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The Impact of Using the Le-Diabet Application on Self-Efficacy and Blood Glucose Levels in Diabetes Patients

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The Impact of Using the Le-Diabet Application on Self-Efficacy and Blood Glucose Levels in Diabetes Patients

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LE Conceptualization, Data Curation, Formal Analysis, Methodology, Validation, Visualization, Writing – Original Draft, Review & Editing; WH Conceptualization, Resources, Supervision, and Writing –Review & Editing

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ABSTRACT

Le-Diabet is an Android mobile application developed for diabetes management, and its effectiveness remains unknown. This research investigates its impact on self-efficacy and blood glucose levels in diabetes patients. Using a quasi-experimental approach, the study employed a pretest and posttest control group design. The sample involved 28 respondents in the control group and 34 respondents in the intervention group, selected through purposive sampling based on criteria such as diagnosed diabetes, smartphone usage, and six weeks of Le-Diabet application use. Self-efficacy was measured using the Diabetes Management Self-Efficacy Scale (DMSES), while blood glucose levels were monitored with a glucometer. Data analysis involved paired and unpaired T-tests. The results revealed a significant increase in self-efficacy scores by 3.1 points (P=0.000, 95% CI= -6.006 - -1.876) in the intervention group, whereas the control group experienced a decrease of 1.9 points. Both groups exhibited an increase in blood glucose levels, with a significant rise of 35.6 mg/dL (P=0.035, 95% CI= -68.578 - -2.636) in the control group and a non-significant increase of 3.59 mg/dL (P=0.076, 95% CI= -22.759 - 15.582). in the intervention group. The research concludes that the use of the Le-Diabet application enhances self-efficacy and maintains blood glucose stability, but it has not shown an impact on metabolic syndrome indicators in diabetic patients. Further research is needed, utilizing a larger and more diverse sample from various age groups, and extending the duration of the study to evaluate the long-term impact of the applied intervention.

Keywords: blood glucose, le-diabet, self-efficacy

INTRODUCTION

The prevalence of diabetes mellitus in Indonesia is estimated to continue to increase both at the national and global levels. The World Health Organization (WHO) estimates that by 2030 the number of diabetes sufferers in Indonesia will increase threefold since 2000. In 2000 there were around 8.4 million diabetes sufferers, while in 2030 the estimate will reach 21.3 million people [1]. This prediction shows a significant upward trend. The results of Basic Health Research in 2018 show that the prevalence of diabetes in Indonesia reached 8.5% [2] [3]. This shows that more than 8% of Indonesia's population suffers from diabetes. This data highlights the importance of efforts to prevent and manage diabetes in Indonesia.

The Indonesian Endocrinology Association states that there are five pillars of diabetes management, namely education, diet, physical activity, medication, and blood sugar monitoring[1]. The five pillars of diabetes management cannot be separated because they are continuous with one another. Of the five pillars, education is the key to the success of the other four pillars. Insufficient education will result in a lack of knowledge, thereby triggering a high prevalence of diabetes and high complications due to diabetes itself [4].

Diabetes is a chronic disease that needs to be controlled throughout life, so the patient's role in managing the disease is very important. The patient's ability to control and reduce the impact of the disease they suffer from affects the process and results of diabetes management [5]. This ability is known as diabetes self-care management which can help patients control blood sugar thereby reducing the risk of complications [6]. Self-care management can prevent morbidity and even death and long-term complications [7].

Many ways can be done to provide education to patients and families regarding diabetes and self-care management, namely by utilizing digital information technology which is currently

continuing to develop [8]. There are 90.54% of households in Indonesia who use cellular telephones [9]. This allows cellular phones, which are now better known as smartphones, to be used as an educational medium for diabetes sufferers [10]. There are several smartphone software that can be used as a health education medium, such as websites and mobile applications.

