

**The Effect of Android-based DM Diet Education Program on Eating Behavior of DM Type 2 Patients in Bandung City Health Centres**

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Abstrak

Edukasi Diabetes Melitus (DM) adalah pendidikan, pelatihan, pengetahuan dan keterampilan dalam mengelola DM. Pendidikan memberikan manfaat penting bagi penderita DM, yaitu mendapatkan pengetahuan tentang DM, dan dapat menerapkan informasi yang diterima dengan baik dan benar. Tujuan dari penelitian ini adalah untuk menguji pengaruh program edukasi diet DM berbasis Android pada perubahan perilaku makan dan kadar glukosa darah. Desain penelitian menggunakan cluster randomized control trial dengan pre-post intervention study yang dilakukan terhadap 33 pasien kelompok intervensi dan 37 pasien DM kelompok kontrol. Proporsi subyek perempuan lebih tinggi daripada subyek laki-laki antara kelompok perlakuan. Intervensi pendidikan gizi dengan media aplikasi secara signifikan meningkatkan skor persepsi tingkat keparahan penyakit DM, ekspektasi pengobatan DM dan praktik kebiasaan makan. Namun, dibandingkan dengan konseling, peningkatan persepsi tingkat keparahan penyakit DM secara signifikan berbeda, tetapi untuk persepsi harapan pengobatan DM dan praktik kebiasaan makan tidak berbeda secara signifikan. Meskipun peningkatan skor persepsi tingkat keparahan penyakit, harapan pengobatan DM dan kebiasaan makan pada kelompok intervensi lebih tinggi daripada kelompok kontrol. Dengan demikian, penggunaan kedua metode intervensi pendidikan gizi memiliki dampak positif pada peningkatan persepsi keparahan, harapan pengobatan dan praktik kebiasaan makan pasien DM tipe 2.

Abstract

DM education is education, training, knowledge and skill in managing DM. Education provides important benefits for people with DM to get knowledge about DM and to be able to apply information that is received properly and correctly. The purpose of this study was to examine the effect of Android-based DM diet education program on changes in eating behavior and blood glucose levels. The study design used a cluster randomized control trial with a pre-post intervention study conducted on 33 DM patients in the intervention group and 37 patients in the DM control group. The proportion of female subjects was higher than male subjects in treatment groups. Nutrition education intervention with application as the media significantly increased DM disease severity perception score, expectations of DM treatment, and eating habits practice. Compared to counseling, the increase in perception of the severity of DM disease was significantly different, but for DM treatment expectation perceptions and the practice of eating habits were not significantly different. However, the DM treatment expectations, practice of eating habits, and fasting blood sugar checks in the intervention group were higher than the control group. Thus, the use of both nutritional education intervention methods has a positive impact on increasing perceptions of severity, treatment expectations, and the practice of eating habits of DM type 2 patients.

INTRODUCTION

According to the data, in 2014, there were 422 million people suffered from diabetes worldwide or the prevalence was 8.5% among adult populations (WHO, 2016). In Indonesia, the data show that there is an increase of the diabetes prevalence in Indonesia from 5.7% in 2007 to 8.5% or around 11.2 million in 2018 (Risksedas, 2018). The data of International Diabetes Federation (2015) present the prediction of the number of diabetes patients in Indonesia is around 10 million. Similar to the situation worldwide, diabetes becomes one of the highest cause of death in Indonesia. The data of Sample Registration Survey in 2014 shows that diabetes becomes the third highest cause of death in Indonesia with the percentage 6.7%, after stroke (21.1%) and heart disease (12.9%). If it is not prevented, this condition would decrease the productivity and cause disability and early death (Kemenkes, 2016).

The high number of the DM sufferers has an impact on the complication of DM. DM has two complications, including acute complication (hypoglycemia and diabetic ketoacidosis) and chronic complication (macro vascular and micro vascular diseases). The complication of DM could affect our body if the sufferers do not use a proper treatment (Sutedjo, 2010). The complication of DM could be prevented by 4 pillar of managements, including DM education, a good and balance DM diet, the use of a suitable and regular medication, and exercise (Lumenta, 2006).

