

Educational Model Based on Health Belief Model to Increase the Resilience of People with Type - 2 Diabetes Mellitus: An Experimental Embedded Mixed Methods Study

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Abstract Deaths from diabetes are very high in Indonesia. This shows that the resilience of people with diabetes is very low. Low resilience is a result of poor self-care behavior in people with diabetes. This study aimed to produce an educational model based on Health Belief Model, and determine the effectiveness of the educational model to increase the resilience of people with type-2 diabetes mellitus (T2DM). This study used mixed methods with an experimental embedded design. Informants in the qualitative study totaled seven people. The qualitative study was conducted to explore the health belief model as well as identify the risk and asset factors associated with the resilience of people with T2DM. The educational model designed from a qualitative study was tested on 28 respondents in Pancur Batu District, Indonesia. Before being given education, the assessments of behavioral resilience (diabetes self-care) and health resilience (HbA1c levels) were carried out. Diabetes self-care behavior was measured using the summary diabetes self-care activities (SDSCA) instrument. Diabetes self-care and HbA1c levels were measured again after three months and six months from the baseline to see the effectiveness of the educational program. The Cochran test showed that there

was a significant increase in the resilience of people with T2DM after taking the HBM-based education program ($p < 0.01$). The educational model based on HBM is effective in increasing the resilience of people with T2DM; therefore, this educational model should be applied to increase the resilience and quality of life of people with diabetes at health centers.

Keywords Educational Model, HBM, Self-Care Behavior, Diabetes Resilience

1. Introduction

Diabetes mellitus (DM) is a group of metabolic diseases characterized by increased blood glucose levels (hyperglycemia), which occur as a result of abnormalities in insulin secretion, insulin activity or both. Chronic hyperglycemia in diabetes is associated with damage, dysfunction and failure of other organs, especially the eyes, kidneys, heart, nerves and blood vessels [1].

The number of people with diabetes mellitus in the world

shows a very significant increase. In 2013, the world population aged 20 to 79 years who suffer from diabetes was 382 million; in 2015, there were 415 million; in 2017, there were 451 million; in 2019, it increased to 463 million and to 537 million in 2021 (10.5 %). It is predicted that by 2045, the world's population suffering from diabetes mellitus will increase to 783.2 million people or by 12.2 percent [2]–[5].

The prevalence of diabetes mellitus also continues to increase in Indonesia [6]. The number of Indonesian people aged 18 years and over diagnosed with diabetes mellitus in 2019 is 10.7 million people or 6.2 percent, and there are around 73.7 cases of diabetes mellitus that are not diagnosed. Currently, Indonesia ranks fifth with the largest number of people with DM in the world [5].

The Sustainable Development Goals (SDGs) are a global commitment in an effort to improve the welfare of society [7]. One of the SDGs targets in Indonesia is to reduce by one third the premature death rate due to non-communicable diseases (NCD) by 2030, through prevention and treatment, and improve mental health and well-being [8]. One of the non-communicable diseases that is a global problem today is diabetes mellitus. Diabetes mellitus is one of the ten highest causes of death in the world from 2000 to 2019. Diabetes is the ninth leading cause of death in high-income countries and sixth in middle-income countries. This shows that diabetes is a serious health problem that needs special attention [9].

The global death rate due to diabetes mellitus in 2019 is 4.2 million people and in 2021 it increases to 6.7 million people. Indonesia is in the sixth position of the country with the highest death due to diabetes in the world [4], [5]. The high death rate from diabetes in Indonesia is caused by the low ability of people with DM to manage their disease, yet if managed properly, morbidity and mortality due to diabetes can be reduced. Several studies conducted also illustrate the low level of adherence of people with DM in Indonesia in managing diabetes [10], [11].

Diabetes greatly affects the quality of human resources and has an impact on increasing health costs which is large. Health costs for people with DM in Indonesia are two times greater than those who do not have DM [4], [12].

Poor diabetes management will lead to serious complications and premature death. People with diabetes mellitus can live a healthy and long life with the application of good self-management and the support of health workers [3]. Education is a very important requirement for people with diabetes so that they can manage the conditions that arise due to diabetes [13]. In general, the purpose of the education is to assist people with DM in making decisions, self-care behaviors, problem solving and actively collaborating with health workers to improve health status, quality of life and manage effective health costs [14].

The management of diabetes mellitus requires a lifetime commitment and it is not uncommon for sufferers to feel bored, tired and hopeless. This can lead to the emergence of several psychological symptoms called diabetes burnout

syndrome. Symptoms are often characterized by non-compliance with diabetes management, ignoring blood glucose levels and diet management [15]; therefore, people with diabetes are required to be resilient in managing their disease.

Resilience is a dynamic process that involves the role of various individual and social or environmental factors that reflect a person's strength and resilience to rise from negative emotional experiences when facing difficult situations that are full of pressure or contain significant obstacles [16].

Low resilience is associated with high stress, poor quality of life and poor control of glucose levels in people with diabetes mellitus [17]. Interventions aimed at increasing resilience in people with type 2 diabetes mellitus make an important contribution in reducing the risk of diabetes complications and improving the quality of life of people with type 2 diabetes mellitus [18]. Health workers should consider interventions to increase the resilience of people with diabetes so that they can achieve controlled glycemic conditions [19].