Several studies on mobile applications have been carried out. The research results stated that the "e-diary" mobile application was effective for use as an educational medium in increasing diabetes sufferers' diet compliance. The results of the study showed that there was an increase in the average diet compliance in diabetes patients by 0.80. The results of the Wilcoxon Rank Test analysis obtained a P-value of 0.006. This shows that implementing the mobile e-diary application is meaningful and significantly effective in increasing dietary compliance in diabetes mellitus patients [11]. This is in line with research results which state that education based on the mobile application "Teman Diabetes" has been proven to be effective and has a clinically significant positive effect on the knowledge and attitudes of diabetes sufferers [12].

The Le-Diabet application, as the latest Android-based innovation developed by researchers, stands out as distinctive software with its unique features. Integrated with a comprehensive diabetes management concept, Le-Diabet comprises five main pillars: education, dietary patterns, physical activity, self-blood glucose monitoring, and diabetes therapy. The education provided by Le-Diabet includes up-to-date information on diabetes and its management, directly linked to the website of the Ministry of Health of the Republic of Indonesia. Designed with attractive and user-friendly features, the application facilitates ease of operation for patients. Users can input their current data, and Le-Diabet provides relevant recommendations, covering aspects such as dietary needs with sample menus, physical activity, healthcare management, and required therapies [13].

Le-Diabet also offers statistical features to monitor trends in examination results, including blood glucose levels, HbA1C, blood pressure, cholesterol, and other examinations. With its alarm features, Le-Diabet assists users in remembering medication, appointment times, and other necessary tasks. With Le-Diabet, users can independently monitor their conditions, receive recommendations tailored to their health status, and acquire in-depth knowledge about diabetes [13]. Education through Le-Diabet is expected to enhance the self-efficacy of patients, aiding in achieving optimal glucose control. However, the effectiveness of implementing Le-Diabet in diabetes patients still requires further investigation. Therefore, this research aims to evaluate the extent to which Le-Diabet contributes to the improvement of self-efficacy and the management of blood glucose levels in diabetes patients.

METHODS

Research design

This study employs a quasi-experimental method with a pretest and posttest control group design approach. In the pretest phase, before the intervention is implemented, both groups, namely the intervention group and the control group, undergo measurements of relevant variables to assess their initial conditions. Subsequently, the intervention group receives the intervention, while the control group does not undergo any intervention. The posttest phase is conducted on both groups after the intervention is completed to evaluate the impact of changes that may occur due to the intervention.

Study Participants

The total sample was 62 respondents, namely the control group 28 patients, and the intervention group 34 diabetes patients. Sampling was taken using a purposive sampling technique with inclusion criteria: patients with a medical diagnosis of diabetes mellitus, owning and using a smartphone either alone or with their family, and willing to use the Le-Diabet application for 6 weeks.

Variable, Instrument and Data Collection

The measured variables involve self-efficacy and blood glucose levels before and after intervention in both the control and intervention groups. Additionally, other variables serving as indicators of metabolic syndrome are also measured, including systolic and diastolic blood pressure, blood cholesterol, uric acid, and respondent's body weight. All measurements are taken twice, both before and after the 6-week intervention period, in both the control and intervention groups.

Self-efficacy is assessed using the Indonesian version of the Diabetes Management Self-Efficacy Scale, comprising 20 items. The instrument employs a 4-point Likert scale: very incapable = 1, incapable = 2, capable = 3, and very capable = 4. Self-efficacy scores range from 20 to 60. The instrument's validity was tested on 30 respondents, yielding a Cronbach's alpha value of 0.939 (95% CI)[14].

Blood glucose and metabolic syndrome indicator measurements are conducted using peripheral blood samples after patients have fasted for a minimum of 10 hours and only consumed water before the examination. The examination tools used have consistent brands and types for all respondents, and the results are presented in mg/dL. Blood pressure is measured using an electric sphygmomanometer in mmHg, while respondents' body weight is measured using an electric scale

in kilogram (Kg). All instruments have undergone a calibration process, including instrument calibration, results calibration, and battery calibration, performed at the Laboratory of Health Polytechnic of the Ministry of Health in Bandung, Indonesia.

