Jurnal Info Kesehatan
Vol. 23, No. 2, June 2025, pp. 218-224
P-ISSN 0216-504X, E-ISSN 2620-536X
DOI: *10.31965/infokes.Vol23.Iss2.1263*
Journal homepage: *https://jurnal.poltekkeskupang.ac.id/index.php/infokes*

RESEARCH **Open Access**

Implementation of Stress Management to Decrease Blood Glucose Level of People with Diabetes Mellitus

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Received: 11 July 2023 Revised: 6 May 2025 Accepted: 16 June 2025

Abstract
Chronic hyperglycemia in patients with diabetes mellitus (DM) can be worsened by prolonged physical and emotional stress, which increases stress hormones like cortisol and raises blood glucose levels. Effective stress management is therefore essential to prevent glucose fluctuations and reduce the risk of diabetes-related complications. Techniques such as deep breathing exercises, progressive muscle relaxation, and hypnosis have been shown to lower stress hormones, enhance endorphin release, and improve glycemic control. This study aimed to measure patients' blood sugar levels before and after administering stress management interventions, including deep breathing relaxation techniques and five-finger hypnosis. The study method used a quasi-experimental design with a pre- and post-test approach, without a control group, was used. A total of 61 DM patients from the Diabetes Center in Ternate City were recruited through simple random sampling. The intervention consisted of deep breathing exercises, progressive muscle relaxation, and five-finger hypnosis. Blood glucose levels were measured before and after the intervention. Data analysis involved paired t-tests, ANOVA, and correlation tests. The results showed that the mean blood glucose level decreased from 215.75 mg/dL to 209.62 mg/dL following the intervention, with a mean difference of -6.13 mg/dL. However, this reduction was not statistically significant ($p = 0.0593$; $\alpha = 0.05$). It was concluded that there was a decrease in blood glucose levels after the intervention, although the difference was not statistically significant. The application of this study suggests that stress management techniques such as deep breathing, relaxation, and five-finger hypnosis may provide benefits in managing stress. Further studies using controlled designs and larger sample sizes are recommended.

Keywords: Diabetes Mellitus, Blood Glucose Level, Stress Management.

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1. INTRODUCTION

Diabetes mellitus (DM) is a progressive disease that causes acute and chronic complications. If not managed properly, it will result in various chronic complications, such as cerebrovascular disease, coronary heart disease, rheumatic vascular disease, and eye, kidney, and nerve disorders. People with diabetes mellitus are 2 times more likely to have coronary heart disease and cerebrovascular disease, five times more likely to suffer from ulcers/gangrene, seven times more likely to suffer from terminal renal failure, and 25 times more likely to experience blindness due to retinal damage than patients without diabetes and non-diabetic (Perkumpulan Endokrinologi Indonesia, 2021).

The number of DM sufferers according to the WHO Global Report on Diabetes, 382 million people were living with diabetes in 2013 and it is estimated that by 2035 the number of DM sufferers will increase to 592 million people and it is estimated that of these 382 million people (World Health Organization, 2016). 175 million some of them have not been diagnosed so that they are at risk of developing progressively into complications unnoticed and without prevention (Kementerian Kesehatan Republik Indonesia, 2014).

Riskesdas (2018) showed the prevalence of non-communicable diseases, including cancer, stroke, chronic kidney disease, diabetes mellitus, and hypertension. Based on blood sugar checks, the prevalence of diabetes mellitus increased from 6.9 percent to 8.5 percent. The high prevalence of non-communicable diseases is related to the behavior of the Indonesian people, such as the Indonesian people's diet, which consists of more foods high in sugar and salt, which are pleasing to the tongue. According to the 2018 Riskesdas report, North Maluku Province is one of the regions in Indonesia with a prevalence of DM sufferers of 1.1% (Badan Penelitian dan Pengembangan Kesehatan, 2019).

Based on data from the UPTD Diabetes Center Ternate, the number of diabetes patient visits in 2017 was 3018. In 2018, the number of visits increased to 3498, and in 2019, it increased to 3937. The latest data show that the number of visits decreased from 2020 to 1965 due to the COVID-19 pandemic (UPTD Diabetes Center, 2021).

The prevalence of type 2 DM will be increased by hyperglycemia or increased blood glucose levels in patients. Hyperglycemia, which is not managed properly, can lead to complications in patients with type 2 DM. The impact of hyperglycemia, namely all of these studies, consistently shows that hyperglycemia causes an immunosuppressive condition that exacerbates inflammatory conditions, can trigger myocardial cell death resulting in heart failure, resulting in an increase in systolic blood pressure (-diastolic), causing tissue to experience hypoperfusion in parts of the brain, developing into infarction then brain cell damage and stroke to occur (Kresnoadi, 2017).

Attempts to heal back to normal are complicated if complications occur because the damage will generally be permanent. Prevention efforts are needed earlier to overcome these complications and are expected to be very useful in avoiding various unfavorable conditions. Without effective interventions, the incidence of type 2 DM will increase due to increased life expectancy, reduced mortality from infectious diseases, and increased risk factors due to incorrect lifestyle and diet, obesity, lack of physical activity, and stress (Perkumpulan Endokrinologi Indonesia, 2021).