DM education is an education, training, knowledge, and skill in managing and preventing DM (Waspadji, 2009). Education gives an important benefit for DM sufferer including acquiring knowledge related to DM, acquiring ability in acknowledging and facing the symptoms properly, and implementing information properly (PERKENI, 2015)

The lack of healthcare infrastructure, the lack of access to the medical experts, and the lack of electronic information systems provided are the causes of unsuccessful education of the DM sufferer (Sadowski et al. 2012). In lessening the obstacles on the healthcare access, the use of new technology, such as smartphone, gives a lot of benefits in the intervention process on the knowledge of DM sufferers (Forjuoh, 2014).

The research related to intervention of nutrition

education on the diabetes sufferer in Indonesia through the implementation of application in android-based smartphone is limited, even not existed. So far, the application in android based smartphone only explains about diabetes mellitus in general and there has not been an application that explains and manages the diabetes mellitus diet specifically. From the above situation, the researcher is interested to test the effect of DM diet education program through android based application on behavior (knowledge, behavior, and practice) and the blood glucose level of the diabetes type 2 sufferers in Bandung Health Centers. The education program of DM diet is a development of excel based education program for the nutritionist in conducting nutrition consultation. The research of the diet education program is based on android and intended for diabetes sufferers to improve their knowledge on diabetes and food management.

METHODS

The design of this study was a cluster randomized control trial with pre-post intervention study. The decision of three locations of the research was conducted randomly on 25 health centers that had prolanis program (Program of chronic disease management) from 71 existed health centers. From 25 selected health centers in the location of the research, three health centers were chosen for the research. The three of health centers were randomized to decide two centers for intervention groups and one health center as the control group.

The android based application of DM diet was implemented to the intervention group and the control group receive counselling from the researcher without the utilization of application. The research was conducted from April – July 2019 for four effective months. This research had been approved by the research ethical commission that involve human subject from the Institut Pertanian Bogor No: 134/IT3.KEPMSMIPB/SK/2018.

Number and Data Collection of Subjects

The subject of this research were diabetes type 2 patients in three health centers including Sukajadi Health Centers and Pasundan Health Centers as the in-

intervention group and Kujangsari Health Center as the control group. Meanwhile, the sample of the study were the member of prolanis program (Program of chronic disease management) and had been screened based on the inclusion and exclusion criteria. The inclusion criteria of the research including aged 40 – 85 years, owning android-based smartphone (for intervention group), and were willing to involve in the research by filling in the informed consent. The exclusion criteria are experiencing complication that have impacts on DM diet (such as kidney diseases and heart problems), following a therapy and receiving medicine from another doctor (not the health center doctor), receiving similar intervention from another research, participating in another research, and not willing to obey the research procedure. The minimum number of the subject in this research was calculated by a formula from the research of Widyastuti (2013), as follows:

$$N_c = \frac{2[Z_{1-\alpha} + Z_{1-\beta}]^2 \sigma^2}{(\mu_c - \mu_t)^2}$$

$$n_t = n_c \quad n = 2n_c$$

$$N_c = \frac{2[1.96+0.84]^2 5.21^2}{(3.79)^2}$$

$$N = 30 \approx 40$$

According to the calculation, the number of subject for each group were 30 persons. The calculation was adapted to the condition of the health center, where one prolanis activity included 40 persons.

Procedure

The subject screening was conducted in three health centers that had been decided through the cluster randomized control trial. The subjects that would fulfil the criteria were decided. The intervention stages includes pre-test (base line), intervention, and post-test (end line). In the base line stage, after the blood sample was taken, the explanation was given to the samples who were willing to join in the research. The explanation was conducted by the researcher and the doctor responsible for the health care. After explanation, interview and pre-test, by filling in the questionnaire by the sample, were conducted. The questionnaire measured the behavior with Health Belief Model method before

intervention.

The intervention stage was conducted by giving education of DM diet to the patients of diabetes type 2 patients through android based DM diet program application for intervention group and PowerPoint Presentation for control group, conducted once by the researcher. The research was helped by the health center officials (at least graduated from diploma degree). The method used in the DM diet education is direct face to face method in the Health Center hall. The technique used was lecturing and practice (for intervention group) that was conducted for 45-60 minutes and discussion for 15-25 minutes.

