The Impact of Psychological Stress on Glycemic Control in Type 2 Diabetes

By

Samia Rashid Tithi

20346061

A thesis submitted to the School of Pharmacy in partial fulfillment of the requirements for the degree of Bachelor of Pharmacy (Hons.)

School of Pharmacy

BRAC University

February,2025

Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing a degree at Brac University.

2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.

3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.

4. I have acknowledged all main sources of help.

Samia Rashid Tithi

20346061

Approval

The thesis titled “The Impact of Psychological Stress on Glycemic Control in Type 2 Diabetes” submitted by Samia Rashid Tithi (20346061), of Summer, 2020 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy.

Supervised By:

_____

Dr. Sabrina Sharmin

Associate Professor

School of Pharmacy

Brac University

Approved By:

Dean:

_____

A.F.M. Yusuf Haider, PhD

Acting Dean, School of Pharmacy

Professor, Department of Mathematics and Natural Sciences

Brac University

Ethics Statement

This study did not involve any human participants, human specimens or tissue, vertebrate animals or cephalopods, vertebrate embryos or tissues and field research.

Abstract

Diabetes Mellitus type 2 (T2DM) is a significant chronic metabolic syndrome whose global prevalence is growing, and there is a growing body of evidence arguing that psychological stress is critical to its onset and progression. The biological pathways that are triggered by stress include hypothalamic-pituitary-adrenal (HPA) axis, responses of the autonomic nervous system, and persistent inflammation, which are all involved in insulin insensitivity and b-cell dysfunction. Together with these processes, psychosocial determinants such as diabetes-related distress, lack of social support, maladaptive coping and occupational strain contribute to poor self-care and glycemic control. According to recent research, it is possible to achieve positive results when the use of psychological and behavioral interventions in the context of managing diabetes is considered. Evidence-based interventions like Cognitive Behavioral Therapy (CBT), Mindfulness-Based Stress Reduction (MBSR), and structured mental health support have been demonstrated to decrease stress and increase levels of HbA1c, and complementary programs like yoga, relaxation training, mobile health applications, and peer-support programs can be used to increase access and patient response. Collectively, these results demonstrate that a glucose-based model should be replaced with a holistic biopsychosocial model, where stress management is the key to enhanced long-term metabolic stability, adherence to treatment, and quality of life.

Keywords

Type 2 Diabetes Mellitus; Psychological Stress; HPA Axis; Cortisol; Diabetes Distress.

Dedication

This research is dedicated to my family, teachers and friends.

Acknowledgement

I would very much like to begin with my deepest appreciation to Almighty Allah for giving me the strength, patience, and perseverance to carry out and complete this research work. Heartfelt gratitude goes to my respected supervisor, Sabrina Sharmin, (Lecturer, School of Pharmacy, Brac University), for her invaluable guidance, continuous support, and insightful suggestions throughout the course of my thesis. Her expertise and encouragement were vital for the successful completion of this work.

I would also like to sincerely thank Honorable F.M. Yusuf Haider, Acting Dean, School of Pharmacy, Brac University, for his kind support and for providing the necessary facilities during my research. My beloved family and friends require my deep gratitude for offering, understanding, and supporting me throughout this journey. Their belief in me during the hard times was truly a source of strength.

Table of Contents

List of Tables

List of Figures

List of Acronyms

ACTH	Adrenocorticotropic Hormone
ANS	Autonomic Nervous System
CBT	Cognitive Behavioral Therapy
CRH	Corticotropin-Releasing Hormone
DDS	Diabetes Distress Scale
ER	Stress Endoplasmic Reticulum Stress
GLP-1	Glucagon-Like Peptide-1
GBA	Gut-Brain Axis
HbA1c	Hemoglobin A1c
HPA Axis	Hypothalamic–Pituitary–Adrenal Axis
HRV	Heart Rate Variability
IL-6	Interleukin-6
IRS-1	Insulin Receptor Substrate-1
MBSR	Mindfulness-Based Stress Reduction
PSS	Perceived Stress Scale
ROS	Reactive Oxygen Species
SAM	Sympathetic-Adrenal-Medullary System
SCFA	Short-Chain Fatty Acid
T2DM	Type 2 Diabetes Mellitus
TNF-α	Tumor Necrosis Factor-alpha
WHO	World Health Organization

Chapter 1: Introduction

Diabetes mellitus is a persistent metabolic disorder that is characterized by sustained hyperglycemia due to a defect in insulin release, insulin action or a mixture of the two. It is one of the most prevalent non-communicable diseases in the world and carries extreme chronic complications of cardiovascular disease, neuropathy, nephropathy and retinopathy. The disease poses a significant health care system burden worldwide and poses a significant quality of life problem. Type 2 diabetes mellitus (T2DM) is a prevalent form of diabetes and it is the cause of about 90 percent of all diabetes cases (Liu et al., 2024). Now, nearly 90% of the diabetes cases have been attributed to type 2 diabetes in which almost one out of every eleven individuals in the world is affected by it. The age of over middle aged and elderly patients initially diagnosed with type 2 diabetes is ever increasing and is now the major population affected by the condition. People with type 2 diabetes are in constant need of treatment to regulate blood glucose levels. There is a strong association between neuropathy and diabetic retinopathy and the effectiveness of glycemic management. Poorly managed blood glucose can lead to severe complications, such as blindness, kidney failure, diabetic foot, and other consequences, that have an extreme impact on the quality of life in general. In the clinical setting, there are a number of intervention methods to enhance glycemic regulation in middle aged and elderly adults with type 2 diabetes that are used by health professionals at the present time. Multidisciplinary management of diabetes involves self-management of diabetes, patient education, blood level monitoring of glucose, dietary therapy, physical activity, and pharmaceutical measures to decrease the level of glucose. Diabetic patients who successfully manage their condition well in old age have a higher chance of controlling their glucose adequately than patients who lack the self-management skills. One meta-analysis showed

that education regarding self-management of diabetes is associated with improved short-term glucose levels and a decline in the levels of diabetic complications. However, the regulation of glucose among patients with type 2 diabetes remains poor. Guidelines based on evidence have been used to suggest that one-third of type 2 diabetes patients do not achieve target levels of glycated hemoglobin (HbA1c). One survey showed that only half of adult diabetic patients in the US with type 2 diabetes had achieved a treatment goal of less than 7 percent glycated hemoglobin. The emotional states of worry, hopelessness, and distress are common among middle-aged and older adults diagnosed with type 2 diabetes because the treatment process requires a long period and poses a financial burden. Research found out that a significant number of patients who have been diagnosed with type 2 diabetes are struggling with mental health conditions. Psychological challenges have negative implications on the glycemic control, medication adherence and self-management practices of patients with diabetes, thereby raising their chances of cardiovascular events and mortality. Psychological treatments, such as cognitive-behavioral therapy (CBT) and counseling, including motivational interviewing, are administered to improve self-management. With the use of psychological therapies, healthcare staff will be able to actively mould the perception and attitude of individuals, which will lead to the increase of diabetes management and the quality of life. The standards of medical treatment of diabetes-2020 published by the American Diabetes Association pays attention to the relevance of the psychosocial well-being of people with diabetes and promotes the use of psychosocial care as a core component of the recommended treatment. Successful diabetes management is based on the combination of extensive psychological support.