Data Analysis

Univariate analysis was used to analyze the average and percentage of patient age, gender, occupation, and patient nutritional status, which were presented in the frequency distribution table. Bivariate analysis was used to determine the effect of the intervention and the differences between the control and intervention groups. Before carrying out bivariate analysis, a data normality test was carried out, which resulted in normally distributed data. On this basis, the analysis was carried out using the paired and unpaired T-Test.

Ethical Clearance

This research has received approval from the Health Research Ethics Committee of Politeknik Kesehatan Kemenkes Bandung, Indonesia, with approval number No. 44/KEPK/EC/IV/2023. During the research, the researcher pays attention to the ethical principles of information to consent, respect for human rights, beneficence and non-maleficence.

RESULTS

The characteristics of respondents based on age, gender, occupation, and nutritional status were presented in Table 1. The results from Table 1 indicated that the majority of respondents in both groups were in the late elderly age category. Most respondents were female, the majority of whom

were not employed, and their nutritional status predominantly fell into the overweight and obese categories in both groups.

Table 1. Characteristics of Respondents

Variables	Control Group		Intervention Group	
	n = 28	%	n = 34	%
Age				
- Early old age	6	16.6	9	24.3
- Late old age	22	59.5	25	67.6
Gender				
- Man	5	13.5	8	21.6
- Woman	23	62.2	26	70.3
Work				
- Work	3	10.7	9	24.3
- Doesn't work	25	89.3	25	67.6
Nutritional status				
- Normal	12	42.8	16	47
- Over weight and obese	16	57.1	18	53

The effectiveness of the Le-Diabet application was measured against the respondents' self-efficacy variables and blood glucose levels. Metabolic syndrome indicators were also measured in this study, such as blood pressure, blood cholesterol, uric acid, and the respondent's body weight, which were also analyzed considering that these factors are closely related to changes in the respondent's blood glucose. All measurements were carried out twice with an interval of 6 weeks in both the

control and intervention groups. The average measurement results pre and post- intervention in the two groups can be seen in Table 2.

Table 2 indicated that at pre-intervention, it was observed that among the 7 variables investigated, only 2 variables exhibited a significant mean difference between the two groups: systolic blood pressure (P=0.015, 95% CI=3.030-27.129) and diastolic blood pressure (P=0.048, 95%CI=0.067-13.685), whereas the remaining variables: self-efficacy, blood glucose, total cholesterol, respondents' uric acid, and body weight showed no significant mean difference between the two groups. However, this pattern changed in the post-intervention data. Post-intervention data revealed alterations in the mean values of all variables in both groups. Nevertheless, only 3 variables demonstrated significant differences between the two groups: self-efficacy (P=0.000, 95% CI= -8.179 - -2.799), blood glucose (P=0.001, 95% CI=23.785-90.497), and systolic blood pressure (P=0.028, 95% CI=0.919-15.509), while the other variables showed no significant mean differences (P > 0.05).

Table 2. Description of the Mean Self-Efficacy, Blood Glucose, Blood Pressure, Cholesterol, Uric Acid, and Body Weight of Respondents in the Control and Intervention Groups Pre and Post-Intervention

Variabel	**Intervention**	**Control Group**	**Intervention Group**	**P *value***	**95% CI**	
					Lower	**Upper**
Self-efficacy	Pre	45.286	44.941	0.871	-3.902	4.591
	Post	43.393	48.882	0.000*	-8.179	-2.799
Blood Glucose	Pre	157.857	142.647	0.194	-7.999	38.420
	Post	193.464	136.324	0.001*	23.785	90.497
Systolic blood pressure	Pre	151.786	136.706	0.015*	3.030	27.129
	Post	138.714	130,500	0.028*	0.919	15.509

Diastolic blood pressure	Pre	92.464	85.588	0.048*	0.067	13.685
	Post	83.714	82.353	0.566	-3.352	6.074
Total cholesterol	Pre	213.714	201.882	0.228	-7.599	31.263
	Post	222.250	208.147	0.091	-2.325	30.531
Gout	Pre	5.879	6.359	0.309	-1.417	0.456
	Post	5.689	5.927	0.484	-0.911	0.436
Weight	Pre	59.346	61.566	0.471	-8.344	3.904
	Post	58.705	61.146	0.435	-8.651	3.770

*Significant

The effectiveness of using the Le-Diabet application on diabetes management indicators, namely self-efficacy, blood glucose, blood pressure, cholesterol, uric acid, and respondents' body weight can be seen in Table 3.

