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EFFECTIVENESS OF DIABETES DAILY CARE CALCULATOR APPLICATION ON SELF-MANAGEMENT OF TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT
Type 2 DM can affect aspects of the sufferer's quality of life and carries a risk of complications. DM requires good self-management to be able to control glucose levels. Education is an important component in patient self-management so that patients can control their disease. Smartphone technology through application implementation can be utilized to create innovative solutions. This research develops and applies a daily care diabetes calculator based on a mobile application that provides information on the pillars of diabetes management that is easily accessible to patients and embeds a smart calculator to calculate diet based on the patient's calorie needs and physical activity. The aim of the research is to determine the effectiveness of applying the daily care diabetes calculator application for self-management of Type 2 Diabetes Mellitus patients. This type of quantitative research with a quasi-experiment design uses a one group pre and posttest approach without control group. The research was conducted at RSUD dr. Rasidin. Sampling was taken using a consecutive sampling technique with a sample size of 22 people. The intervention was given for 2 weeks and self-management was assessed using the The Summary of Diabetes Self-care Activities (SDSCA) questionnaire. with the validity and reliability test values for thisinstrument being r = 0,80 and α : 0,74. Data analysis using paired t test The average self-management score before implementing the diabetes daily care calculator application was 40.32 and the average self-management score after was 63.18. Implementation of a daily care diabetes calculator based on a mobile application is effective in improving self-management of type 2 diabetes mellitus patients ($p<0.05$). This application can be used by nurses as an extension in caring for patients at home, so that the care process provided remains sustainable.

Keywords: applications; diabetes mellitus; self management

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INTRODUCTION

Type 2 diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia or high blood sugar levels and impaired carbohydrate, protein, and fat metabolism caused by insulin resistance (J. M. Black & Hawks, 2014b). Type 2 DM results from the body's refusal or failure to use insulin properly and is sometimes combined with a relative insulin deficiency (Notoadmodjo, 2012). Type 2 DM can occur even though the pancreas can still produce insulin, but the insulin produced is of poor quality resulting in increased blood glucose. Patients usually do not need additional insulin injections but require drugs that work to improve insulin function, lower glucose, and improve sugar processing in the liver (Alisa et al., 2020). Various epidemiological studies have shown that there is an increasing trend in the incidence and prevalence of type 2 DM in various parts of the world. World Health

Organisation (WHO) predicts a considerable increase in the number of patients with type 2 DM in the coming years (Perkeni, 2021). Type 2 DM is the most common type of diabetes, accounting for approximately 90% of all type 2 DM cases (IDF, 2021). At the end of 2021, IDF confirmed that diabetes is a global health emergency in the 21st century. In 2021, more than half a billion people worldwide were living with diabetes, or 537 million people to be exact, and this number is projected to reach 643 million by 2030 and 783 by 2045.

Indonesia in 2021 is the 10th country with the highest number of people with type 2 DM, which is 19,465,100 people (IDF, 2021). World Health Organisation (WHO) predicts an increase in the number of patients with type 2 DM in Indonesia from 8.4 million in 2000 to around 21.3 million in 2030. The highest prevalence of type 2 DM was found in Jakarta in 2018 (3.4%) (Riskesdas, 2018). Meanwhile, West Sumatra has a prevalence of type 2 DM (1.6%) (Riskesdas, 2018). In Padang City in 2018 with a total of 5,252 cases of type 2 DM, it increased in 2019, which was found to be 17,017 cases (Padang City Health Office, 2019). In 2022 Puskemas Andalas became the first patient with type 2 DM in Padang city where the number of sufferers reached 1,017 people. Type 2 DM can affect aspects of the quality of life of sufferers and has a risk of complications (Ridhani et al., 2021). Complications that occur due to DM disease can be in the form of disorders of both macrovascular and microvascular blood vessels, as well as disorders of the nervous system or neuropathy (Perkeni, 2021). Macrovascular events in America such as stroke by (6.6%), acute myocardial infarction by (9.8%), coronary heart disease by (9.1%), and congestive heart failure by (7.9%) (ADA, 2016). According to Perkeni (Perkeni, 2019), self-management by type 2 DM patients is needed, known as self-management in diabetes management to prevent DM complications.

Diabetes mellitus requires continuous therapy to be able to control glucose levels properly, in addition to pharmacological therapy, non-pharmacological therapy is also needed to maximize blood glucose control, including in this case self-management measures. Diabetes self-management aims to achieve blood sugar levels within the normal range so as to prevent complications and reduce morbidity and mortality rates due to diabetes mellitus (Ningrum et al., 2019). Research conducted by Alisa et al., (2020) found that more than half, namely 44 people (60.3%) of 73 respondents with type 2 diabetes mellitus had poor self-management. The results of the study (Kardila, Intan et al., 2022) show that the implementation of self-care in type 2 DM patients has not been maximized both in terms of maintenance, monitoring management, and self-confidence. Based on research conducted by Windani et al., (Windani et al., 2019) it was found that self-management in type 2 DM patients based on diet was found to be 48.6% with a moderate level and 37.0% with a poor level. Self-management behavior based on medication was 16.7% with a moderate level and 39.1% with a poor level. Self-management behavior based on physical exercise was 98.6% with a moderate level and none with a poor level. Self-management behavior based on blood sugar monitoring was 50.0% with a moderate level and 33.3% with a poor level. Self-management behavior based on foot care was 94.9% with a moderate level and 7% with a poor level. Patients' quality of life can be affected and also cause complications if self-management is poor (Jargalsaikhan et al., 2019).