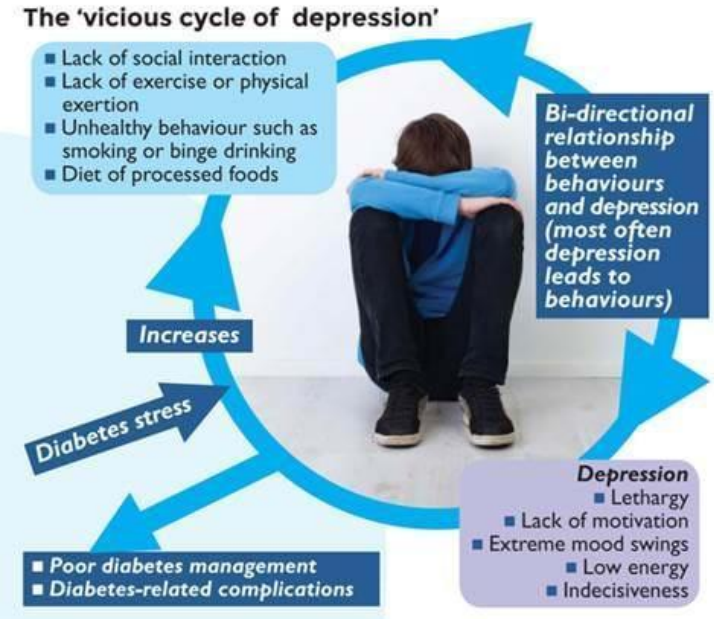

Figure 1: The vicious cycle of depression in diabetes management. Depression and unhealthy behaviors contribute to poor diabetes control, while inadequate glycemic management further aggravates depression (Smith et al., 2020).

Medical and nursing professionals, both in the country and internationally, have in recent years been involved in research activity on psychological therapies aimed at enhancing the understanding and self-management practices of disease. The aim is to enhance glycemic control outcomes and prognosis on a regular basis. Recent studies in the world today validate the positive impact that psychological therapies have in eliminating negative emotions such as anxiety and sadness in individuals with type 2 diabetes. It is still debated how certain psychological therapies can be used to influence glycemic control in middle-aged and older adults with type 2 diabetes (Liu, Z., Sang, X., Liu, Y., Yu, C. and Wan, H.2024). A meta-analysis has suggested the possible benefits of psychological treatments in controlling the levels of HbA1c, alleviating depression, and alleviating the pain associated with diabetes among diabetic patients. Another rigorous research with longer follow up period is, however, necessary in order to determine conclusive data on this question. A meta-analysis revealed that psychological treatments on individuals with type

2 diabetes do not have significant therapeutic benefits to improve glycemic control. In this research, a meta-analysis of available literature was done carefully to present medical evidence-based support on the therapeutic use of psychological therapies in glycemic control among middle and old patients with type 2 diabetes. The objective was to determine the effectiveness of psychological interventions in enhancing the glycemic regulation of middle-aged and senior patients with diabetes mellitus type 2.

1.1 Diabetes and Psychological Stress:

Diabetes mellitus (DM) is a metabolic disorder, which is chronic non-communicable, and is usually accompanied by either the excess of sugar in the blood or insulin resistance or both (American Diabetes Association, 2023). Type 2 diabetes (T2D) is the most prevalent and closely associated with lifestyle, obesity and genetic predisposition. It is not a disease that is limited to metabolic disorder but also requires complex interactions between behavioral, environmental and psychological variables. Psychological stress is now being addressed as a significant glycemic control modulator in T2D. Stress causes the hypothalamic-pituitary- adrenal (HPA) axis and sympathetic nervous system activation, which secrete glucocorticoids and catecholamines, thereby possibly influencing insulin sensitivity and b- cells. Health behaviors including diet, physical activity, and medication adherence are other ways that chronic stress can influence the health of individuals, and indirectly influence blood glucose levels. Psychological stress and its effect on glycemic regulation are significant in the general control of diabetes. The latest studies argue that the stress test and intervention strategy must be regarded as the standard clinical measure of metabolic improvement of T2D patients (Smith et al., 2022; Lee and Kim, 2023).

1.2 Aim of The Study:

This research will attempt to provide a review of the application of psychological therapies in the treatment of type 2 diabetes mellitus and particularly in middle aged and older adult patients. This review will evaluate the psychological intervention role in the glycemic control and emotional well-being encouraging effective self-management behaviors and reducing the risk of developing diabetes related complications. These analyses of the available evidence will result in the study describing the value of the application of psychological support in mainstream diabetes care, and uncover the gaps in the existing literature that need to be addressed further.

1.3 Objectives of the Study:

The objectives of this study are:

- To examine the psychophysiological and behavioral mechanisms through which psychological stress may cause glycemic control in patients with diabetes type 2 diabetes mellitus.

- To identify the impact of psychological stress on management of diabetes, self-care behavior, treatment adherence and outcomes of T2DM in middle-aged and elderly patients.

- To examine the effectiveness of psychological and psychosocial interventions (such as cognitive behavioral treatment, mindfulness-based stress reduction, and combinations between care models) in improving glycemic control and mood.

- To provide the research-based policies to the healthcare providers and policymakers as well as patients to incorporate the psychological support as one of the elements of the entire program of diabetes management.

Chapter 2

Methodology

This study reviews various scholarly articles that appraise the impact of psychological stress in the management of blood sugar control in people with Type 2 Diabetes. In this review, the literature was collected in the databases of authoritative sources, such as PubMed, Google scholar, ScienceDirect, and Wiley Online Library. The research material was based on articles in Diabetes Care, as well as the Journal of Obesity and Diabetes, The Lancet Diabetes and Endocrinology and Psychosomatic Medicine. The chosen sources met very high requirements of reliability and correspondence to the multifactorial relationship between mental strains and blood sugar control in individuals with Type 2 Diabetes.

The appraised research materials consisted of clinical and laboratory tests, longitudinal and cross-section studies, systematic reviews, and meta-analyses that provide all the information regarding the topic. Various psychological disorders including stress, depression, anxiety and diabetes distress are examined concerning their potential impact on glucose regulation and insulin resistance. This thesis includes coherent proper attribution with all references and citations following the American Psychological Association (APA) 7th edition citation style in all parts of the writing.

Chapter 3

The Psychophysiological Impact of Stress on Glycemic Control in Type 2 Diabetes

3.1 Overview of Psychological Stress and Its Effects

The American Psychological Association (APA 2022) holds that psychological stress is formed when mental and emotional conditions of individuals who see discrepancies between the demands of the environment and their response capabilities (APA 2022). This stress manifests as acute or chronic stress which triggers neural-endocrine process. We experience two major systems when faced with a psychological stressor, which are the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic-adrenal-medullary (SAM) system (McEwen and Akil, 2022). The cortisol and adrenaline are stress hormones that are activated using these systems in the preparation of the body to encounter threats through the regulation of immune functions, anabolic processes, and cardiovascular activities.

The HPA axis controls the body in terms of stress. Upon the occurrence of a stressor, the hypothalamus will secrete corticotropin-releasing hormone (CRH) which will stimulate the release of adrenocorticotropic hormone (ACTH) by the anterior pituitary gland. This causes the adrenal cortex to release cortisol, the primary hormone of stress (Tsigos et al., 2021). The cortisol assists the body in stressful periods by controlling metabolic activities that elevate blood glucose through gluconeogenesis, energy supply and immunity. Usually, it is advantageous to stimulate and activate the HPA axis acutely. Chronic state of stress, that is typical of psychosocial stress over a prolonged period, however, interferes with the operation of the negative feedback loops and genetically changes the neural network that controls the homeostasis of the body.

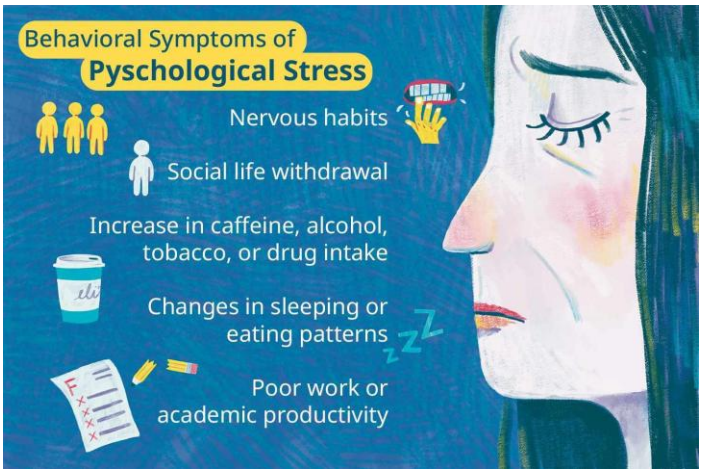

Figure 2: Behavioral symptoms of psychological stress. Stress contributes to nervous habits, social withdrawal, substance use, irregular sleep or eating, and reduced productivity (Lee et al., 2023).

