This elevation of blood glucose is seen not only in physical

Access this article online

www.ijss-sn.com

Month of Submission : 04-2023
Month of Peer Review : 04-2023
Month of Acceptance : 05-2023
Month of Publishing : 05-2023

Corresponding Author: Prof. (Dr.) Debasish Chakraborty, Professor, Department of Physiology and Academic in-charge, Agartala Govt. Medical College (AGMC), PO. Kunjavan, Agartala - 799 006, Tripura (West), India.

stress but also other form of stress such as psychosocial stress which is experienced in routine day lifestyle.

Psychosocial stress does not require increase in the blood glucose levels. Moreover, if the individual undergoes this type of stress daily, there will be elevated blood glucose levels. The consequences of stress on the endocrine system bring changes in the glucose metabolism processes.[4]

The relationship between stressful experiences and controlling blood glucose levels is very different among individuals with T2DM. Stress can affect blood glucose levels directly (by acting on the neuroendocrine system) or indirectly.[5] It can be considered a cause and yet a consequence of diabetes. On one hand, stress increases glucose and glycosylated hemoglobin A1C (HbA1C) and, on the other hand, diabetes and its consequences can increase stress levels among individuals with type 2 diabetes as well as causing other physical, behavioral, and mental disorders.[6-8] Cortisol is released in response to stress and stimulates the formation of glucose and glycogenolysis, leading to high blood glucose levels. Stimulation of the secretion of different hormones during stress elevates blood glucose levels.[9] Timely assessment of stress and counseling the patients are highly essential in the management of diabetes. Hence, the present study is undertaken to evaluate the stress levels in type 2 diabetes mellitus (T2DM) patients.

MATERIALS AND METHODS

Objective

The objective of the study was to assess the stress level among the patients with T2DM and their glycemic control.

A hospital-based cross-sectional study was done in 120 adults with T2DM attending diabetes and nutritional clinic OPD of AGMC and GBP Hospital, Agartala. Ethical clearance was obtained from the ethical committee of AGMC and GBPH. The study subjects were initially evaluated by general history, clinical examination, and blood reports. Study was conducted from Jan 2023–Mar 2023.

Inclusion Criteria for the Cases

1. Patients aged between 30 and 60 years.
2. Diagnosed cases of T2DM as given by the American Diabetes Association.[10]

Patients who fulfill the following criteria for the diagnosis of diabetes mellitus:

a. Symptoms of diabetes plus random blood glucose (RBS) concentration ≥11.1 mmol/L (200 mg/dL) or
b. Fasting plasma glucose (FBS) ≥7.0 mmol/l (126 mg/dl) or
c. Hemoglobin A1c ≥ 6.5% or
d. 2 h plasma glucose (post prandial blood sugar [PPBS]) ≥11.1 mmol/L (200 mg/dL) during an oral glucose tolerance test.
3. Cooperative and willing to participate in the study.

Exclusion Criteria for the Cases

1. Those who are not willing to participate in the study.
2. Critically ill patients unable to respond to the questionnaire.
3. Patients with other psychological disorders.

Study Tools

- Sphygmomanometer-Omron digital BP machine HEM 7120.
- Height measuring stand – Stadiometer -Bioplus; height – 20 cm - 205 cm. Graduation – scale of 1 mm ruler printed along both sides of the measuring rod.
- Weighing machine – Omron HN 289 automatic personal digital weight machine.
- Investigating materials for the estimation of blood sugar and glycosylated HbA1c – Hitachi HPLC system Model-Chromaster for QC laboratory by scientific technology solution.
- Case study format
- Perceived stress scale (PSS) questionnaire

The PSS is a classic tool for stress assessment. The questions in this scale ask about one's feelings and thoughts during the last monthIn each case, one was asked to indicate how often he/she felt or thought a certain way.

For each question, the patient should choose from the following alternatives:

- 0 – Never,
- 1 – Almost never,
- 2 – Sometimes,
- 3 – Fairly often,
- 4 – Very often.

Individual scores on the PSS can range from 0 to 40 with higher scores indicating higher perceived stress.

- Scores ranging from 0 to 13 was considered low stress.
- Scores ranging from 14 to 26 was considered moderate stress.
- Scores ranging from 27 to 40 was considered high stress.