After a month of DM diet intervention education, the repetition of materials and practice by using application, monitoring, and evaluation of the DM diet education were conducted. The repetition and monitoring were conducted twice and at the third month, interview and post-test were conducted to measure the diabetes behavior as the last data.

Type and Data Collection Method

The primer data used in this research includes: the characteristics of the diabetes sufferers (age, sex, education, number of family member, earning, physical activity, medicine, occupation, period of living with diabetes mellitus, nutritional status/BMI). Data characteristics and behavior were collected through questionnaire and guided by the researcher and the nutritionist of the health center. Meanwhile, the fasting blood glucose level of the sample was conducted with the standardized tools and procedures in the health center laboratory in Bandung. The secondary data includes the characteristics of the health center, the number of prolanis member suffered from DM, and DM diagnosis of prolanis member.

Data Analysis

The data process and analysis were conducted by using Microsoft Excel 2013 and SPSS Version 16.0. The research variable were analyzed through descriptive analysis, normality test, independent and paired t-test. To see the influence of the DM diet education program and the level of blood glucose level of diabetes mellitus type 2 patients of each groups analyzed by using independent t-test. If the data were not distributed normally, it would be tested by using Mann Whitney

test. To find out the behavior differences and the blood glucose level of the DM patients before and after receiving DM diet program for the intervention group and for the control group was analyzed by paired t-test. If the data distribution was not normal, the data would be analyzed by Wilcoxon.

RESULT

The subject of this research were the patients in the health centers in Bandung, including Pasundan Health Center, Sukajadi Health Center, and Kujangsari Health Center.

Table 1. Distribution of Subjects based on Individual

Characteristics	Severity of DM Medication		Diet Practice
	(pre-test)	(pre-test)	(pre-test)
Sex			
Male	6.0±1.1	15.7±1.7	1.5±0.5
Female	6.2±1.6	15.6±1.3	1.6±0.5
	p=0.51, r=0.08	p=0.92, r=-0.01	p=0.3, r=-0.13
Age			
<45	7.0± -	14.0± -	2.0± -
45 - 54	7.0±0.7	16.2±1.3	1.6±0.5
55 - 64	5.8±	15.6±1.4	1.5±0.5
65 - 74	6.2±	15.7±1.6	1.7±0.5
>75	5.3±	15.5±1.4	1.3±0.5
	p=0.49, r=-0.08	p=0.94, r=-0.01	p=0.93, r=0.02
Education			
Do not Graduated from Primary School	6.0±1.0	16.3±1.5	0.3±0.6
Primary School	5.3±2.3	15.1±1.6	0.2±0.4
Junior High School	6.2±0.9	16.3±1.0	0.4±0.5
Senior High School	5.9±1.5	15.4±1.4	0.5±0.5
Higher Education	6.5±1.1	15.7±1.7	0.4±0.5
	p=0.26, r=0.14	p=0.62, r=-0.06	p=0.26, r=0.14
Activity			
Light	5.8±1.5	15.6±1.6	0.4±0.5
Moderate	6.2±1.5	15.9±1.6	0.4±0.5
Heavy	5.9±1.1	14.9±1.5	0.4±.52
	p=0.77, r=0.04	p=0.77, r=-0.04	p=0.77, r=-0.04
Occupation			
House Wife	5.9±1.6	15.8±1.4	0.4±0.5
Retirement	6.1±1.1	15.1±1.6	0.5±0.5
Private Employee	6.4±1.1	16.0±1.6	0.4±0.5
	p=0.60, r=0.06	p=0.41, r=-0.10	p=0.57, r=0.07
Income			
< Regional Minimum Income	6.0±1.4	15.6±1.5	0.4±0.5
≥ Regional Minimum Income	6.0±1.5	15.7±1.4	0.4±0.5
	p=0.96, r=0.01	p=0.84, r=0.02	p=0.69, r=0.05
Period of Suffered from DM			
<10 years	6.1±1.3	15.3±1.4	0.4±0.5
≥ 10 years	5.9±1.6	16.0±1.4	0.4±0.5
	p=0.71, r=-0.05	p=0.031, r=0.26	p=0.81, r=0.03
BMI			
Thin	5.3±3.8	15.3±0.6	- ± -
Normal	6.1±1.3	15.5±1.4	0.5±0.5
Overweight	6.0±1.4	15.9±1.4	0.3±0.5
Obese	5.9±1.1	16.0±2.0	0.8±0.5
	p=0.45, r=-0.09	p=0.28, r=0.13	p=0.49, r=0.08

¹significant if p<0.05 with Mann-Whitney test

The result of t-test shows that there is no significant differences between intervention and control group whether in the severity of the DM, the benefits of medication, and the subject diet practice for intervention and control group before intervention.