The long-term consequences of stress on cortisol level and psychological stress closely correlate with the impairment of glucose metabolism that has a significant effect on the patients of T2DM. Cortisol augments the hepatic glucose synthesis in the liver and decreases glucose uptake in the peripheral tissues, all of which leads to insulin intolerance (Lee et al., 2023). In addition, chronic stress may decrease insulin receptor expression and interfere into the insulin-regulating pathways. Such effects are not effective in controlling glycemia because it continuously leads to high blood glucose levels in patients with T2DM (Kim & Feldman, 2022).

Other behavioral aspects of life that influence diabetes are also influenced by stress such as inadequate diet, exercise, and non-compliance with the diabetic diet and medications among other factors, which impact negatively on glycemic control (ADA, 2024). Single research conducted by Smith et al. (2023) has determined that the high-perceived-stress group of participants achieved statistically significant higher HbA1c, which confirms the relationship between psychological stress and poor glycemic control.

3.2 The Stress Response and Its Influence on the Body

The hypothalamic-pituitary-adrenal and sympathetic-adrenal-medullary systems are two basic stress response systems that are mainly involved in the process of coping with the body stress response mechanisms. In response to the listed systems they release cortisol, adrenaline-epinephrine and others such as noradrenaline. Cortisol or the stress hormone is the adrenal cortex secretion triggered by the stimulation of the adrenocorticotropic hormone (ACTH) of the pituitary gland by the corticotropin-releasing hormone (CRH) secreted by the hypothalamus (Tsigos & Chrousos, 2021). By the time the adrenal medulla releases the two rapidly, the body is prepared to fight or flee, raising both its heart rate and blood pressure. The long-term effects of cortisol are always present: they stimulate blood glucose by means of hepatic gluconeogenesis, and altering the immune and inflammatory systems in response to stress (Knezevic et al., 2023).

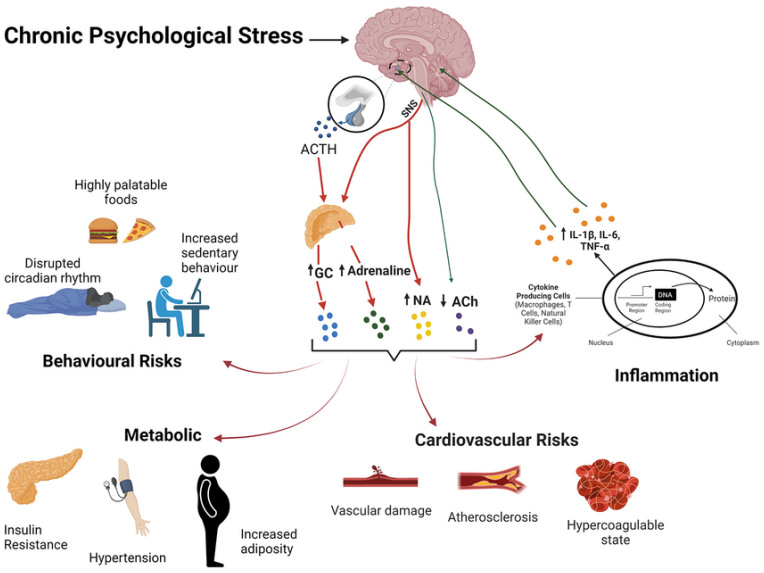

Figure 3: The stress response and its effects on body systems. Chronic psychological stress triggers the HPA axis, increases cortisol release, and contributes to metabolic, cardiovascular, and inflammatory risks (Knezevic et al., 2023).

Conversely the short-term effects of stress responses are beneficial, which is running/stimulating of the HPA axis. Therefore, a negative outcome of cortisol levels can be experienced particularly by the ones who have or are likely to have T2DM. Excessive depleted cortisol damages cell festoon insulin decrease 4.1 Biological Factors: Mechanisms of the Interaction between Stress and Glycemic Dysregulation.

Psychological stress influences glycemic control and this is connected to many biological mechanisms which include genetic predispositions, neuroendocrine imbalance, activation of the autonomous nervous system and inflammatory responses. All these processes culminate in insulin resistance and dysfunction of the b-cells and ultimately hyperglycemia. The insulin signaling was disrupted by high levels of cortisol in the state of chronic stress, which caused an increase in lipolysis and FFAs in the blood (Kim and Feldman, 2022).

Besides peripheral tissue resistance to insulin, chronic stress is the impairment of the pancreatic beta cells. Studies have also reported that elevated glucocorticoid levels have deleterious effects on the insulin secretion of the pancreatic beta cells by acting through influences such as amplified production of oxidative stress that is evident in the destruction of pancreatic beta cells (Sic et al., 2023). Therefore, psychological stress can be considered a significant factor that leads to glycemic dysregulation and diabetes progression because it has a negative impact on the insulin sensitivity and insulin release.

It then impacts on behavior and physiology and makes diabetes further worse since it is an emotional stressor. Patients undergo increased maladaptive behavior such as eating emotionally, being inactive, sleep deprivation, and not adhering to the instructions on the drugs and diet due to stressors, which deteriorate the glycemic control (ADA, 2024). Perceived stress is another variable that is directly related to diabetes distress and is a type of burnout associated with chronic disease management; it was determined that diabetes distress is directly associated with higher HbA1c (Smith et al., 2023).

Increased perception of stress is also expected to be correlated with poor glycemic control, and recent studies have confirmed the latter. In 2023, researchers reviewed that T2DM older adults who reported more stress had a significantly higher mean HbA1c as compared to their counterparts, regardless of demographic or medical factors (Brown et al., 2023). These findings indicate that physiological characteristics and behavior of such clients should also be put into consideration in the management of stress in T2DM.

3.3 Psychological Stress in Individuals with Type 2 Diabetes

The patients with T2DM are likely to experience psychological stress since the illness is chronic and most of the symptoms are self-treatable. Cumulative stress encompasses things such as checking blood sugar, taking the right doses of medications, being on a restricted diet, and feared complications. This situation predisposes T2DM patients to such psychological issues as anxiety, depression, and diabetes distress (Fisher et al., 2022).

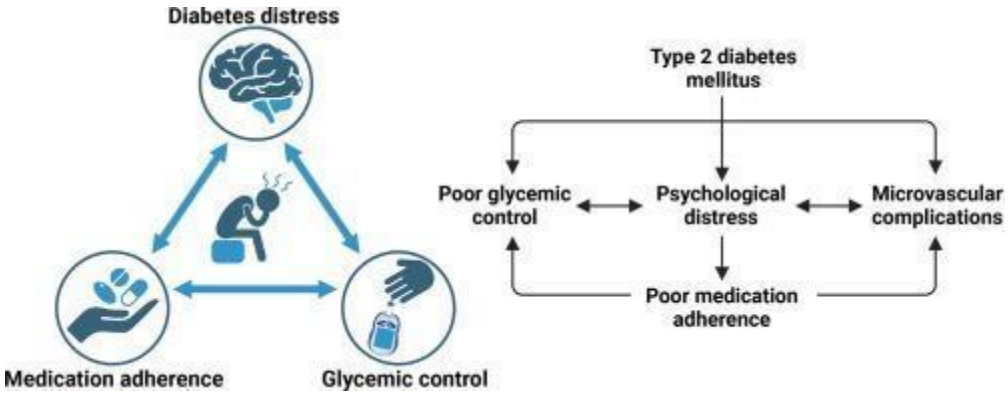

Figure 4: The psychological distress associated with type 2 diabetes mellitus. Diabetes distress contributes to poor medication adherence, impaired glycemic control, and increased complications (Fisher et al., 2022).