Table 3 depicted the research findings, recording the average changes before and after the intervention in both groups for all variables. In the control group, there was a decrease in the average self-efficacy by 1.9 post-intervention. Meanwhile, the intervention group exhibited a significant increase in the average self-efficacy by 3.1 after the intervention compared to before (P=0.000, 95% CI= -6.006 - -1.876).

The average blood glucose increased in both groups after the intervention. However, the increase in average blood glucose in the control group was significantly higher than in the intervention group. The control group experienced a significant increase in blood glucose by 35.6 mg/dL (P=0.035, 95% CI= -68.578 - -2.636). Meanwhile, the intervention group showed a stable increase in the average blood glucose, only by 3.59 mg/dL, and the statistical test indicated a non-significant increase (P=0.076, 95% CI= -22.759 - 15.582).

Table 3 also indicated changes in indicators of metabolic syndrome, such as systolic and diastolic blood pressure, which decreased in both groups after the intervention. Other variables, like cholesterol, uric acid, and body weight, showed changes in averages in both groups, but these changes were not significant (P > 0.05).

Table 3. Effects of Using the Le-Diabet Application

Variable		Mean	Standard deviation	P-value	95% CI Lower	95% CI Upper	N
Self Efficacy							
Control Group	Pre	45.286	9.610	0.220	-1.203	4.988	28
	Post	43.393	4.954				
Intervention Group	Pre	44.941	6.237	0.000*	-6.006	-1.876	34
	Post	48.882	5.515				
Blood Glucose							
Control Group	Pre	157.857	52.175	0.035*	-68.578	-2.636	28
	Post	193.464	81.518				
Intervention Group	Pre	142.647	34.811	0.706	-22.759	15.582	34
	Post	146.235	54.756				
Systolic blood pressure							
Control Group	Pre	151.786	23.776	0.008*	3.783	22.359	28
	Post	138.714	16.608				
Intervention Group	Pre	136.706	23.464	0.142	-2.191	14.603	34
	Post	130,500	12.066				

Diastolic blood pressure							
Control Group	Pre	92.464	14.393	0.002*	3.474	14.026	28
	Post	83.714	10.359				
Intervention Group	Pre	85.588	12.409	0.100	-0.656	7.126	34
	Post	82.353	8.198				
Total cholesterol							
Control Group	Pre	213.714	37.507	0.328	-26.132	9.060	28
	Post	222.250	33.861				
Intervention Group	Pre	201.882	38.514	0.247	-17.082	4.553	34
	Post	208.147	30.741				
Gout							
Control Group	Pre	5.879	1.864	0.504	-0.385	0.763	28
	Post	5.689	1.409				
Intervention Group	Pre	6.359	1.809	.133	-0.138	1.003	34
	Post	5.927	1.242				
Weight							
Control Group	Pre	59.346	10.307	0.174	-0.302	1.584	28
	Post	58.705	11.095				
Intervention Group	Pre	61.566	13.220	0.587	-1.138	1.979	34
	Post	61.146	12.978				

*Significant

DISCUSSION

Self-care management by utilizing digital information technology is currently continuing to develop. Technological advances support the acceleration of increasing knowledge and disseminating information, especially regarding diabetes mellitus. The use of cellular telephones, which nowadays has become a necessity in daily activities, can be used as an educational medium for diabetes patients [11].