The results of research conducted by (Marbun et al., 2021) found that more than 50% of patients with type 2 diabetes mellitus have low knowledge with low self-care skills. The results of this study are in line with research conducted by (Despitasari & Sastra, 2020) which found that the proportion of patients with type 2 diabetes mellitus with poor self-care management was found to be more in patients with poor diabetes knowledge (70.3%) compared to patients with good diabetes knowledge (34.8%) at the Special Polyclinic for

Internal Diseases of Dr. M. Djamil Padang Hospital. Education for diabetes patients is an important component of patient self-management so that patients can control their disease. In the current digital era, smartphone technology through the implementation of applications can be utilized to create innovative solutions and provide efficiency in controlling chronic diseases (Abaza & Marschollek, 2017). One of the innovative solutions that can be developed to improve the self-management of DM patients in managing their disease is a diabetes daily care calculator that can be used by patients anywhere. Applications that have been developed so far in the form of telenursing only contain information on diabetes management pillars so that to calculate the patient's diet, the patient will consult with a nurse or doctor via video or chat. Telenursing media that have been developed are based on telephone, text messages, virtual visits, and websites. The results of a literature review (Abaza & Marschollek, 2017) showed that telenursing provides benefits in remote diabetes management. Based on the limitations of existing telenursing media, the researcher will develop a mobile application-based diabetes daily care calculator. The application to be developed provides diabetes management pillar information that is easily accessible to patients and also embeds a smart calculator to calculate diet based on physical activity and insulin needs of patients. So that through this application, patients can independently determine their daily diet.

An initial survey conducted at Dr. Rasidin Hospital on 10 patients with type 2 DM found 7 patients with poor self-management and 3 people with good self-management. The results of the patient interview stated that the patient had received education and counseling about diabetes from the Puskesmas. Patients have never used applications on their smartphones for disease management. Patients also said that they have not set a diet according to calorie needs due to limited knowledge and access to diet or drug consultations every day. Based on the existing phenomena and the limitations of previous research, further research was conducted on the "Effectiveness of Diabetes Daily Care Calculator Application on Self-Management of Type 2 Diabetes Mellitus Patients".

METHOD

The research design used in this study was a quasi-experiment with a pre and post without control-group design approach. This research was conducted at Dr. Rasidin Hospital, Padang City. This research was conducted in July - November 2023. The sampling technique used was nonprobability sampling with consecutive sampling based on the inclusion and exclusion criteria set. The inclusion criteria for this study were: a. Willing to be a research respondent, b. Patients can communicate well, c. Patients have an Android smartphone, d. Age 25 - 60 years old. The exclusion criteria in this study are patients who have decreased consciousness and are not cooperative. The number of samples in this study was 22 people. The intervention provided was the application of the diabetes daily care calculator application where patients were given education and counseling which included the pillars of DM management and dietary calculations using the application. The intervention was given for 2 weeks. Self-management was defined as the ability of respondents to manage themselves in relation to type 2 DM disease which includes diet control, physical activity, blood sugar control, medication, and foot care. Self-management was assessed before and after the intervention using The Summary of Diabetes Self-Care Activities (SDSCA) questionnaire. The questionnaire has been tested for validity and reliability with the validity and reliability test values for this instrument being $r = 0,80$ and $\alpha : 0,74$. This study was conducted after obtaining research ethics approval number: Skep/519/KEPK/XI/2023. Data analysis to see the difference between pretest and posttest results used paired t-tests because the data was normally distributed. The interpretation of the research results is seen based on the p-value obtained in the bivariate test used paired t-tests.

RESULTS

Self-management scores on respondents before and after the application of the diabetes daily care calculator application can be seen in the following table.

Table 1.
Self-Management Score Before and After the Application (n = 22)

Measure	**f**	Mean ± SD	Min-Max
Before	22	40,32 ± 15,74	20 - 72
After	22	63,18 ± 13,26	35 - 80

Table 1. above, the average score of self-management before the application of the diabetes daily care calculator application is 40.32 and the average score of self-management after the application of the diabetes daily care calculator application is 63.18. The effectiveness of the application of the diabetes daily care calculator application on self-management of Diabetes Mellitus patients can be seen based on the difference in self-management scores before and after the intervention is given and based on the results of the paired T-test in the following table.