The distress associated with diabetes is not clinical depression, it is the distress associated with the management of diabetes. It is directly connected with anxiety and results in the emerged feelings of burnout, fear of complications, and frustration upon the management of the disease (Kalra et al., 2021). Such feelings can disrupt motivation, make patients unwilling to comply with medical recommendations and drugs, and, in this way, influence glycemic control. An example is that anxiety has been known to increase the release of cortisol, which in turn promotes hyperglycemia and augmented insulin resistance (Knezevic et al., 2023).

Based on different studies, stress has been credited with triggering an alarming pattern of glycemic outcomes. In one of the works by Smith et al. (2023), the HbA1c levels were significantly higher in people with T2DM with high levels of perceived stress compared to the individuals with lower levels of perceived stress. Correspondingly, in another study a cross-sectional survey by Al Hayek et al. as well but in 2021 has not left behind the results of poor glycemic control with patients with diabetes having high levels of emotional distress.

These findings underscore the necessity to appropriately learn about psychological stress as an external variable in diabetes care. Healthcare professionals need to prescribe and administer counseling, stress levels, and behavior change management to the clients, as they are required since they possess impaired psychosocial well-being, co-morbid depression, and psychometric indicators of low levels of health literacy regarding T2DM.

3.4 Impact of Stress on Diabetes Management

It was found that psychological stress produces negative effects on the effectiveness of self-management of diabetes; it is essential in controlling the glucose level of individuals with T2DM. It leads to stress and non-adherence to the conventional diabetes routines: using the medication as prescribed, monitoring the level of blood glucose, and administering insulin injections. It is also stated that under the influence of stress, they are likely to sacrifice the drug or delay some of the self-care activities that need to be performed as they are too emotionally exhausted or overwhelmed (Fisher et al., 2022).

Behavioral changes also arise out of stress and they are not conducive to diabetes management. The stated reasons why people experience stress or get stressed influence their unhealthy food

preferences by choosing food items rich in sugar and fat or by eating less and performing less physical activity (Kalra et al., 2021). Additionally, stress and sleep deprivation as a result of working shifts and other causes may demotivate an individual to exercise and cook nutritious food. Such behaviors contribute to the improvement of hyperglycemia, which is resistance to insulin, making the condition worse.

Conversely, the research has demonstrated that social and emotional support are protective elements capable of reducing the effects of stress on self-management of diabetes. It will also open the way family members, peers, or other healthcare givers can motivate patients to better self-preservation, other than defining the ways of managing the common emotional disorders. Brown et al. (2023) claim that individuals possessed close communities had more compliant behavior in terms of drug use and adherence to a diet as compared to individuals without this support. It also prevents perceived stress, manages the levels of stress, and influences glycemic control (Knezevic et al., 2023).

Therefore, psychological factors, as well as the encouragement of social support, cannot be left out of the adequate diabetes program as regular self-care could considerably enhance the health outcomes of a patient.

3.5 Psychosocial Interventions and Their Effectiveness

Therapies such as cognitive behavioral therapy, mindfulness and relaxation practices are now a norm and useful tool in alleviating the degree of psychological stress in a particular health condition, in this case T2DM. They are to assist not only in losing stress but also improving the mood overall and, therefore, managing diabetes.

CBT is one of the psychosocial interventions that have been studied most with respect to diabetes distress. It helps the client to be aware of those thinking patterns and challenge them in a manner that will produce discomfort. CBT was shown to contribute to a reduction in the anxiety and depression scale of diabetic patients, which is related to inadequate glycemic control (Mae et al., 2021). In addition, as Fisher et al., 2022, note, CBT promotes self-compliance with diabetes management and treatment and reduces the level of HbA1c.

Mental activities that are part of mindfulness practices entail attention and acceptance of all the events that are unfolding at the moment. The authors indicate that mindfulness interventions have been discovered to significantly reduce self-reported levels of stress and improve the overall health of T2DM patients (Zhao et al., 2023). Such programs also provide patients with the ability to achieve better glycemic control by promoting better physical exercises and healthy diets (Basu et al., 2022).

The lowering of cortisol levels and reduction of the activity of the sympathetic nervous system has been indicated among the relaxation methods, such as the progressive muscle relaxation and deep breathing. The methods can be used in the programs of diabetes care and contribute to the improvement of the positive changes in glucose regulation and emotional well-being of diabetics (Knezevic et al., 2023). The psychosocial interventions are not theories, hypothetical treatments, there are case studies and clinical trials of the treatments. The recent study by Smith et al. (2023) demonstrated that the CBT was positively associated with the glycemic control and psychological well-being of patients with T2DM. In a second cross-sectional study, also on self-reported mindfulness by Lee et al. (2022), they observed that perceived mindfulness practices decrease stress and improve the outcomes of diabetes in the people.

Chapter 04: Influences on the Effect of Psychological Stress on Glycemic Control

4.1 Biological Mechanisms of the Interplay of Stress and Glycemic Dysregulation

Psychological stress influences glycemic control via several biological pathways that include genetic disposition, neuroendocrine dysfunction, activation of the autonomic nervous system, and inflammatory effects of stress. The combination of these mechanisms produces insulin resistance and b-cell dysfunction, which leads to hyperglycemia.

4.1.1 Genetic Disposition and Response to Stress

Genetic processes are highly important in the predisposition of an individual to stress-related dysregulation of glucose metabolism. Stress-regulatory genes NR3C1 and FKBP5 may vary to change the sensitivity of the glucocorticoid receptor causing an exaggerated cortisol response to stress (Qin et al., 2023). Repeated cortisol exposure disrupts the signaling of the insulin receptor in skeletal muscle and adipose tissue favoring peripheral insulin resistance. Besides genetic polymorphism, epigenetic alterations, including the DNA methylation of stress responsive genes, can also enhance risk to stress-induced hyperglycemia. These familial yet reversible modifications amplify the hypothalamic-pituitary-adrenal (HPA) axis stimulation to psychological pressure, the effect of which exacerbates the metabolic irregularities.

4.1.2 HPA Axis Dysregulation

The diurnal cortisol secretion rhythm is altered by chronic stress, often causing a continuously high evening cortisol level. This aberrant cortisol rhythm promotes hepatic gluconeogenesis and inhibits peripheral uptake of glucose and so exacerbates chronic hyperglycemia (Knezevic et al., 2023). Exposure to high levels of cortisol also affects long-lasting pancreatic b-cell activity, which inhibits the transcription and release of insulin and increases glycemic dysregulation. Therefore, dysfunction of the HPA axis becomes a central pathway in the association between psychological stress and insulin resistance as well as the dysfunction of insulin production.

4.1.3 Activation of the Autonomic Nervous System (ANS)

Psychological stress also causes the autonomic nervous system (and especially sympathetic overactivity) that elevates catecholamine release (adrenaline and noradrenaline). The hormones activate glycogenolysis and gluconeogenesis, which increases the level of glucose in the circulation. Catecholamines also inhibit the release of insulin and disrupt glucose uptake mediated by insulin in the peripheral tissues (Sic et al., 2023). This is accompanied by stress-induced parasympathetic dysfunction that inhibits postprandial insulin secretion and alters the gastrointestinal hormone signaling, such as glucagon-like peptide-1 (GLP-1) and is also a cause of glucose dysregulation. Autonomic balance, therefore, increases the stress metabolic impact.

