Impact of Smartphone Application Education on Stress in Type 2 Diabetes Mellitus Patients

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A B S T R A C T

Introduction: Lack of knowledge about managing health and the duration of the disease causes stress in Diabetes Mellitus (DM) patients. Uncertainty about their future health and the ongoing burden of disease can worsen the mental health of type 2 diabetes mellitus (T2DM) patients. Smartphone application education can be a solution for T2DM patients in reducing stress regarding their health condition. This study aims to determine the impact of smartphone application education on stress in type 2 diabetes mellitus patients. **Methods:** The design in this research is a pre-test and post-test control group design. The research was conducted in the period October 2023 – January 2024. Respondents in this study were T2DM patients. The locations of this research were nine Public Health Centers in Kediri City, Indonesia. The sample in this study was 131 respondents. **Results:** The results of the research showed that the stress score for T2DM sufferers in the pre-test was 41.34, after three months of smartphone application education, post-test the mean stress decreased was 4.31, and the p-value 0.000. There is a mean difference October – November was 13.50, November – December was 10.77, December – January was 12.76 and the P-Value was 0.008. **Conclusion:** There was a decrease in stress during the periods of October, November, December, and January after being given smartphone application education. Smartphone applications are effective in reducing stress in T2DM patients.

1. Introduction

One common and often overlooked aspect of type-2 diabetes mellitus (T2DM) sufferers is stress. T2DM is often associated with anxiety due to a lack of knowledge in managing health. The mental health of T2DM patients may worsen due to uncertainty about their future health and the ongoing burden of the disease.[1] Diabetes mellitus (DM) patients feel helpless and frustrated because of the difficulty of managing a chronic disease, so they experience pressure due to the demands of treatment and lifestyle changes.[2] Severe causes if a patient suffers from DM are hypertension, cardiovascular disease, cerebrovascular disease, and kidney disease so the patient also suffers from psychological problems.[3] The World Health Organization (WHO) states that Indonesia ranks 4th in the number of people suffering from DM, followed by the United States, India, and China. WHO estimates that the number of DM patients in Indonesia will increase from 8.4 million in 2000 to 21. 3 million in 2030. IDF estimates that the number of patients will increase from 7.0 million in 2009 to 12.0 million in 2030. Although the data shows an increase in prevalence, it can be concluded that the number of DM patients in Indonesia will increase by 2-3 times by 2030. The city of Kediri ranks number 19 out of 38 cities and regencies in East Java Province, Indonesia as DM sufferers with 867,257 cases in 2021.[4]

Sudden changes in life cause DM patients to show several negative psychological reactions, including

anger, stress, and depression. Stress can significantly affect not only a person's physical health but also a person's mental health.[5] Not all T2DM patients, especially the elderly, have the knowledge or skills necessary to use smartphone applications during preliminary studies. The main concerns are the security of health information stored in the app and data privacy. There has never been any health education using smartphone applications at the Public Health Center in Kediri City, Indonesia. Smartphone applications can help typ 2 diabetes mellitus (T2DM) patients manage stress. To help people monitor and manage their stress levels, these smartphone applications can offer features such as stress management techniques, mindfulness exercises, and stress education.[6] Studies also show that people with T2DM experience high stress and anxiety for a long time.[7] The prevalence of the intervention group who received education for three months using smartphone applications experienced an increase in self-care.[8] Smartphone applications created specifically for people with T2DM can be a useful tool for improving their well-being and managing their diabetes overall.[9] Therefore, to maintain their best health, T2DM sufferers must acquire efficient stress management skills using smartphone applications. The objective of this study is to know the impact of smartphone application education on stress in T2DM.