The research results showed an increase in self-management behavior and indicators of successful diabetes control in African Americans with type-2 diabetes mellitus after being given resilience-based education [20], and there is a significant relationship between resilience and diabetes control [21]. Based on the results of this research, it is suggested that resilience be a consideration in managing diabetes.

Health workers as educators are recommended to evaluate perceptions, supporting and inhibiting factors that may be felt or experienced by people with diabetes in carrying out self-management activities [22], [23]. This opinion supports the theory of the health belief model which states that a person's health behavior is influenced by perceptions of disease threats, obstacles and benefits of behavior, self-efficacy and cues to action [24].

2. Methods

The design in this study is an experimental embedded design with an exploratory sequential strategy approach [25], [26]. Overall, this research is divided into two stages. The first stage is constructing an educational model through exploration of health beliefs dimensions in people with T2DM, while the second stage is testing the model produced in the first stage of the study. The educational model trials used a quasi-experimental method with a one group pre-test post-test design without control.

Informants in the qualitative research were six people with T2DM in Pancur Batu District and a village midwife on duty in there. The selection of informants was carried out in a *purposive way*. The development of the educational model began with exploring the health beliefs of people with T2DM. Information collected included perceived threats, perceived benefits, perceived barriers, self-efficacy,

and cues to action related to diabetes. Based on the results of the interviews obtained, then identification of the risks and assets of behavioral resilience was carried out. From these findings, the educational model was designed to increase diabetes resilience.

The number of samples in the quantitative study was calculated with a 95% confidence interval, 5% error, 90% power, and a 15% sample volume loss considered, using the following formula [27], [28].

$$n = \frac{(\sigma)^2(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

$$= \frac{(1,22)^2(1,96 + 1,28)^2}{(8,67 - 7,88)^2}$$

$$n = 25$$

$$n = \frac{n}{1 - f}$$

$$n = \frac{25}{1 - 0,15} = \frac{25}{0,85} = 30$$

It was determined that the sample allocation in this study was 30 people. The inclusion criteria were having T2DM for less than 10 years, HbA1c level > 7.5%, no serious complications such as gangrene, CHD, CRF, and being willing to take part in an educational program of eight sessions for eight weeks, and willing to be evaluated for six months. Exclusion criteria were people with T2DM who received insulin therapy. In conducting this study, there was a loss of two respondents, so the number of samples analyzed was 28 people.

Collecting quantitative research data was carried out by interviewing using a questionnaire to identify the characteristics, diabetes self-care behavior and control glycemic of respondents. Diabetes self-care behavior was measured using the summary diabetes self-care activities (SDSCA) instrument, instrument in the Indonesian version has been tested for validity and reliability and has been declared valid and reliable [29], [30]. Examination of HbA1c levels was carried out by taking blood samples through the veins of each respondent, then the blood

samples were sent to the Laboratory in Medan City. Measurements of diabetes self-care, and HbA1c level were carried out three times, at the beginning before the education program, after completing education (three months from baseline) and six months from baseline.

3. Results and Discussion

3.1. Results

3.1.1. Qualitative Study

The informants for this qualitative research were six people with T2DM in Pancur Batu District. The age of the informants ranged from 48 to 72 years, and they had T2DM for a variety of times, ranging from six months to ten years. The researcher also took an informant who works as a village midwife in Pancur Batu District who knows a lot about the health conditions and health behaviors of people with T2DM in her working area. Description of the characteristics of the informants can be seen in the following Table 1.

Table 1. Characteristics of Informants

Informan	Gende	Age	Education	Occupatio	duratio
II	Femal	48	Junior	Housewife	6

At this stage, the researchers investigated the HBM dimensions of informants who have T2DM, and confirmed the information obtained to the village midwife, then the researchers conducted content analysis and identified the risks and assets that contribute to the resilience process in people with T2DM. The following are the themes obtained from interviews with informants (Table 2).

Based on the content analysis results of HBM exploration in people with T2DM, the identified risks are lack of knowledge, diabetes burnout syndrome, and low self-efficacy. While the assets are positive perceptions about the threat of disease, positive perceptions about the benefits of health behavior, and family and social support. Based on these findings, an educational program was designed as follows (Table 3).

Table 2. Results of content analysis from HBM exploration

HBM Dimensions	Sub Theme	Theme
<i>Perceived treat</i>	- There is awareness of the threat of diabetes complications	Positive perception of the threat of disease
	- Believe that diabetes is a serious disease	
<i>Perceived benefits</i>	- Feel the benefits when maintaining a diet management	Positive perception of the benefits of implementing diabetes self-care
	- Feel the benefits when doing physical exercise regularly	
	- Do not know the benefits of physical exercise	Lack of knowledge about the benefits of diabetes management
- Do not know the benefits of IBGM		
- Do not know the benefits of foot care		
<i>Perceived barriers</i>	- Perpetrate the myth that diabetes medications can cause kidney failure	Lack of knowledge
	- Feel that doing IBMG regularly is not important	
	- Do not know how to do diabetic foot care	<i>Diabetes Burnout syndrome</i>
	- Feel that taking medicine is useless	
<i>Self Efficacy</i>	- Feel tired of taking medication continuously	Low self-efficacy
	- Unable to suppress appetite	
<i>Cues to action</i>	- Families remind to take care of diet management, taking medicine and do physical exercise	Family and social support
	- The village midwife always reminds to take regular medicine and invites the people with to do physical exercise at the health center every week	