Data Collection

120 type 2 diabetic patients attending diabetes and nutrition clinic were included in the study. Data were collected from the participants after obtaining their informed consent. Sociodemographic variables such as name, age, and sex were noted as per the case study format. The duration for

which they are suffering from T2DM and their blood sugar (RBS, fasting blood sugar [FBS], and PPBS) and HbA1c levels were also noted from their medical documents. Stress level was assessed among the study participants using a predesigned standard questionnaire, PSS.

Data Analysis

Data were analyzed using SPSS software. Descriptive statistics and other suitable statistical tests were used as per applicability. Data were expressed in terms of mean and standard deviation. A probability value <0.05 was considered statistically significant.

RESULTS

A total of 120 T2DM patients had participated in this study. Among them, 56.7% were male and 43.3% were female as shown in Figure 1. Mean age group was 43.24 ± 4.4 years. Age-wise distribution of the study participants is shown in Figure 2. Mean duration of the disease was 7 ± 3.34 years. Disease duration of the study participants is shown in Figure 3. The blood sugar parameters estimated were the FBS, PPBS, and the glycosylated HbA1C. Figure 4 shows the FBS, Figure 5 shows the PPBS, Figure 6 shows the HbA1C of the study participants. Figure 7 shows the gender-wise distribution of the glycemic control. Figure 8 shows the mean and standard deviation of the HbA1C level and PSS. Mean value and standard deviation of HbA1C level and perceived stress score is shown in Table 1. Figure 9 shows the percentage of scores of PSS of the study participants as low, moderate, and high scores. Figure 10 shows the gender-wise distribution of PSS. There was positive correlation between stress and HbA1C level but not significant (*P* value – 0.034 and r value −0.23) as shown in Figure 11. The HbA1C level among the diabetic patients with mild, moderate, and severe stress is shown in Figure 12. Figure 13 shows the PSS scores and the type of anti-diabetic medication consumed by the study participants.