4.1.4 Inflammation Due to Stress

Proinflammatory cytokines including interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-a) are promoted by chronic stress. Such cytokines disrupt the insulin receptor signaling pathway by phosphorylating insulin receptor substrate-1 (IRS-1), thus, leading to insulin resistance (Lee et al., 2023). Also, due to oxidative stress and endoplasmic reticulum (ER) stress caused by chronic hyperglycemia, the production of reactive oxygen species (ROS) occurs, disabling the action of pancreatic b-cells. Cytokine-mediated inflammation and oxidative/ER stress have mutually reinforced effects in a vicious cycle of the inhibition of insulin signaling and prolonged hyperglycemia.

4.1.5 Biological Mechanisms Integration

Stress and glycemic dysregulation have a high level of interconnections in the biological pathways. HPA axis dysregulation leads to higher cortisol levels, which, combined with hyperactivity of the sympathetic nervous system, enhance hepatic glucose production, and inhibit peripheral glucose uptake. Paralleling these effects of chronic stress, inflammatory and oxidative/ER stress pathways impair insulin signaling and b-cell functions, exacerbating the effects of chronic stress.

Combination of these processes shows that psychological stress has both direct and indirect consequences on glucose homeostasis that leads to chronic hyperglycemia. Such overall interplay is demonstrated in Figure 4.1 that shows how the psychological stress, the malfunction of the HPA axis, the loss of the ability to control glucose, and the b-cell damage interact. These effects are further increased by genetic predisposition and epigenetic changes which predispose individuals to stress-induced glycemic dysregulation in Type 2 Diabetes Mellitus (T2DM).

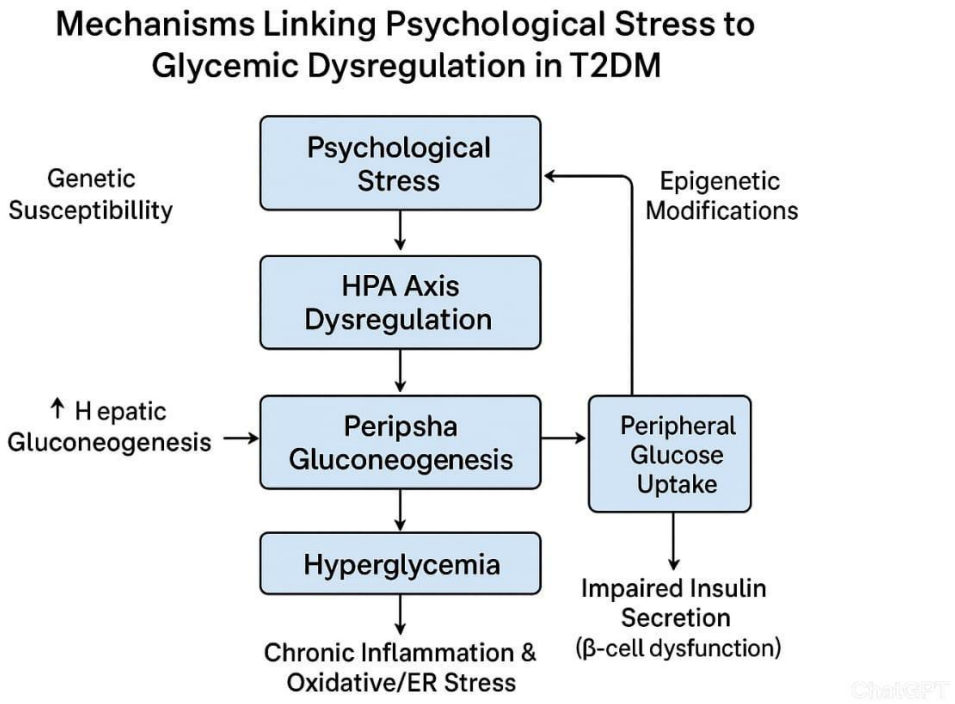

Figure 5: Mechanisms linking psychological stress to glycemic dysregulation in type 2 diabetes mellitus. Psychological stress induces HPA axis dysregulation, promotes hepatic gluconeogenesis, reduces peripheral glucose uptake, and impairs insulin secretion, ultimately leading to hyperglycemia (Kim & Feldman, 2022).

Figure 4.1: Mechanisms linking psychological stress to glycemic dysregulation in Type 2 Diabetes Mellitus (T2DM).

Psychological stress results in HPA axis malfunction with an increase in hepatic gluconeogenesis and a decrease in peripheral glucose uptake, resulting in hyperglycemia. Chronic hyperglycemia facilitates oxidative and ER stress, which stimulates chronic inflammation and b-cell dysfunction. Individual susceptibility to these processes is also increased by genetic susceptibility and epigenetic alteration, and further exacerbates stress-induced metabolic imbalance.

4.2 Psychosocial and Behavioral Factors

Psychosocial stressors have a significant effect on glycemic control consequences in patients with Type 2 Diabetes Mellitus (T2DM). Diabetes distress is a disease-specific stress, which is also a key predictor of adherence and glycemic outcomes in the absence of clinical depression and adds to the psychological burden of living with a chronic disease (Fisher et al., 2022). Psychological stress is complicated by emotional exhaustion, the fear of complications, and frustration with self-care activities, thus worsening the metabolic results.

4.2.1 Diabetes Distress and Emotional Burden

Diabetes distress is a continuous mental burden of dealing with diabetes. In comparison to generalized anxiety or depression, it is directly connected with specific difficulties of diabetes management, e.g., frequent observations, nutrition limits, and the threat of complications. As distress escalates, patients are shown to be less adherent to medication, less motivated to exercise, and exhibiting poor eating patterns, all of which result in inadequate glycemic regulation. The continued presence of this emotional load increases both the effects of stress on mental health and metabolism.

4.2.2 Role of Social Support

Social support is a very important buffer against the impact of stress that is detrimental in T2DM. Patients that have strong support systems, such as family, friends and medical professionals, report less diabetes distress and have an enhanced level of coping. These positive interactions offer both emotional comfort and practical support as well as self-care accountability. The improvement of the support systems is correlated with the enhanced management of diabetes and reduced HbA1c levels (Brown et al., 2023). Conversely, the absence or low level of social support aggravates distress which exposes the patient to stress induced glycemic dysregulation.

The effects of the disturbances of diabetes distress, social support, coping, occupational stress, lifestyle behaviors, and sleep disturbances are summarized in Table 4.1 and combined with the psychosocial and behavioral stress pathways and their effects on glycemic control.

Table 01: Psychosocial and Behavioral Stress Pathways Affecting Glycemic Control in T2DM

Domain	Stress Mechanism	Impact on Glycemic Control
Diabetes Distress	Emotional burden, fear of complications, self-care frustration	↓ Adherence, ↑ hyperglycemia
Social Support	Presence or absence of supportive networks	Strong support → ↓ HbA1c; Isolation → ↑ distress
Coping Strategies	Adaptive (problem-solving, seeking help) vs. Maladaptive (avoidance, overeating)	Adaptive → better outcomes; Maladaptive → poor outcomes
Work Stress	Occupational pressure, reduced self-care time	↑ Cortisol → worsens metabolic control
Lifestyle Behaviors	Stress-induced insomnia, poor sleep quality	↑ Blood glucose, ↓ treatment adherence

Sleep Disturbances	Stress-induced insomnia, poor sleep quality	↓ Insulin sensitivity, ↑ dysglycemia

The table is a summary of the significant psychosocial and behavioral mediators, which mediate the impacts of stress on the glycemic outcomes of Type 2 Diabetes Mellitus (T2DM). Poor social support, diabetes distress, maladaptive coping mechanisms, and work-related stress are also factors causing the deterioration of the metabolic indicators and lifestyle disruptions and sleep disturbances impair the insulin sensitivity and glucose regulation further.