2. Methods

The design in this research is a pre-test and post-test control group design. The research was conducted in the period October 2023 – January 2024. Respondents in this study were T2DM patients at nine Public Health Centers in Kediri City, Indonesia. Sample measurements can use the G-Power formula with a power effect size analysis type of 0.5, α err probability 0.05, and power 0.5, resulting in a minimum sample of 119 respondents. To avoid errors, the sample size needs to be increased by 10%. Thus, the total sample in this study was 131 respondents.[10] Inclusion criteria were having and being able to use a smartphone application, being diagnosed with T2DM with fasting blood sugar > 126 mg/dl, aged between 36-65 years, and willing to take part in the study for three months. Education is carried out using the "Rizki Diabetes" smartphone application, namely understanding DM, diet, physical activity, pharmacological therapy, foot care, stress management in DM, consultation via WhatsApp with researchers, emergency button, and music therapy. Education is carried out using a contextual teaching and learning model, namely a learning method as the center of the teaching and learning process in T2DM so that it will develop the patient's motivation, interest, and ability to be innovative and active in learning independently at home while providing education that can be applied in everyday life.

The depression anxiety stress scale 21 is a set of subjective scales designed to measure the negative emotional states of depression, anxiety, and stress. This questionnaire consists of 21 question items with the answer choices never (0), sometimes (1), often (2), and almost all the time (3), the score obtained is then multiplied by 2 to calculate the final score. The results of the assessment were: Normal: 0-14, Mild: 15-18, Moderate: 19-25, Severe: 26-33, and very severe: ≥34.[11] The researcher, T2DM patients, and the person in charge of T2DM patients at the public health center agreed on a schedule for the research. Nurses and nursing students assisted the researcher during data collection. This research has been approved by the STRADA Indonesia Health Research Ethics Committee with reference number 000354/EC/KEPK/I/08/2023 on 21 August 2023.

3. Results and Discussion

Table 1 Characteristics of total respondents from the T2DM patient sample at the Public Health Center in Kediri City, Indonesia was 131 respondents. Almost all of the respondents were female 61.8%. Most respondents aged 56-65 years was 51.1%. Almost half of the respondents have a tertiary school education, which was 29.0%, almost all of the respondents employed, which was 77.1%, Almost half of the respondents have a duration DM of 1-5 years was 44.3%, and almost all of the respondents have income per month ≤ 2.300.000 was 53.4%.

Table 1. Respondent characteristics.

Respondent characteristics		Frequency	Percentage (%)
Gender	Male	50	38.2
	Female	81	61.8
Age, years	36-45	23	17.6
	46-55	41	31.3
	56-65	67	51.1
Educational level	No formal education	16	12.2
	Primary school	26	19.8
	Secondary school	32	24.5
	Tertiary school	38	29.0
	University	19	14.5
Employment status	Unemployed	30	22.9
	Employed	101	77.1
Duration DM, years	≤ 1	36	27.5
	1 - 5	58	44.3
	≥ 5	37	28.2
Income per month (Rp)	≤ 2.300.000	70	53.4
	>2.300.00	61	46.6

The normality test on standard residuals using Shapiro Wilk with a p-value < 0.05 in October was 0.030, November was 0.000, January was 0.018, and a p-value> 0.05 in December was 0.435. The data below is not normally distributed.

Table 2, using the Friedman test, shows that the mean stress of T2DM patients was highest in October with a mean of 41.34 and lowest in January with a mean of 4.31. Table 2 shows a p-value of 0.000 <0.05, namely that there is a significant difference in the mean decrease in stress results each measurement time. The use of smartphone applications can reduce stress every month for T2DM patients at the nine Public Health Centers in Kediri City, Indonesia.

Table 2. The impact of smartphone application education on stress in type 2 diabetes mellitus patients.

No	Month	n	Mean	Mean Rank	Std. Deviation	Minimum	Maximum	p-value
1	October	9	41.34	4.00	3.03	34.29	45.29	
2	November	9	27.84	3.00	3.36	19.21	29.68	0.000
3	December	9	17.07	2.00	4.35	9.84	23.81	
4	January	9	4.31	1.00	1.67	3.02	8.10	