Spearman test was conducted to find out the relationship between the characteristics of the subject with the severity of DM, the benefits of medication, and diet practice before intervention. Table 2 shows that the period of the patient suffered from DM has a significant positive relationship with the medication expectancy of the subject before intervention (r=0.26, p<0.05). Sex, age, education, activity, occupation, income, and BMI did not influence the severity of DM, medication expectancy, and diet practice.

Table 3 shows the intervention of DM diet education, in general, indicates an improvement on behavior (perception of DM severity and medication benefits) from baseline to end line. The distribution of subjects related to the severity of DM when pre-test (baseline) were mostly on the medium category for intervention group (51.5%) and control group (45.9%). The result of t-test between intervention group and control group shows that there is a significant differences between pre-test score of the intervention and control group (Table 3).

Most of the subject were in the medium, high category related to DM medication expectancy perception before intervention whether for intervention group or control group (Table 4). The result of t-test in pre-test (baseline), and post-test (end line) between the intervention groups shows that nutritional education, through android application or counseling, gave a positive impact on the score of perception of medication expectancy for DM.

Perception of DM medication expectancy in the intervention group increased significantly in the end line data collection if compared to the baseline data. It shows that the repetition of exposure could give significant impacts on the higher increase. Nutritional education would be better to be conducted continuously and repetitively to have a better attitude and behavior (Khomsan et al. 2007).

Table 2. Relationship between Subject Characteristics and the Severity of DM, medication expectancy, and fasting diet practice before intervention.

Characteristics	Severity of DM	Medication Expectancy	Diet Practice
	(pre-test)	(pre-test)	(pre-test)
Sex			
Male	6.0±1.1	15.7±1.7	1.5±0.5
Female	6.2±1.6	15.6±1.3	1.6±0.5
	p=0.51, r=0.08	p=0.92, r=-0.01	p=0.3, r=-0.13
Age			
<45	7.0± -	14.0± -	2.0± -
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65 - 74	6.2±	15.7±1.6	1.7±0.5
>75	5.3±	15.5±1.4	1.3±0.5
	p=0.49, r=-0.08	p=0.94, r=-0.01	p=0.93, r=0.02
Education			
Do not Graduated from Primary School	6.0±1.0	16.3±1.5	0.3±0.6
Primary School	5.3±2.3	15.1±1.6	0.2±0.4
Junior High School	6.2±0.9	16.3±1.0	0.4±0.5
Senior High School	5.9±1.5	15.4±1.4	0.5±0.5
Higher Education	6.5±1.1	15.7±1.7	0.4±0.5
	p=0.26, r=0.14	p=0.62, r=-0.06	p=0.26, r=0.14
Activity			
Light	5.8±1.5	15.6±1.6	0.4±0.5
Moderate	6.2±1.5	15.9±1.6	0.4±0.5
Heavy	5.9±1.1	14.9±1.5	0.4±.52
	p=0.77, r=0.04	p=0.77, r=-0.04	p=0.77, r=-0.04
Occupation			
House Wife	5.9±1.6	15.8±1.4	0.4±0.5
Retirement	6.1±1.1	15.1±1.6	0.5±0.5
Private Employee	6.4±1.1	16.0±1.6	0.4±0.5
	p=0.60, r=0.06	p=0.41, r=-0.10	p=0.57, r=0.07
Income			
< Regional Minimum Income	6.0±1.4	15.6±1.5	0.4±0.5
≥ Regional Minimum Income	6.0±1.5	15.7±1.4	0.4±0.5
	p=0.96, r=0.01	p=0.84, r=0.02	p=0.69, r=0.05
Period of Suffered from DM			
<10 years	6.1±1.3	15.3±1.4	0.4±0.5
≥ 10 years	5.9±1.6	16.0±1.4	0.4±0.5
	p=0.71, r=-0.05	p=0.031, r=0.26	p=0.81, r=0.03
BMI			
Thin	5.3±3.8	15.3±0.6	- ± -
Normal	6.1±1.3	15.5±1.4	0.5±0.5
Overweight	6.0±1.4	15.9±1.4	0.3±0.5
Obese	5.9±1.1	16.0±2.0	0.8±0.5
	p=0.45, r=-0.09	p=0.28, r=0.13	p=0.49, r=0.08