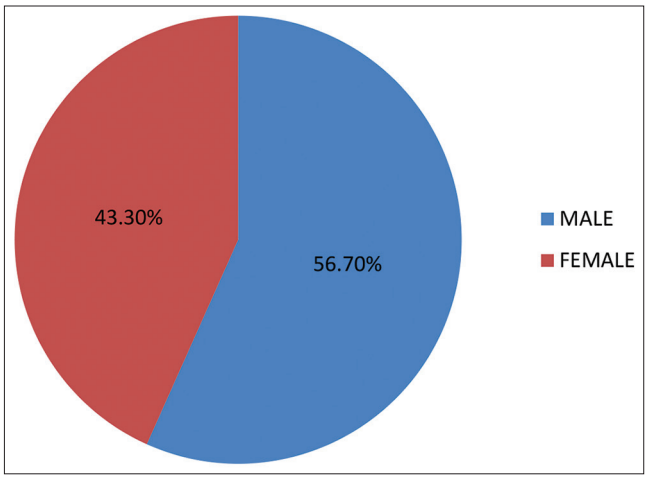

Figure 1: Gender-wise distribution of the study participants

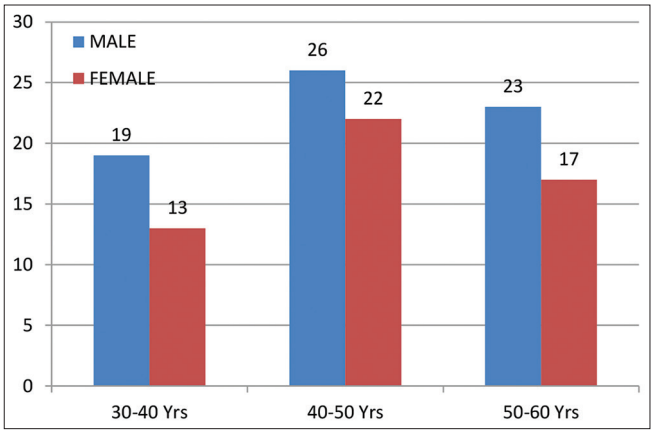

Figure 2: Age-wise distribution of study participants

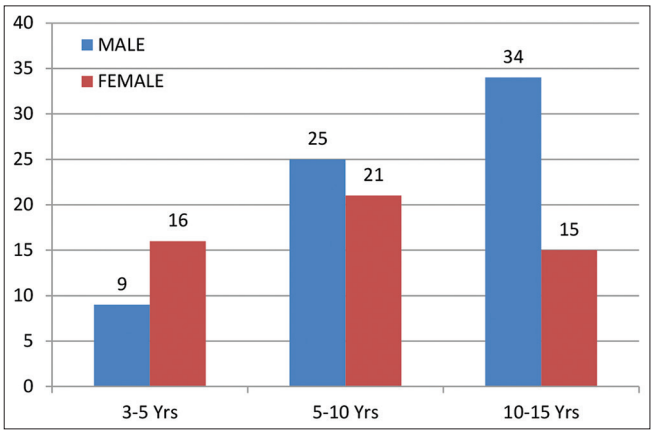

Figure 3: Disease duration of the study participants

DISCUSSION

Type 2 diabetes is a chronic disease that is expanding at an alarming rate in the world. Several studies have shown that psychological stress plays a dual role (cause and effect) in its relationship with diabetes. The consequences of stress on the endocrine system bring disturb the homeostasis of glucose metabolism processes.

In our study, we found that, among the study participants, 56.7% were male and 43.3% were female. Mean age group was 43.24 ± 4.4 years. Mean duration of the disease was 7 ± 3.34 years. The PSS showed a significant increase in stress level among the type 2 diabetic patients (*P* value: 0.01). However, the positive correlation between stress and HbA1C was not statistically significant (*P* value: 0.034 and r value: 0.23). Around 40% of the study participants showed a moderate score in the PSS and around 79.1% of them had poor glycemic control.

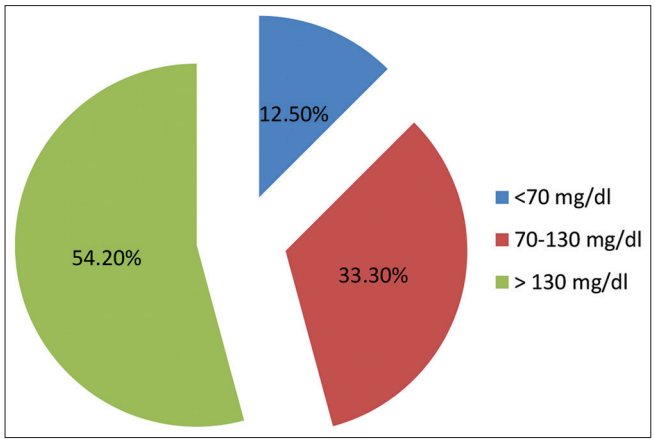

Figure 4: Fasting blood sugar of the study participants

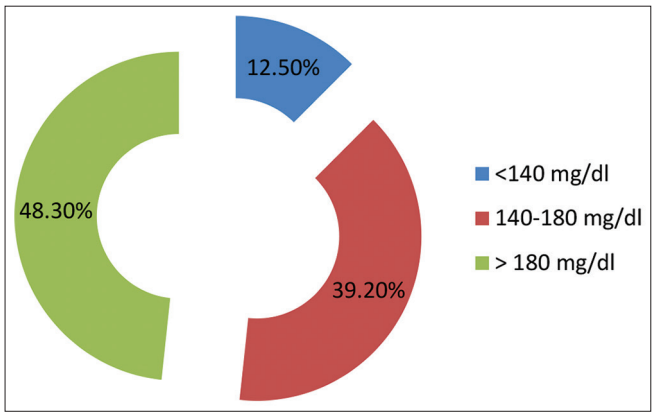

Figure 5: Postprandial blood sugar of the study participants

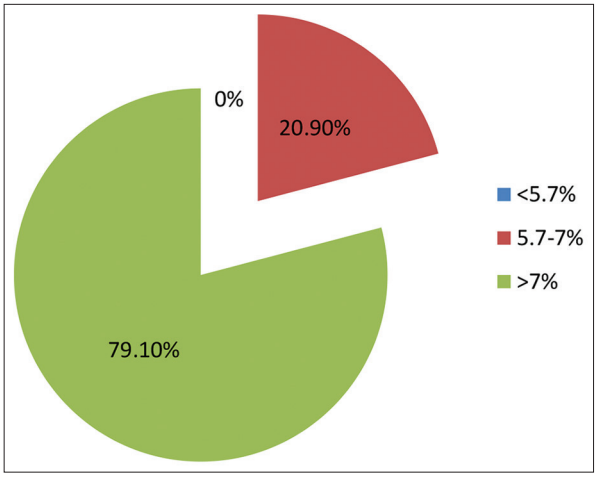

Figure 6: Hemoglobin A1C of the study participants

The result of this study was in association with the study conducted by Surwit *et al.*[1] where he revealed that more than 30% of patients were given add-on insulin with OHD for better glycemic control, of which about 44% had significantly high stress. Although there could be many other factors that may be affecting blood glucose, the study showed that the stress was a potential contributor to it.