Table 2.
Differences in Self-Management Score Before and After Application (n=22)

Variable	Mean	SD	Mean Difference	p
Self-Management				
Before	40,32	15,74	-22,86	0.000*
After	63,18	13,26		

Based on the table above, the difference in self-management before and after the application of the diabetes daily care calculator application is 22.86 in 22 patients with diabetes mellitus. Based on the t-dependent statistical test (paired test), the p-value = 0.000 (ρ <0.05), meaning that the application of the diabetes daily care calculator application affects the self-management of DM patients. Based on these results, it is concluded that the application of the diabetes daily care calculator application is effective in improving the self-management of DM patients.

DISCUSSION

Based on the results of the study, the average self-management score before the application of the diabetes daily care calculator application was 40.32, where this score was categorized in the moderate range. These results are in line with research conducted by Kurniawati et al. in 2019 where it was found that the average self-management score before being given a diabetes self-management education intervention in patients with type 2 diabetes mellitus was 42.17, this result was also categorized in the moderate range (Kurniawati et al., 2021). Self-management is a form of behavior that focuses on individual roles and responsibilities in disease management. Research conducted by Suhanda et al. (2016) explains that self-care management in patients with type 2 diabetes mellitus is still classified as poor and there is no self-care management activity that is carried out comprehensively, thus showing that self-care management of type 2 diabetes mellitus is still not getting maximum attention by sufferers and health workers.

Self-management consists of aspects of diet management, physical activity or exercise, medication consumption, blood glucose control, and prevention of complications such as foot care. Increased blood glucose levels (hyperglycaemia) in patients with type 2 DM can cause various problems in patients (Desnita & Surya, 2023). Basically, humans need self-management for themselves except for people who are unable to carry out self-care independently with the need for the help of others. Self-management is an activity carried out by someone for themselves in order to maintain their health, life, and well-being. Self-

management behavior for people with type 2 diabetes mellitus consists of physical activity (exercise), dietary management, blood glucose control, medication, and prevention of complications/foot care. Adhering to a series of routine self-management actions that will last a lifetime for diabetes patients is basically a big challenge and not an easy thing to do. Some of the factors that influence patients with type 2 diabetes mellitus to be undisciplined in performing self-care management include low knowledge, lack of family support, and not optimal utilization of health services (Luthfa & Fadhilah, 2019).

After the application of the diabetes daily care calculator application in patients with type 2 diabetes mellitus, the average score of self-management of patients with type 2 diabetes mellitus is in a good category with a score of 63.18. This is in line with the results of research by Kurniawati et al. 2019 where it was found that the average self-management score after being given a diabetes self-management education intervention in patients with type 2 diabetes mellitus was 72.47 in the good category (Kurniawati et al., 2021). Self-management scores are in a good category after treatment occurs because respondents get structured interventions. According to the researcher's analysis, respondents are given education and mobile-based applications that can be used by respondents as a reference in managing their disease. The use of applications to empower patients in self-care makes active patients contribute to the management of their disease so as to increase self-care awareness in optimizing health and preventing complications.

Based on the results of the study, the difference in self-management before and after the application of the diabetes daily care calculator application was 22.86 in 22 patients with diabetes mellitus. Based on the t-dependent statistical test (paired test), the p-value = 0.000 (ρ <0.05), meaning that the application of the diabetes daily care calculator application affects the self-management of DM patients. Based on these results, the application of the diabetes daily care calculator application is effective in improving the self-management of DM patients. The results of this study are in line with research (Luawo et al., 2019) on the application of DM e-diary as a monitoring tool for self-care management of dietary management of DM patients, where the application of e-diary in diabetes mellitus patients is significant and significantly effective in improving self-care management of dietary management in diabetes mellitus patients. Research by Veazie et al. in 2018 on "Mobile Applications for Self Management of Diabetes" states that applications for diabetes self-management can improve self-management outcomes in the short term, but the effect cannot be distinguished from the effect of health services that clients also get directly. Detailed and long-term evaluations are needed to determine the effect of these applications on diabetes mellitus such as blood pressure, blood sugar, weight, and client quality of life (Veazie et al., 2018).

The diabetes daily care calculator application uses a smartphone as a means of facilitating the implementation of self-management of diabetes patients. All self-management activities are included in the android-based programme including diet management, physical exercise, blood sugar control and diabetes treatment, and foot care. Researchers are currently trying to create an android-based application with the hope of facilitating self-management in diabetes mellitus patients. The information obtained through the application directly will also increase patient knowledge so that this will also be able to change patient behavior during self-management. This is as explained by Orem that Self-care focuses on how to improve the client's ability to behave in ways that can affect their health. This ability is carried out by the client himself which aims to improve health status. The diabetes daily care calculator application is one of the innovations to provide sustainable health services. The integration of

technology in the care of diabetic patients has the potential to empower diabetic patients in self-care and reduce the risk of complications.

CONCLUSION

The application of the diabetes daily care calculator application is effective in improving self-management in diabetes mellitus patients. The information obtained by patients through the application increases patient knowledge, thereby increasing patient compliance in managing their disease. This application can be utilized by nurses as an extension of their hands in caring for patients at home so that the care process provided is sustainable.

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