¹significant if p<0.05 with Spearman test

Table 3. Subject Distribution based on severity perception of DM

Severity of DM	Intervention	Control	Total	p value
	n (%)	n (%)	n (%)	
Pre-test				
Low	2 (6.1)	6 (16.2)	8 (11.4)	0.3621
Medium	17(51.5)	17 (45.9)	34 (48.6)	
High	14(42.4)	14 (37.8)	28 (40.0)	
Score (average±SD)	6.2±1.3	5.9±1.5	6.0±1.5	
Post-test				
Low	1 (3.0)	1 (16.2)	2 (2.9)	0.0021
Medium	1(3.0)	12 (45.9)	13 (18.6)	
High	31(93.9)	24 (37.8)	55 (78.6)	
Score (average±SD)	7.6±0.8	6.9±1.1	7.2±1.0	
Delta (Post-test – Pre-test)	1.42	1	1.2	0.043
p value	0.0002	0.0002	0.0002	

¹significant if p<0.05 with t-test intervention and control group

Table 4. Distribution of Subject based on the perception

Medication Expectancy of DM	Interven-	Control	Total	p value
	n (%)	n (%)	n (%)	
Pre-test				
Low	0 (0.0)	0 (0.0)	0 (0.0)	0.0621
Medium	11(33.3)	22 (59.5)	33 (47.1)	
High	22 (66.7)	15 (40.5)	37 (52.9)	
Score (average±SD)	16.0±1.4	15.4±1.5	15.7±1.5	
Post-test				
Low	0 (0.0)	0 (0.0)	0 (0.0)	0.0051
Medium	2 (6.1)	7(18.9)	9(12.9)	
High	31 (93.9)	30(81.1)	61(87.1)	
Score (average±SD)	17.8±1.4	16.8±1.6	17.3±1.6	
Delta (Post-test – Pre-test)	1.8	1.4	1.6	0.230
p value	0.0002	0.0002	0.0002	

¹significant if p<0.05 with t-test between the intervention and control group

²significant if p<0.05 with paired t-test (Wilcoxon)

Table 5. Distribution of Subject based on Practice of

Practice of Eating Habit	Intervention	Control	Total	p value
	n (%)	n (%)	n (%)	
Pre-test				
Disobedient	17 (51.5)	24 (64.9)	41 (58.6)	0.2611
Obedient	16 (48.5)	13 (35.1)	29 (41.4)	
Score (average±SD)	0.5±0.5	0.4±0.5	0.4±0.5	
Post-test				
Disobedient	12 (36.4)	21 (56.8)	33(47.1)	0.091
Obedient	21 (63.6)	16 (43.2)	37(52.9)	
Score (average±SD)	0.6±0.5	0.4±0.5	0.5±0.5	
Delta (Post-test – Pre-test)	0.1	0	0	
p value	0.0252	0.0832	0.052	

¹significant if p<0.05 with t-test between the intervention and control group

The distribution of subject based on the practice of eating habit when pre-test (baseline) most of them were in the disobedient category on DM diet for intervention group (51.5%) and for control group (64.9%). The result of t-test for intervention and control group shows that there was no significant differences between the pre-test score of intervention group and control group (Table 5).