Figure 1 the Wilcoxon test is carried out, it is explained that in the period October - November, the mean stress was 13.50, the standard deviation was 1.33, and there was a difference in stress during this period with a P-Value 0.008. In the period November - December, the mean stress was 10.77, the standard deviation was 3.72, and there was a difference in stress during this period with a p-value of 0.008. In the period December - January there was in the mean stress was 12.76, the standard deviation was 4.22, and there was a difference in stress in that period with a p-value of 0.008.
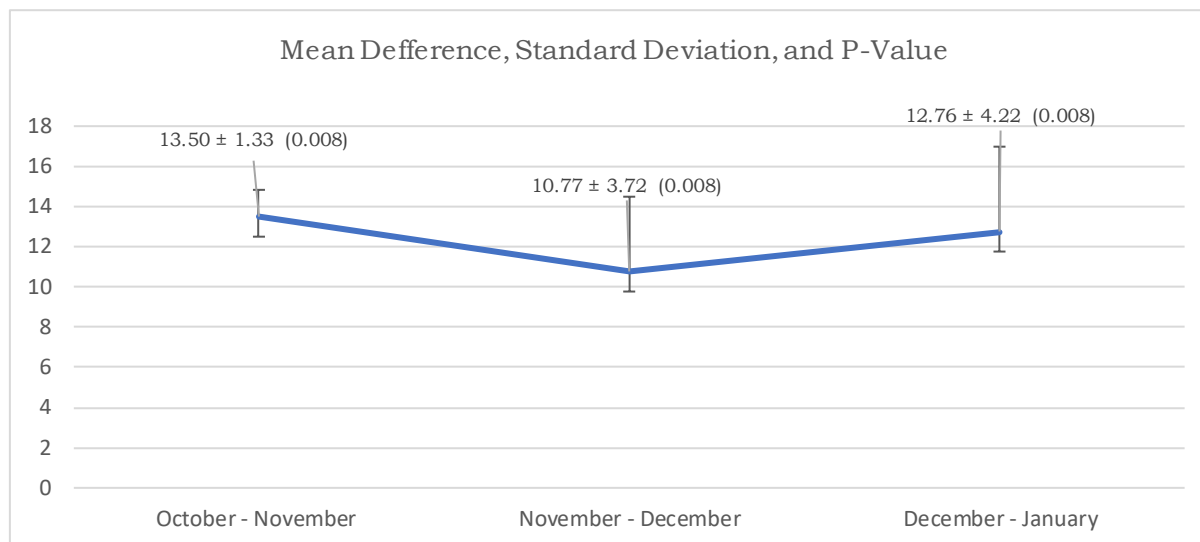
Figure 1. The impact of smartphone application education among stress in type 2 diabetes mellitus patients.

Mobile Phone App can provide psychoeducation on healthy lifestyles and the latest news about treating depression in DM patients for six weeks with participants mostly women between the ages of 41-60 years. There was a decrease in stress in DM patients every week. This education can help users understand the importance of self-care and how to manage health holistically. The mobile phone App can help users organize and remind them of times to check blood sugar, physical activity, or take medication. These reminders can help create regular habits to control depression.[12] Mobile Health learning can help DM sufferers control depression and anxiety by doing physical activity. Mobile Health Learning can identify changes in depression and anxiety related to mental health conditions through voice or text data. There is a relationship between mental health and being able to treat symptoms of depression and anxiety in a randomized controlled trial.[13] Most respondents monitor via the application by measuring blood sugar and then uploading it to the application with a mean upload of ± 0.2 per 24 hours (342 uploads in 7 weeks). Thus, postprandial blood glucose decreased with ± SD being 89 ± 12 mg/dL for breakfast, 122 ± 23 mg/dL for lunch, and 122 ± 22 mg/dL for dinner. With a decrease in blood glucose, DM patients become calm and the patient's stress decreases.[14]