4.2.3 Coping Strategies

The coping styles embraced by patients have a great impact on the outcome of diabetes. Problem-solving, seeking social support, and adopting a positive reframing are some of the adaptive coping mechanisms that are related to better treatment adherence and increased glycemic control. On the other hand, maladaptive strategies such as avoidance, denial, or overeating due to emotions deteriorate and lower metabolic performance under stress (Kalra et al., 2021). The issue is also aggravated by work-related stress, where job-related demands decrease the time to self-care, and add to physiological stress responses, including higher cortisol secretion, which exacerbates the metabolic indicators (Zhao et al., 2023)

4.2.4 Stress and Health-Related Behaviors

The changes in the key health-related practices that are core in managing diabetes are the direct result of psychological stress. The American Diabetes Association (2024) confirms that chronic stress often leads to inappropriate dieting, lack of physical exercise, and lack of medication adherence, which are the main factors causing the rise in blood sugar. Unhealthy lifestyle habits, including overeating, alcohol and smoking, are also promoted by stress, which once again negatively affects glycemic regulation (Kim and Feldman, 2022).

Also, insulin sensitivity and disrupted glucose metabolism are further impediments to effective management of diabetes, with stressed-induced sleep disruptions contributing to the problem (Knezevic et al., 2023).

Chapter 05: Mechanisms of Psychological Stress in Influencing Glycemic Control

5.1 Stress and Insulin Resistance

When stress is experienced, cascades of hormonal activity are initiated, which involve cortisol and adrenaline as important factors in the body fight or flight response. The insulin sensitivity decreases induced by the glucocorticoid hormone cortisol are due to the fact that this hormone decreases the muscle and adipose tissue glucose uptake and increases the hepatic glucose production (Knezevic et al., 2023). Glycogenolysis along with lipolysis is used by the body to produce more circulating glucose by the influence of adrenaline. The hormones have a short-term protective effect but have long term devastating effects to health systems.

The main process that leads to the development of hyperglycemia in stressed people is cortisol-mediated gluconeogenesis since it allows the liver to make glucose out of other materials. In case gluconeogenesis remains active excessively, the level of blood glucose will be constantly elevated, which is especially dangerous to insulin-resistant individuals (Lee et al., 2023).

There is amplification of stress on the immune system which aggravates insulin resistance due to inflammation. Long-term stress triggers the production of more pro-inflammatory cytokines in the human body (tumor necrosis factor-alpha TNF-a and interleukin-6 IL-6) thereby disrupting the insulin receptor signaling (Kim and Feldman, 2022).

5.2 Impact of Chronic Stress on the HPA Axis

The hypothalamic-pituitary-adrenal (HPA) axis is the major stress response pathway of the body that regulates hormone functions. Long-term psychological stress causes the HPA axis to be in a constant state of activation resulting in inappropriate release of cortisol. The persistence of the HPA axis suppresses the glucoregulation because it decreases the sensitivity of cortisol receptors (Tsigos et al., 2021).

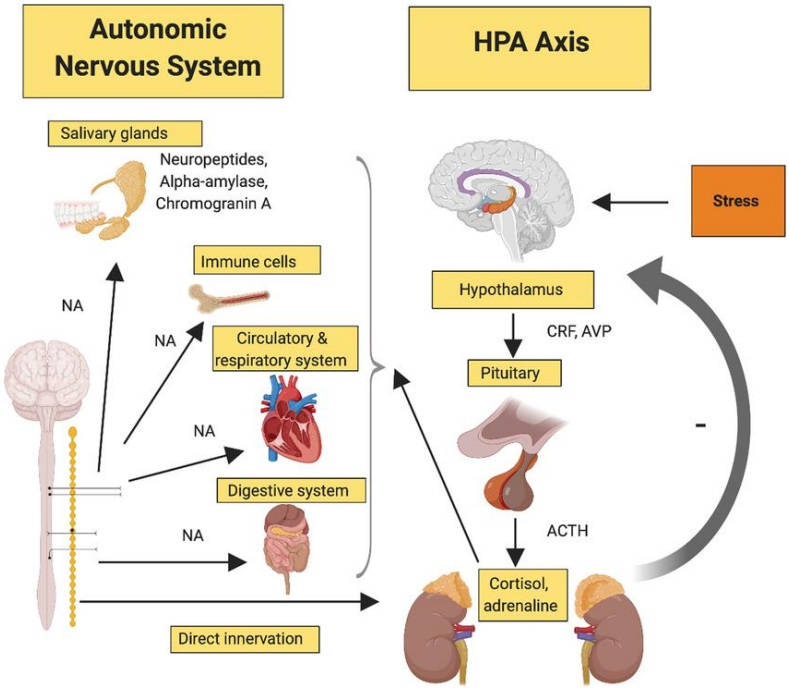

Figure 6: Stress causes the HPA axis to be in a constant state of activation resulting in inappropriate release of cortisol. The persistence of the HPA axis suppresses the glucoregulation because it decreases the sensitivity of cortisol receptors (Tsigos et al., 2021).

Scientific research has proved that disrupted cortisol rhythms with flat diurnal curves cause low insulin secretion and insensitivity issues. Such factors disrupt the normal glucose and insulin patterns, which result in instability in metabolism (Mohan et al., 2023).

Cortisol promotes the accumulation of visceral fat since visceral fat produces cytokines that cause inflammation during the metabolic process. Insulin resistance is closely linked to the buildup of the visceral fat and increases the risk of cardiovascular diseases among individuals with T2DM (Knezevic et al., 2023). The chronic stress causes functional damage to the metabolism through two primary pathways: neuroendocrine changes and alteration of adipose tissue regions.

5.3 Autonomic Nervous System and Stress

The sympathetic part of the autonomic nervous system plays a very strong role in glycemic dysregulation in stressful circumstances. Stress responses activate the sympathetic nervous system, causing catecholamine release, which results in the hepatic glucose release and insulin secretion inhibition (Sic et al., 2023).

Sympathetic activation in the long-term results in a hyperadrenergic state, resulting in the maintenance of high blood glucose levels. The diagnostic issue arises with the T2DM specifically since the patients begin with an impaired response to insulin. Kim and Feldman (2022) claim that the baroreceptor sensitivity and parasympathetic activity decrease and glucose regulation worsens because of the life-long unremitting autonomic stress. The heart rate variability (HRV) functionality is the measure of autonomic control and is inversely correlated with stress.

Reduced HRV is a medical indicator of poor autonomic functioning and directly correlated with adverse blood glucose outcomes in patients with type 2 diabetes (Zhao et al., 2023). Stress in the psyche leads to autonomic dysregulation, an organic association between stressors and metabolic disease.

5.4 Inflammation and Stress

The continuous stressful condition results in inflammation that results in insulin resistance. Lee et al. (2023) claim that the release of IL-6 TNF-a and C-reactive protein (CRP) is caused by the activated cytokine cascade of the stress response. These toxins impair the insulin signaling pathways and glucose uptake. These cytokines disrupt the insulin receptor substrate (IRS), downstream signaling pathways, especially in skeletal muscle and liver tissues.The impairment of glucose metabolism is a consequence of endothelial dysfunction since the inflammatory stress leads to insulin and glucose vascular delivery issues between the target tissues (Mohan et al., 2023). In the long run, inflammatory reactions result in apoptosis of beta cells, thereby lowering their insulin production capabilities in the long run.

The connection between stress levels and poor glycemic control among diabetic patients is clear as the levels of high CRP and IL-6 are considered (Kim and Feldman, 2022). The biomarkers give indications of systemic stress and help in the anticipation of the influence of systemic stress on the metabolic state of T2DM.

5.5 The Gut-Brain Axis in Stress and Glycemic Control

Research undertaken over the past ten years has given promise that the gut-to-brain axis, or gut-brain axis, is the cause of the effects of stress on metabolic health. This bi-directional communication channel allows the CN system to interface with the EN system via endocrine, neural and immune networks.