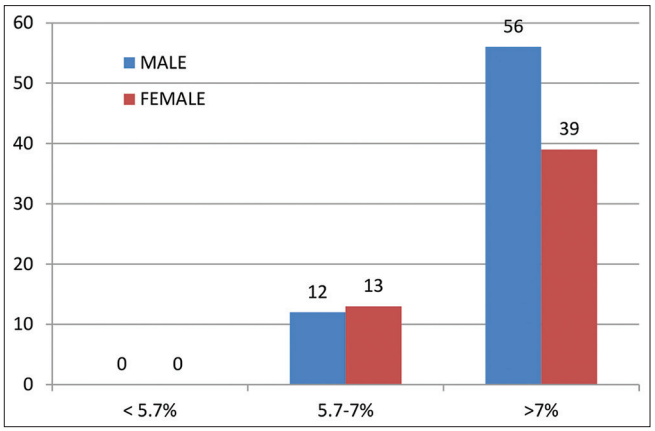

Figure 7: Gender-wise distribution of hemoglobin A1C level among the study participants

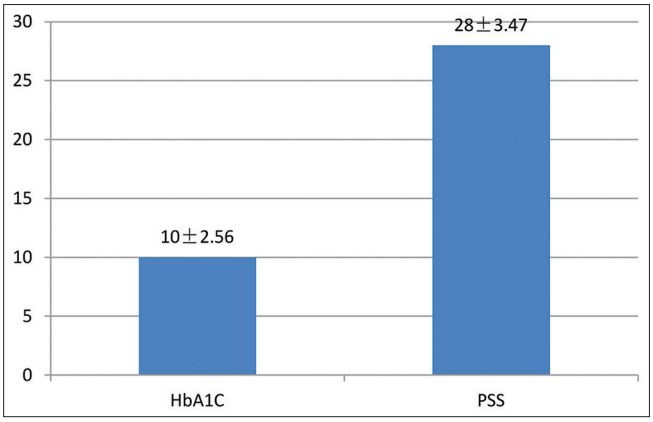

Figure 8: Mean ± standard deviation of the hemoglobin A1C level and perceived stress scale of the study participants

Table 1: Mean±standard deviation and their *P* values (*P* < 0.05 was considered statistically significant)

Parameter	Mean ± standard deviation	*P* value
HbA1C	10±2.56	0.002
PSS	28±3.47	0.01

PSS: Perceived stress scale, HbA1C: Hemoglobin A1C

Vasanth *et al.*[3] in their study conducted on 400 diabetic patients, results showed that the fasting blood glucose levels were a direct reflection of the stress levels ($P < 0.05$), whereas the glycemic index (HbA1c level) was found to be linked to both treatment adherence and stress.

Saboo and Rahule[7] concluded that more than 30% of the patients had poor glycemic control, of which about 40% had significantly high stress and also that that there is a direct correlation between stress and glycemic control as when stress increases the possibility of having poor glycemic control also increases. Toshihiro *et al.*,[11] Brunner and Kivimäki,[12] Li *et al.*,[13] also concluded that psychological distress significantly increases the risk of T2DM.