The results of the study showed that there was a significant increase in mean self-efficacy of 3.1 in the intervention group, whereas, in the control group, there was a decrease in self-efficacy. The research results show that using the Le-Diabet application can significantly increase respondents' self-efficacy (P = 0.0005). The results of this study are in line with Marbun et al., 2012 who states that smartphone applications can influence self-efficacy in diabetes patients so that applications can facilitate the process of self-management, and treatment adherence, and increase blood glucose control in diabetes patients [14]. Self-efficacy has a positive relationship with the self-care of diabetes patients and self-care is needed to maximize diabetes self-management [15]. Self-efficacy is a person's belief in their ability to organize and carry out actions that support their health, which is very necessary for diabetes patients to increase their independence in managing their disease. [16].

Blood glucose examination is the main indicator in diabetes management. Blood glucose levels are important in monitoring the success of diabetes management. The results of the study showed that in both groups the mean blood glucose of respondents was above normal both pre and post-intervention. Post-intervention blood glucose showed results that did not match expectations, where the mean blood glucose level increased in both groups. In the control group, there was a significant mean increase of 35.6 mg/dL (P = 0.0002), and in the intervention group blood glucose was relatively stable, there was a slight increase of 3.59 mg/dL but not significant (P = 0.100).

This shows that the Le-Diabet application can be used as a diabetes education medium to facilitate independent diabetes management so that respondents' blood glucose control becomes better. The research results are in line with other research which states that Android-based applications increase knowledge about diabetes self-management so that they can help diabetes patients adhere to their therapy so that glycemic control becomes better [17].

Other metabolic syndrome indicators, such as blood pressure, total blood cholesterol, uric acid, and body weight, demonstrated non-significant changes. Effective diabetes control is not only reflected in the stability of blood glucose levels but also in maintaining blood pressure, lipid profile, and body weight within the normal range according to predefined targets [1]. Although the research results indicate changes in intervention outcomes in both groups, these changes are not statistically significant. This finding suggests that the use of the Le-Diabet application has not yet yielded a significant impact in regulating metabolic syndrome indicators. Long-term research is necessary to assess the intervention's impact on metabolic syndrome as a long-term outcome.

The respondents in this study were all elderly patients, most of them were women, almost all of them did not work, and the nutritional status of most of them fell into the overweight and obese categories. Apart from that, both respondents also had a mean of systolic and diastolic blood pressure that was higher than normal, a high mean of cholesterol, and a relatively high mean of uric acid. This data shows that respondents have high-risk factors, so efforts are needed to control glycemic and metabolic control to avoid diabetes complications. Therefore, it is important to increase knowledge and attitudes regarding diabetes, adopt a healthy lifestyle and balanced diet, exercise regularly, and avoid smoking to reduce the development of diabetes [1,18].

This study has several limitations. The limited sample size, along with a focus on the elderly in sample selection, inhibits the generalization of results to a broader population. Confounding variables such as lifestyle and adherence to medication need special attention to ensure more accurate results. Additionally, the variability in the sample's ability to use the Le-Diabet is also a crucial factor that needs to be considered. Time constraints in the study also serve as a limiting factor in evaluating the long-term impact of application usage. Therefore, this study emphasizes the importance of carefully addressing these factors to ensure more valid and applicable results.

CONCLUSION

The study concludes that the use of the Le-Diabet application in diabetic patients can improve self-efficacy and maintain blood glucose stability. However, the intervention's effect on metabolic syndrome indicators has not shown a significant impact.

RECOMMENDATION

Recommendations for future research include extending this study over a more extended period to gain a deeper understanding of the intervention's impact on metabolic syndrome indicators. Enhancing the quality of the research can be achieved by utilizing a larger and more diverse sample across various age groups. The significance of considering factors such as patients' lifestyle and medication adherence should be acknowledged and taken into account in the design of subsequent research. Additionally, attention should be given to patients' proficiency in using the Le-Diabet application as a factor that may influence intervention outcomes. Consequently, future research endeavors can provide a more comprehensive and applicable insight into the long-term effects of this intervention.

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