The Gut microbiota profile of the body is affected by stress over long periods and extends the wi-fi range of pro-inflammatory microorganisms. It is known that this condition leads to issues with the glucose metabolism process and with insulin sensitivity (Zhao et al., 2023). It also causes a shift in gut permeability in such a way that endotoxins like LPS may translocate to the blood and

cause systemic inflammation and this has been found to cause insulin resistance. In addition, it influences the concentrations of metabolites of SCFAs, which are essential in glucose level control. SCFAs will also be adversely impacted, as the production of the latter is inhibited by stress, thus influencing signaling metabolism (Mohan et al., 2023). The neurotransmitters generated in the gut influence the brain and the loop is formed to serve as a continuous feedback loop of stress and volatility both in glycemia.

Based on our findings, it is evident that regarding the parsimonious comorbidity of stress to diabetes, one must consider the gut, brain, and metabolic trinity in the gravity that they deserve.

Chapter 6

Strategies for Managing Psychological Stress in Diabetes Care

6.1 Cognitive Behavioral Therapy (CBT)

The present paper will review these kinds of psychological interventions and compare the effectiveness of Cognitive Behavioral Therapy (CBT) to control stress levels of T2DM patients. Such cognitive behavioral therapies help the patient to identify various negative thinking patterns that result in discomfort and change their emotional and behavioral performance. Thus, its method is structured on the development of coping skills, the enhancement of problem-solving skills, and the development of healthy behavioral practices that are all applied when facing stress related to diabetes (Manea et al., 2021).

In self-care activities, T2DM patients are faced with stress regarding their activities, complication, interference, and disease-related burnout. CBT assists in direct recreating of realistic and more productive methods of thinking in order to solve cognitive distortions like, I shall never be able to cope with this diabetes. To illustrate this, a CBT example would be that an individual is taught to think differently when he/she occasionally relinquishes the control of diet; he/she is made to envision it as not a failure but as a learning process.

As the later part implies, it has sufficient research evidence to show that it is effective in the management of diabetes. Literature was published by Zhao et al. (2023) stating that CBT reduced distress about diabetes, improved emotional well-being, and reduced the level of HbA1c. This paper compared the outcomes of CBT and standard care given to a control group of the non-diabetic patients and the outcome of the CBT on the 62 patients with type 2 diabetes found that

there were significant improvements in the level of treatment insight and adherence, and also, in the level of glycemic control, in the twelve weeks.

Confidence in self-management abilities, known as self-efficacy, is another important aspect addressed in CBT. Self-efficacy is important in relation to the outcome. Depression is well-treated in tandem with self-management, which is why CBT is useful even at the metabolic level.

6.2 Mindfulness-Based Stress Reduction (MBSR)

An example of an intervention based on meditation, breathing, and stress-reducing techniques, MBSR focuses on an individual's relaxation response to stress and developed from one of Ka Zen's programmers. Subsequently, MBSR has been modified for the T2DM population where emotional stress complicates the management of the disease.

In the case of MBSR, the therapy that impacts on individuals with diabetes most states that MBSR works by removing activities of stress, sometimes referred to as physiological stress activity. Stress and anxiety are replaced with mindfulness where slow breathing and minimal movement are used as anchors. This permits activity of the HPA axis and cortisol to lower (Lee et al, 2023), thereby inducing changes to—with respect to insulin sensitivity and glucose homeostasis—the body's primary stress response.

As T2DM patients, MBSR also reinforces emotional regulation. Anxiety and depression are diminished and coping mechanisms are developed, thus the quality of life improves with regard to exercise, diet, and medication compliance (Zhao et al., 2023).

“Diagnostics and practical studies integrating Mindfulness-Based Stress Reduction (MBSR) in therapeutic frameworks for people having diabetes have been on the rise in recent years. Another study published in 2022 showed how an 8-week programmed of MBSR diminished stress perception and lowered the HbA1c levels of T2DM patients relative to a control group (Patel et al 2022). Also, supporting the previous findings, Basu et al. (2023) in their meta-synthesis reported that mindfulness interventions tend to be correlated with slight to moderate improvements in the levels of glycaemia and the underlying psychological wellness in the subjects." Moreover, patients reported enhanced quality of life, concentration, and symptom control. Thus, MBSR is an important adjunct to diabetes care that improves psychological and metabolic health.”

6.3 Integrated Diabetes and Mental Health Care

One of the most significant reforms recently taking place in managing diabetes is Team [Motion], which also involves mind-and-body aspects. Mental and metabolic management is often done in tandem during traditional care; however, the connection between stress and glycemic control is often ignored. Integrated diabetes and mental health care closes this gap, which involves the collaboration of numerous specialists such as endocrinologists, psychologists, diabetes educators, and social workers in the health care system to offer holistic, integrated and patient-centered care.

This is designed on the premise that mental diseases like depression, anxiety, and diabetes distress are not merely intermediary comorbidities; they are fundamental in the control of diabetes distress (Kalra et al., 2021). It is a major objective of psychological treatment to provide supportive care enhancing recovery during the period of medical treatment.

The 2023 study of Mohan et al. examined an integrated care programme in which T2DM patients with more pronounced stress symptoms attended joint visits with both diabetic specialist doctors and therapists. The patients, in turn, reported decreased stress, a greater appreciation of the care received, and a significant improvement in the HbA1c index relative to the baseline within six months after the joint visits. These results are indicative of the rationale that advancing mental value for diabetes care enhances every part of the disease management process.

Still, there are matters to be resolved, such as the lack of cohesive mental health care, the siloed nature of the primary healthcare and health insurance infrastructure, and the lack of mental health care providers. However, new integrated diabetes care approaches, such as teaching diabetes educators basic mental health counselling skills or screening diabetes patients for mental health in primary care, are concrete steps to overcome fragmentation for integrated approaches (Fisher et al., 2022).

The WHO and IDF current guidelines profess the need for and incorporation of psychological assessments as part of diabetes management and treatment for every patient in the practice. As a disease, diabetes in itself is an insidious and prevalent condition which denotes that the best approach to manage its comorbidities and crosscutting issues is to take an integrated one that considers both the sociobiological and structural facets of diabetes care.

6.4. Alternative and Complementary Approaches

6.4.1 Yoga and Physical Activity

Yoga involves the adoption of physical positions, controlling breath, and meditative thinking which yields physical and psychological health benefits. Research suggests that in comparison to pharmacotherapy, incorporating yoga into the treatment regimen can lower the patient's HbA1c level by 1% and improve the patient's overall quality of life simultaneously. Physical exercise that incorporates aerobic and resistance exercise together with mindfulness components improves stress relief and glycaemic control simultaneously.

6.4.2 Relaxation Training

Progressive Muscle Relaxation (PMR) techniques and guided breathing exercises lower muscle tension which calms the anticipation of nerve activity from the sympathetic subdivision of the nervous system, lowers blood pressure, and improves overall metabolic balance. Regular exercise is associated with lower perceived stress and improved self-care and health management among people with T2DM (Thomas et al., 2021).

6.4.3 Technology-Assisted Interventions (mHealth)

Mobile health (mHealth) apps and wearables provide tailored stress management and guided relaxation exercises. Hood et al. (2022) reported that patients who used mobile stress management reminders had better lifestyle habits and less diabetes distress. Wearable devices that measure heart rate variability provide real-time stress management by offering biofeedback.

6.4.4 Peer Support and Community Programs

Interventions using peer support systems utilize emotional understanding and the process of problem solving. Bailey et al. (2020), for instance, shows that organized peer support groups lower diabetes distress and increase diabetes self-management. Community-based programmed are highly utilized in underdeveloped areas, permitting the provision of culturally sensitive teaching along with psychosocial support.