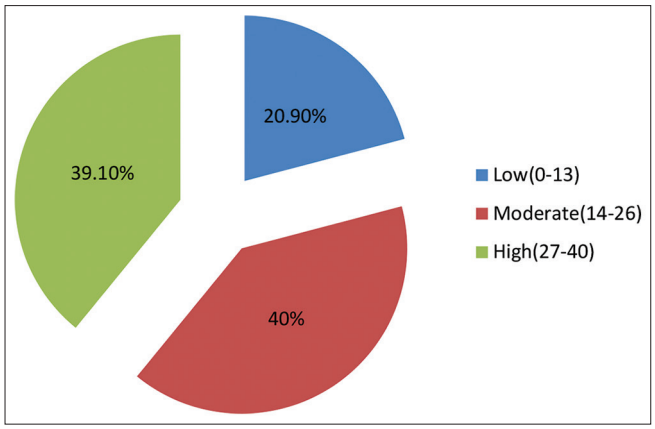

Figure 9: Perceived stress scale score of the study participants

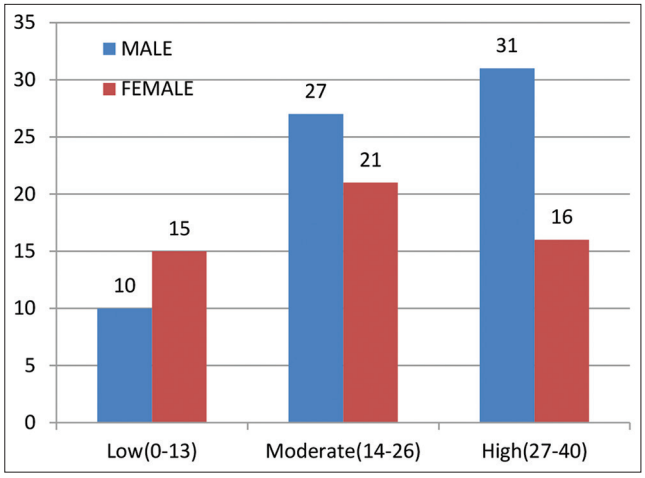

Figure 10: Gender-wise distribution of perceived stress scale among the study participants

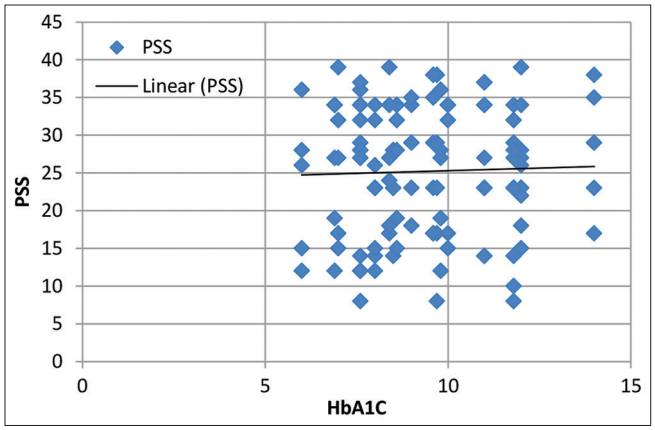

Figure 11: Corelation graph between stress and hemoglobin A1C

The effects of stress on the neuroendocrine system consist of stimulating the nervous system by activating the sympathetic-adrenal-medulla (SAM) followed by hypothalamic–pituitary–adrenal activity. During stress, the sympathetic nervous system stimulates the adrenal glands

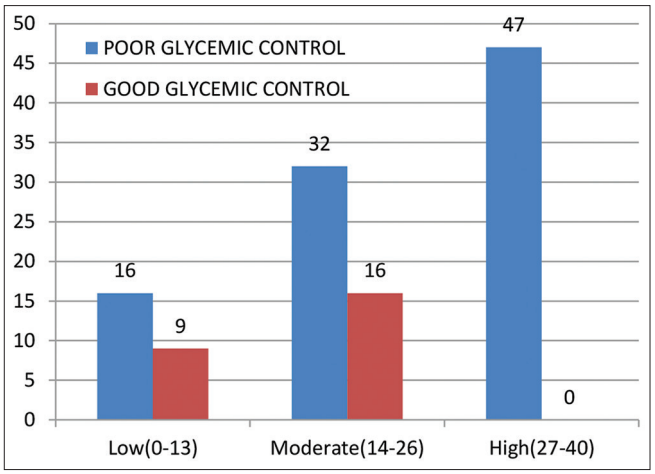

Figure 12: Hemoglobin A1C level among the type 2 diabetes mellitus patients with mild, moderate, and severe stress

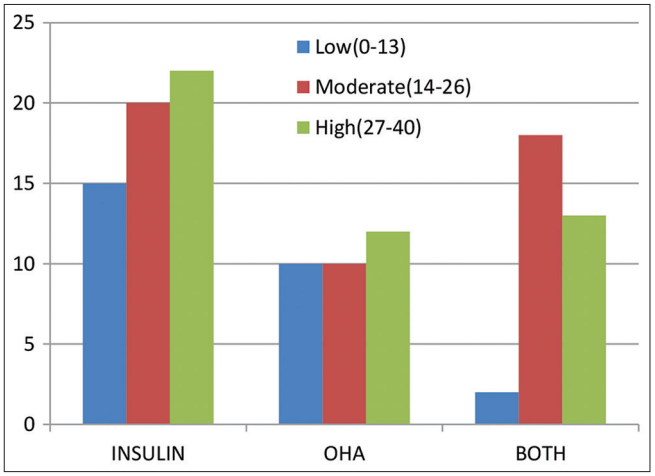

Figure 13: The perceived stress scale score and the type of anti-diabetic medicine consumed among the study participants

of the medulla to secrete epinephrine and norepinephrine into the blood circulation. The activity of these hormones produces metabolic effects, i.e., increased metabolic rate and blood glucose levels. Stress causes the hypothalamus to secrete corticotrophins-releasing factor, which releases adrenocorticotropin and stimulates the adrenal cortex to secrete glucocorticoid hormones, such as cortisol, thereby increasing the production of glucose by the liver and reducing its uptake by tissues. Cortisol affects the breakdown of carbohydrates, proteins, and fats through the gluconeogenesis process, which produces glucose as an energy source and plays a significant role in influencing body functions during the resting period.