This study aimed to explore the effect of stress management on blood sugar levels in patients with diabetes mellitus. Chronic stress can exacerbate hyperglycemia by releasing cortisol, a stress hormone that disrupts glucose metabolism. Previous studies, such as those by Hanum et al. (2016), have demonstrated that stress management techniques, such as deep breathing relaxation and five-finger hypnosis, can significantly reduce stress hormones, improve insulin sensitivity, and stabilize blood sugar levels. The purpose of this research is to measure patients' blood sugar levels before and after administering stress management interventions, including deep breathing relaxation techniques and five-finger hypnosis.

2. RESEARCH METHOD

The study employed a quasi-experimental design using a pre- and post-test approach, without a control group. This research was conducted in the working area of the Diabetes Center in Ternate City from January to December 2019. All patients with diabetes mellitus enrolled at the Diabetes Center in Ternate City during the study period comprised the population. A straightforward random sampling method was used to select 61 responders. The inclusion criteria were as follows: Type 2 Diabetes Mellitus identified, and the patient was aged 35-65 years old. Going to the Diabetes Center regularly for the last three months or more. Patients with complications such as diabetic ketoacidosis or severe hypoglycemia were excluded.

The intervention was carried out over four weeks and involved stress-reduction strategies such as deep breathing and relaxation techniques. Participants were guided through slow, deep breathing exercises three times per week, with each session lasting ten minutes. Additionally, the five-finger hypnosis method was applied twice weekly for fifteen minutes per session. In this method, participants were encouraged to recall pleasant experiences while performing specific hand movements to induce relaxation. All sessions were conducted in a group setting at the Diabetes Center under the supervision of qualified facilitators.

To measure outcomes, blood glucose levels were assessed using a validated glucometer before and after the intervention. Stress levels were also evaluated using a standardized questionnaire administered at the same time points. For data analysis, a paired t-test was employed to compare blood glucose levels before and after the intervention. Meanwhile, ANOVA was used to examine the relationship between participant characteristics and changes in glucose levels. This study was approved by the Health Research Ethics Committee of Tanjungkarang Polytechnic, with ethical clearance number 314/KEPK-TJK/IX/2020. All participants provided written informed consent before taking part in the study.

3. RESULTS AND DISCUSSION

Table 1. Average Blood Sugar Levels with Diabetes Mellitus Before and After Application of Stress Management in the work area of the DM Center in Ternate City.

Variable Measurement	Mean	Median	SD	Min-Max	95 % CI
Pre-Intervention	215.75	207	97.97	92-462	190.66-240.84
Post-Intervention	209.62	189	99.32	43-503	184.18-235.06

Table 1 shows that the average blood sugar level before the intervention was 215.75 mg/dL (95% CI: 190.66-240.84) and decreased to 209.62 mg/dL (95% CI: 184.18-235.06) after the intervention.

Table 2. Analysis of Differences in Blood Sugar Levels with Diabetes Mellitus Before and After the Application of Stress Management in the working area of the DM Center in Ternate City

Measurement	Mean Difference	Standard Deviation (SD)	t-value	p-value
Pre vs Post	-6.13	89.14	0.537	0.0593

Table 2 shows that the average blood sugar level of DM sufferers before the application of stress management was 215.75, which decreased by -6.13 after the application to 209.62. The further analysis showed no significant difference between blood sugar levels in DM patients before and after application (p-value: 0.0593, α: 0.05). Type 2 diabetes mellitus is an insulin-resistant diabetes. In people with type 2 diabetes, the pancreas can still produce insulin, but the quality is poor. Many sufferers do not realize that they have diabetes, because the symptoms are slow, so they are not felt. Sufferers usually only realize after they experience

various complications and are diagnosed by a doctor as having diabetes (Zainuddin et al., 2015).

Findings from a meta-analysis by Zhou et al. (2020) previously revealed that the most common cardiovascular metabolic comorbidities associated with COVID-19 were hypertension (17.1%) and cardio-cerebrovascular disease (16.4%), followed by DM (9.7%) (Zhou et al., 2020). Patients with DM or hypertension in this report had a 2-fold increased risk of severe disease and the need to be admitted to the intensive care unit (ICU). DM patients are immunocompromised hosts because they have immune dysfunction related to their ability to fight infection (Mukona & Zvinavashe, 2020).

Type 2 DM triggers an increase in the patient's GDS. This increase occurs in patients with type 2 DM due to insulin resistance resulting from a long-term poor lifestyle, which causes a decrease in pancreatic function. The two case studies reported that the individuals did not consistently follow a DM diet at home, lacked physical activity, and experienced stress in the form of situational anxiety during assessments, as evidenced by difficulties sleeping and complaints about their unchanging condition. Poor lifestyle choices, such as non-adherence to DM diets, inactivity, and irregular medication, worsen insulin resistance in patients with type 2 DM, reducing the number of insulin receptors on target cells and increasing blood glucose levels (Boku, Ruhyana, & Suprayitno, 2019). Improper management of glucose levels—through diet, physical activity, pharmacological and non-pharmacological treatments, as well as stress from long-term type 2 DM—can result in uncontrolled blood glucose levels and hyperglycemia, exacerbating the condition of insulin resistance in type 2 DM patients.