DISCUSSION

Most of the research subject were the diabetes patient involved in prolanis group in three health centers in Bandung. The distribution of subject related to the severity of DM in pre-test (baseline) were in the medium category for both intervention group (51.5%) and control group (45.9%). The result of t-test between intervention and control group shows that there is a significant difference between the intervention group and control group. After intervention, there is a significant knowledge improvement for both of intervention groups. There is score improvement related to perception of the DM severity for 1-1.2 points. The score of the DM severity perception in post-test is different significantly between the intervention groups. The score of improvement in perception of DM severity score, the intervention group is higher 0.2 points in comparison with the control group, with most of the subjects are in the high category (93.9%) while in the control group only 37.8% who are in the high category. The education media is a helping tool to deliver nutritional and health information easier. The media could prevent a misperception, give brief information, and easier to give understanding (Arsyad 2009; Fitriani 2011).

Similar to the DM severity perception, in general, there is a positive improvement on the DM medication expectancy from baseline to end line. However, some statements were responded by the subject inaccurately that causes the post-test score is lower than the pre-test score. One of those is the low understanding on DM medication expectancy that only through medicine, not holistically in five pillars of DM management and have boredom in doing DM diet. It might be because the subject experience a boredom in medication and have an inaccurate perception in DM medication, where the medication only relies on medicine and perceives if

medication only could heal DM totally. The low number of subject 60.6% on the subject from intervention group and 35.1% from control group who answered that medicine only could control the blood glucose level was caused by the inaccurate understanding in managing DM where the patients really rely on medication.

Most of the subjects, before intervention, were in the medium, high category for medication expectancy of DM for both intervention and control groups (Table 4). Similar to the perception of the severity of DM, the significant result of pre-test (baseline) and post-test (end line) between intervention group shows that nutrition educations, through android application media or counseling, give a positive impact on the improvement of DM medication expectancy score. However, it cannot be seen which intervention method that is better in giving contribution on the improvement of the DM medication expectancy perception. The improvement of the subject behavior related to the perception of medication expectancy shows a significant result for both intervention group. Similar to the severity perception of DM, the significant result of t-test in pre-test (baseline) and post-test (end line) between intervention groups shows that nutrition educations, through android application or counseling, give positive impacts on the improvement of score of DM medication expectancy perception. However, it cannot be seen which method that has a better contribution on the improvement of the perception of DM medication expectancy. The improvement of subject attitude related to the perception of DM medication expectancy shows significant result for both intervention groups.

The measurement of eating habit practice in post-test (end line) showed a significant improvement 0.1 point for intervention group, while for the control group did not have score improvement. The result of the t-test between intervention groups showed a significant difference between intervention groups for eating habit practice score. Although nutrition education intervention through application media gives a little better improvement compared to counseling media, but, statistically the difference was not significant ($p=0.359$). The significant difference in pre-test (baseline) and post-test (end line) between intervention group shows nutrition education through android application gave a positive impact on the improvement of eating habit practice,

while in the control group statistically did not have changes or intervention on control group did not give any influences. Although intervention method on application group give a good result, however it cannot be seen which method that give better contribution on the eating habit practice.

It is related to the statement of Andragogy behavior changes reaction caused by intervention (counseling) on adults could be assessed after one month. The changes on eating behavior is the improvement of knowledge, attitude, and practice in the diet management that is needed to control blood glucose level (Thaha 2003).

In the process of behavior changes, it should be considered that the knowledge change to attitude and to practice is not a linear line. The change of knowledge to attitude is affected by perception related to the problem and the changes. If the attitude has changed, it is the predisposition for behavior changes (Ngatimin 2005).

After intervention, there was an improvement on eating habit score for intervention group while for the control group statistically did not experience changes. This result is relevant with the research that showed intervention had a positive impact on some clinical results and self-efficacy. However, the clinical management technology should be made friendlier for the users before a larger trial phase II is conducted (Faridi et al. 2008; Quinn et al. (2008).

CONCLUSION

The nutritional education media based on application with DM diet material through health believe model successfully improved the perception score of DM severity (22.9%), perception of DM medication expectancy (11.3%), eating habit practice (20%), and the decrease of fasting blood glucose level (0.1%) from the baseline. In compare with the control group, the improvement of perception of DM severity score is different significantly. However, in the DM medication variable, the practice of eating habit, and the fasting blood glucose level check are not different significantly. Therefore, it indicates that DM diet intervention gives positive impacts on the score improvement of all research variables. The nutrition education with application media should be conducted continuously to have a

change on behavior and eating habit practice that would give benefits in controlling fasting blood glucose level of diabetes patients.

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