The cortisol hormone counteracts with insulin and thus increasing glucose production by hepatic gluconeogenesis and by preventing the peripheral utilization of glucose and leads to the development of metabolic syndrome such as

obesity, insulin resistance, and the early determination of stress and related disturbances helps to control diabetes.[5] Therefore, regular psychological counseling should be advised to the patients with type 2 diabetic patients for better control of the disease status and to improve the quality of life.

Limitations of the Present Study

The sample size in the present study is relatively small. Furthermore, unknown and subclinical complications, which are unaccounted for, may contribute to stress level and glycemic control.

CONCLUSION

Psychosocial stress hampers the normal physiology of the endocrine system bringing changes in the glucose metabolism processes. Excess stress among the type 2 diabetic patients deteriorates their glycemic control. Hence, regular assessment of stress and proper counseling of the patients are highly essential in the management of diabetes.

ACKNOWLEDGMENT

We are thankful to the entire department of Physiology and Department of Medicine for their cooperation. We are also thankful to the patients who were agreed to participate in the study.

REFERENCES

1. Surwit RS, Schneider MS, Feinglos MN. Stress and diabetes mellitus. Diabetes Care 1992;15:1413-22.
2. Zamani-Alavijeh F, Araban M, Koohestani HR, Karimy M. The effectiveness of stress management training on blood glucose control in patients with Type 2 diabetes. Diabetol Metab Syndr 2018;10:39.
3. Vasanth R, Ganesh A, Shanker R. Impact of stress on Type 2 diabetes mellitus management. Psychiatr Danub 2017;29 suppl 3:416-21.
4. Melissa LH, Oldmeadow C, Hure A, Luu J, Loxton D, Attia J. Stress increases the risk of Type 2 diabetes onset in women: A 12-year longitudinal study using causal modelling. PLoS One 2017;12:e0172126.
5. Hackett RA, Steptoe A. Type 2 diabetes mellitus and psychological stress-a modifiable risk factor. Nat Rev Endocrinol 2017;13:547-60.
6. Sui H, Sun N, Zhan L, Lu X, Chen T, Mao X. Association between work-related stress and risk for Type 2 diabetes: A systematic review and meta-analysis of prospective cohort studies. PLoS One 2016;11:e0159978.
7. Saboo AV, Rahule TL. Effect of stress on control of Type 2 diabetes mellitus. J Evid Based Med Healthc 2019;6:180-2.
8. Kelly SJ, Ismail M. Stress and Type 2 diabetes: A review of how stress contributes to the development of Type 2 diabetes. Annu Rev Public Health 2015;36:441-62.
9. Kaur H, Kochar R. Stress and diabetes mellitus. Int J Health Sci Res 2017;7:265-72.
10. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2014;37 suppl 1:S81-90.
11. Toshihiro M, Saito K, Takikawa S, Takebe N, Onoda T, Satoh J. Psychosocial factors are independent risk factors for the development of Type 2 diabetes in Japanese workers with impaired fasting glucose and/or impaired glucose tolerance. Diabet Med 2008;25:1211-7.
12. Brunner EJ, Kivimäki M. Epidemiology: Work-related stress and the risk of Type 2 diabetes mellitus. Nat Rev Endocrinol 2013;9:449-50.
13. Li J, Jarczok MN, Loerbroks A, Schöllgen I, Siegrist J, Bosch JA, *et al*. Work stress is associated with diabetes and prediabetes: Cross-sectional results from the MIPH Industrial Cohort Studies. Int J Behav Med 2013;20:495-503.

How to cite this article: Saha A, Chakrabor D, Saha S. Assessment of Level of Stress and Glycemic Control among the Type 2 Diabetes Mellitus Patients: An Observational Study. Int J Sci Stud 2023;11(2):72-77.

Source of Support: Nil, **Conflicts of Interest:** None declared.