The results of statistical tests also showed no significant relationship between blood sugar levels and the quality of life of DM (p-value> 0.05). However, from the data obtained, it was found that the average blood sugar level before the application of stress management was 215.75 (95% CI: 190.66-240.84) and decreased after the application of stress management to 209.62 (184.18-235.06), it can be concluded that there was a decrease in the average blood sugar levels after the application of stress management.

A retrospective study of 451 people with COVID-19 with diabetes and/or hyperglycemia from the US reported that people with uncontrolled hyperglycemia had a longer hospital stay and higher mortality compared to people without diabetes or uncontrolled hyperglycemia (Hartmann-Boyce et al., 2020). For this reason, in this condition, it is necessary to control blood sugar, one of which is to control the stress and anxiety of sufferers.

Stress can increase blood glucose levels because stress stimulates endocrine organs to release epinephrine, which has a very strong effect in causing the process of gluconeogenesis to occur in the liver, so that it will release large amounts of glucose into the blood in a few minutes. This causes an increase in blood glucose levels when stressed or tense. Several factors cause blood sugar to rise, as a lack of exercise, increased amount of food consumed, increased stress and emotional factors, weight and age gain, and the impact of treatment with drugs such as steroids (Muhlisin et al., 2015). For this reason, stress needs to be adequately controlled through stress management so that it is expected to reduce the rate of further complications from DM itself. Adam & Tomayahu, (2019) Found that stress increased blood sugar levels in Diabetes Mellitus at the Kota Barat Health Center in Gorontalo City.

According to Pathan et al. (2023), the results showed that the combination of Slow Breathing Exercise (SBE) and Progressive muscle Relaxation (PMR) significantly reduced systolic and diastolic blood pressure, heart rate, respiratory rate, and anxiety levels compared to the control group. The reduction in systolic and diastolic blood pressure from SBE was more significant than that observed in PMR and significantly higher than that in the control group. In addition, a systematic review that included 46 publications from 16 countries with more than 3,402 adult participants showed that progressive muscle relaxation (PMR) is effective in reducing stress, anxiety, and depression. The effectiveness of PMR increases when combined with other interventions (Muhammad Khir et al., 2024).

In this study, the stress management intervention program that the researchers provided to the participants consisted of psychoeducation on stress and DM, deep breathing relaxation exercises, and five-finger hypnosis to explore the gratitude gained during life. From this application, participants reported that the deep breathing relaxation exercise and five-finger hypnosis had an impact that they could feel directly. This makes participants more motivated to train regularly and calmer. Stress management intervention programs in groups can reduce the stress levels experienced by elderly people with chronic diseases (Hanum et al., 2016).

Pharmacological therapy to lower blood glucose, namely oral hypoglycemic drugs (OHO) or insulin injections (Decroli, 2019). To minimize the side effects of pharmacological therapy, there are non-pharmacological therapies that can be performed on patients with type 2 DM, such as a combination of deep breathing relaxation therapy and Ar-Rahman murotal (Yulianti & Armiyati, 2019), progressive muscle relaxation techniques (Videbeck, 2008; Karokaro & Riduan, 2019), Benson relaxation therapy (Ratnawati, Siregar, & Wahyudi, 2018), deep breathing technique relaxation therapy (Indriyani, & Ambarwati, 2018) autogenic relaxation (Wahyuni et al., 2018), acupressure (Masithoh, Ropi, & Kurniawan, 2016), education diet, and exercise (Selfi, Simbolon & Kusdalinah, 2018).

Combining 5-finger hypnosis and deep breathing relaxation therapy can increase endorphins, which naturally trigger a relaxation response and decrease stress chemicals. Patients' blood glucose levels can decrease due to relaxation techniques, preventing the liver's glucagon from converting to glucose. This combination of treatments works better than non-pharmacological treatments, so it was selected. Furthermore, it is a straightforward, self-administered method that patients may use independently, making it suitable for home and hospital environments.

However, this study has several limitations that should be taken into account. First, the 61-person sample size may not be sufficient to extrapolate the results to the larger group of people with diabetes mellitus. Second, comparing the intervention results with alternative treatments or no therapy is difficult when no control group exists. Third, the brief 4-week trial period might have missed the long-term impact of stress reduction on blood sugar levels. Finally, the result might have been influenced by the individuals' noncompliance with the intervention and other outside influences, such as dietary or pharmaceutical changes. To overcome these constraints, future research could include more extensive, more varied samples, a control group, and extended follow-up times to more accurately evaluate the long-term effects of stress-reduction techniques.

4. CONCLUSION

It was concluded that there was a decrease in blood glucose levels after the intervention, although the difference was not statistically significant. The application of this study suggests that stress management techniques such as deep breathing, relaxation, and five-finger hypnosis may provide benefits in managing stress. Further studies using controlled designs and larger sample sizes are recommended.

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