In T2DM patients, the educational intervention group was carried out using a smartphone application, and the control group without a smartphone application. Next, comparisons are carried out randomly over three to six months. The intervention group used a diabetes management smartphone that allows patients to enter self-care data such as blood glucose levels, carbohydrate intake, medications, and more. The decrease in HbA1c was followed by a gradual decrease in stress from the pre-test, third month, and sixth month.[15] The contextual teaching and learning model smartphone application had a greater impact on reducing blood glucose levels in T2DM patients than the booklet within three months of intervention. This application can be a very useful tool to help people better monitor and manage their health conditions.[16] Individualized and easily available cognitive behavioral therapy smartphone applications have proven to be an invaluable resource in helping DM patients manage their depression. The psychological impact of DM can be overcome and patients can receive full assistance from healthcare practitioners by incorporating this application for cognitive behavioral therapy into the diabetes management care cycle.[17] After carrying out the mobile health intervention in the first 3 months of T2DM, self-efficacy and stress decreased significantly. T2DM patients experienced a relatively higher increase in self-efficacy compared to the control group. There was an effect of mobile health education on reducing stress after 3 months of intervention with a p-value of 0.01.[18]

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Smartphone applications can make it easier to access information and education about stress management in patients with T2DM from time to time. Patients can gain a better understanding of the relationship between stress and diabetes mellitus and understand the stress management strategies they can use. Type 2 diabetes mellitus (T2DM) is a chronic disease characterized by persistent high blood sugar levels. In addition to the physiological impact, T2DM can also have significant consequences on a patient's mental health, with stress being one of the main comorbid factors. Chronic stress can worsen glycemic control, increase the risk of complications, and reduce the patient's quality of life. In this digital era, smartphone technology offers innovative solutions to help T2DM patients manage their stress. Specially designed smartphone applications can provide easy access to information and education about stress management, allowing patients to learn and apply coping strategies independently and personally. Chronic stress triggers a "fight-or-flight" response that involves the release of stress hormones such as cortisol and adrenaline. Stress hormones interfere with the activity of insulin, a hormone that helps body cells take up glucose from the blood. Stress hormones stimulate the liver to produce new glucose from proteins and fatty acids. Stress hormones suppress insulin secretion from the pancreas. Persistent increases in blood sugar levels due to chronic stress can worsen glycemic control in T2DM patients, increasing the risk of complications such as heart disease, stroke, and diabetic nephropathy. Smartphone apps designed for stress management in T2DM patients can offer a variety of useful features. Apps can provide easy-to-understand information about stress, its relationship to T2DM, and its impact on health. This information can help patients increase their understanding of stress and the importance of managing it. Apps can offer a variety of coping strategies that have been proven effective for managing stress, such as relaxation techniques, mindfulness, physical exercise, and cognitive behavioral therapy. Patients can choose the strategy that best suits their needs and preferences. Apps can allow patients to track their stress levels over time. This can help patients to identify stress triggers and develop effective prevention strategies.[16-18]

The application can facilitate connections between T2DM patients through community forums or chat groups. Social support from peers who experience similar conditions can help patients feel more connected and reduce feelings of stress and isolation. Apps can provide reminders to implement coping strategies and achieve stress management goals. Ongoing motivation and support can help patients to stay motivated in their efforts to manage stress. The effectiveness of smartphone applications in stress management in T2DM patients has a strong biological basis. Relaxation techniques such as meditation and deep breathing can help lower stress hormone levels and activate the relaxation response. This can help lower blood pressure, heart rate, and blood sugar levels. Mindfulness can help patients increase their awareness of their thoughts, feelings, and bodily sensations in the present moment. This can help patients focus more on the present and reduce rumination about past or future stress, which can contribute to anxiety and depression. Regular physical exercise can help improve insulin sensitivity, lower blood sugar levels, and reduce stress. Physical exercise can also increase the release of endorphins, hormones that have a mood-boosting effect. CBT helps patients to identify and change negative thought patterns that may contribute to stress. This can help patients to develop more effective coping mechanisms and improve their quality of life. Smartphone apps can be a useful tool to help T2DM patients manage their stress. By providing easy access to information, education, and coping strategies, apps can help patients increase their understanding of stress, develop effective coping mechanisms, and improve their overall quality of life. The biological plausibility aspect of various stress management strategies offered by smartphone applications supports their effectiveness in helping T2DM patients achieve their mental health goals.[17-21]

4. Conclusion

There was a decrease in stress during the periods of October 2023, November 2023, December 2023,

and January 2024 after being given smartphone application education. Smartphone application was effective in reducing stress in T2DM patients.

5. References

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