Chapter 7

Discussion

This thesis attempts to ascertain the elements that comprise the relationship between psychological stress and glycemic control in patients suffering from Type 2 diabetes mellitus (T2DM). We have evaluated biological stress and its psychosocial and psychosocial behavioral stressors in an attempt to identify the pathways stress profoundly causes dysfunction and assess stress-targeted pathways. The assessment findings stress factors; however, psychological stress is and remains a biological factor with effects that pertain to diabetes progression and control.

7.1 Integration of Findings

The psychosocial factors of stress, diabetes-induced distress, inadequate family and social support, and stress coping techniques have been observed to diminish adherence to treatment, regular medication intake, and dietary self-restraint. All these factors point to the fact that stress is and remains a major modifier of glycemic control. Stress is a factor and an independent determinant in the control of diabetes in a management system.

7.2 Comparison with Previous Studies

An abundance of research on psychological approaches to diabetes care has all been in agreement on the matter. Manea et al. (2021) confirmed that cognitive behavioral therapy (CBT) decreased distress and improved diabetes control as measured by HbA1c. Likewise, the works of Zhao et al. (2023) and Patel et al. (2022) showed that participants who underwent mindfulness-based stress reduction (MBSR) not only decreased glycemic variability but also enhanced their

quality of life. These findings are in alignment with the results of this thesis. Also, the integrated care models proposed by the WHO and the IDF also advocate for routine psychological assessments and the integration of mental care providers in diabetes care, which is also in line with what is discussed here.

7.3 Strengths and Limitations

The greatest contribution of this thesis is that it is the first to integrate biological, psychological, and behavioral facets of stress in diabetes for a coherent narrative. Such an undertaking offers a unique perspective on the myriads of mechanisms associated with stress and diabetes. That said, it must be highlighted that the thesis has also been constrained by the dominance of the review on secondary literature and the absence of primary research in the form of longitudinal clinical evidence. In addition, while randomized clinical trials offer evidence for psychosocial approaches to diabetes in primary care, there is a scarcity of expansive and longitudinal research to support the implementation of psychosocial approaches to diabetes across different populations and healthcare systems.

7.4 Implications for Practice

The findings justify the integration of psychological assessment and intervention in diabetes care. Diabetes distress screening, counselling, and the use of stress management programmers are warranted. Aggressive diabetes care, CBT, MBSR, yoga, and peer-support groups,

individually and in combination, should be adjuncts to the standard glucose-centered therapy. Routine psychological care in diabetes management is expected to improve patient compliance and clinical outcomes.

Chapter 8

Conclusion

8.1 Conclusion

The current study substantiates the notion that multiple dimensions of stress are instrumental in modulating blood glucose levels in patients with T2DM. Stress has endocrine, inflammatory, and behavioral components affecting glycemic control. In stress, cortisol release during the HPA-axis activation interferes with insulin and promotes gluconeogenesis in the liver. Also, sympathetic activation worsens hyperglycemia by augmenting catecholamines and insulin suppression.

Chronic psychological stress alters hormonal control and adds inflammatory molecules like interleukin-6, tumor necrosis factor-alpha, and C-reactive protein. These cytokines, which have insulin-molecular interfering with worse insulin sensitivity and reduce glucose transport, especially in skeletal muscle and adipose tissue. As discussed above, diabetes self-management, apart from biological self-management hurdles, concerns psychosocial factors like diabetes distress, working pressure, and social support that inhibit effective diabetes self-management. Distress, anxiety and increased workload, occupancy and responsibilities, ignorance, routinization, and boredom are reflexive of well documented studies, which, unintentionally lead to inadequate dietary habits, physical inactivity and inadequate adherence to prescribed medications. Such behavioral patterns worsen metabolic control and increase the complications of diabetes.

Fortunately, this thesis has also emphasized and evaluated psychosocial approaches to lessen stress concerning glycemic control. More specifically, CBT and MBSR and other relaxation

methods like deep-breathing and progressive muscle relaxation focus on reducing diabetes distress and glycemic control. Further, with mental health support, when chronic invalidating psychological problems can be resolved, sustained bio valuation and mental health integrate biomonitoring and these psychological frameworks, there's an enhanced overall physical and psychological state, and the care of the patient is improved.

A paradigm shift is now necessary: as this study indicates, people with diabetes have now been restricted enough that it is time to look beyond the singular, reductionist model of diabetes to something which isn't solely focused on glucose control. The psychological aspects of diabetes, most of all, must be addressed. The neoclassical model will preserve the desired lifeworld qualities, but only if this is viewed as a holistic framework. In essence, the studies must be perennial, person-centered and maintain the psychobiological and emotional wholeness of the diabetic individual.

8.2 Recommendations

This investigation highlights the need to address the psychological and medical healthcare aspects relating to the mental and medical health in patients with diabetes. With respect to that, these recommendations have been formulated for the key stakeholders responsible for the prevention and control of Type 2 Diabetes Mellitus (T2DM) in their clinical practice.

For Healthcare Providers

Since the majority of patients with diabetes mellitus (DM) are under the care of healthcare practitioners, they need to pay more attention to factors in the patient's life that may contribute to psychological stress and difficulty with glycemic control. First, in the direct management of psychological stress, diabetes distress ought to be formulated and incorporated into the care cycle. In the course of standard assessments, a simple and easily administered tool along with more standardized instruments, such as the Diabetes Distress Scale (DDS) or the Perceived Stress Scale (PSS), may be utilized to assess at-risk patients.

Second, the clinician needs to prescribe or recommend more structured psychological strategies (PS) such as cognitive behavioral therapy (CBT), mindfulness-based stress reduction (MBSR), or relaxation therapy. These have been shown to be effective in the management of mental stress and in the control of glycemic levels. Third, diabetes management should incorporate, especially at the tertiary level, psychologists, counsellors, and behavioral therapists. Such patients require both medical and psychological approaches because treating and managing T2DM entails multiple components.

For Policy Makers and Institutions

The whole system must be changed to enhance the access of the general population to psychological diabetes care. The authorities should focus on increasing the use of blended care delivery systems and strategies that incorporate the human touch and technology in national and regional healthcare systems. Such systems integrate whole-person care where medical care, both primary and secondary, diabetes management, endocrinology, and behavioral health care, are coordinated.

There should also be a persistent focus on the training of primary care practitioners and diabetes educators because they are the first point of contact in identifying and preparing mental health issues in patients. Some of the skills needed are motivational interviewing, stress assessment, and basic counselling.

As for future researchers, literature almost completely lacks studies examining the psychosocial as opposed to the cognitive behavioral therapy (CBT) components of the stress management intervention, particularly their longitudinal impact on glycemic control outcomes, to help contextualize the scientific discussions on diabetes. If psychosocial approaches to diabetes management, with all their associated psychosocial stresses, can be adequately understood, measured, and assessed on the glycemic outcome, the expense and feasibility of such approaches can then be evaluated with the utmost confidence.

Furthermore, scientists should also broaden their consideration of GBA, focusing on stress-related changes in the gut microbiome and their impact on glucose levels. This relatively small area of research has the potential to provide new approaches for the integrated treatment of metabolic and psychiatric disorders.

Finally, there is a gap in stress management medication for diabetes which correlates with people's socio-cultural factors. Such modifications to the programme are expected to enhance effectiveness and increase adherence.

For Patients and Caregivers

Patients and caregivers must ensure that the treatment of diabetes is done every day, and the importance of mindfulness should be incorporated along with walking for exercise, perhaps to help the patient with T2DM to lower their level of stress. “Maintain normative assessment and control psychological activity and stress hormones”.

Family, friends, and peers and participation in self-help and other supporting groups also help to relieve emotional stress and improve self-perception. Diabetes education for caregivers in understanding long-term diabetes care is equally important as learning how to cope with stress.

Lastly, patient self-care through the diabetes self-management support programmed should recognize mental health as one of the highly sensitive aspects that ought to be taken care of. “People with diabetes need to control blood glucose and also need to control diet, emotional and self-confidence".

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