Table 3. The Educational Program based on HBM

Time	Topic	Educator	Method/Medium
1st week	Diabetes mellitus, complication and its prevention	Community Nurse	- lecture, question and answer - Infocus, leaflet
2nd week	- Diabetes management - Diabetes Control target	Community Nurse	- lecture, question and answer - Infocus, leaflet
3rd week	Diet for diabetics	Nutritionists	- lecture, question and answer - Infocus, leaflet
4th week	Myths and facts about Diabetes	Community Nurse	- lecture, discussion - Sharing experiences - Infocus, leaflet
5th week	The importance of anti-diabetic drugs for people with	Doctor	- lecture, question and answer - infocus
6th week	Diabetes foot care	Community Nurse	- lecture, question and answer - Redemonstration - Infocus, videos
7th week	- Stress and blood glucose levels - Stress management - Stress management techniques	Community Nurse	- lecture, discussion, redemonstration
8th week	- Reflection - Review and evaluation	Community Nurse	- Discussion - Sharing experiences - Pocket book

The education program was carried out in groups at the Pancur Batu Village Hall. The duration of the program is eight weeks, consisting of eight sessions, each session lasting 90 to 120 minutes. The resource persons consisted of nutritionists, doctors at the Pancur Batu Health Center, and community nurses. The methods used in education include lectures, demonstrations, and discussions. Respondents also shared experiences, conveyed difficulties,

and motivated others.

3.1.2. Quantitative Study

Respondents in the quantitative study (stage-2) were people with DMT2 in Pancur Batu District with the following characteristics (Table 4);

Respondents who took part in the HBM-based education program totaled 28 people. The majority are female aged

46 to 65 years, high school graduates, housewives, and have suffered from diabetes for more than one year to five years. All respondents in this study had uncontrolled diabetes ($HbA1c > 7.5\%$).

The statistical test results shown in Table 5 show that there are a significant differences in dietary management,

physical exercise, Independent Blood Glucose Monitoring (IBGM), adherence to medication, and foot care ($p < 0.01$), after receiving an education there was an increase in the mean rank of diabetes self-care behavior from 1.43 to 2.79. However, after three months there was a decline again with a mean rank = 1.79 ($p < 0,01$).

Table 4. Characteristics of Respondents

Characteristics	n	Percent
Gender		
Male	10	35,7
Female	18	64,3
Age		
36-45 years	5	17,9
46-55 years	9	32,1
56-65 years	9	32,1
> 65 years	5	17,9
Occupation		
Housewife	12	42,9
Employee	3	10,7
Trader	4	7,1
Farmer	7	25,0
Civil servant	2	7,1
Duration of Suffering Diabetes		
6 months - 1 years	2	7,1
> 1- 5 years	19	67,9
>5-10 years	7	27,0
Achievement of diabetes control		
Not Achieved ($HbA1c \geq 7.5\%$)	28	100
Achieved ($HbA1c < 7.5\%$)	-	-

Table 5. Effect of Educational Model based on HBM toward Diabetes Self-care

Diabetes dimensions	self-care Measurement Time	Mean Ranking	Means	SD	p-value
Dietary Management	Baseline	1.38	18.86	8.54	<0,01
	Three months	2.70	31,32	4.65	
	3 months	1.93	24,36	7,46	
Physical Exercise	Baseline	1.52	6.07	5.08	<0,01
	Three months	2.46	11.57	3.74	
	Six months	2.02	9,25	4.73	
IBGM	Baseline	1.48	0.89	2.01	<0,01
	Three months	2.36	4.36	5,11	
	Six months	2,16	1.57	1.66	
Adherence to medication	Baseline	1.46	4.89	5,16	<0,01
	Three months	2.38	10.25	4.67	
	Six months	2,16	9.36	4.77	
Foot Care	Baseline	1.80	12.82	11.15	<0,01
	Three months	2.55	25,18	8.39	
	Six months	1.64	12,18	7.57	
Total diabetes self-care	Baseline	1.43	43,54	24,21	<0,01
	Three months	2.79	82,68	17.78	
	Six months	1.79	56,71	16,44	

P*: Friedman test

Table 6. Effect of Educational Model Based on HBM toward Diabetes Control Achieved

Diabetes Control	Not achieved		Achieved		total		<i>p -value</i>
	n	%	n	%	n	%	
Baseline	28	100.00	0	0.00	28	100.00	
Three months	20	71,43	8	28.57	28	100.00	<0,01
Six months	17	60,71	11	39,29	28	100.00	

p*: Cochran test

Before participating in the HBM-based education program, none of the respondents had achieved the target of controlling diabetes (HbA1c level <7.5%), after three months of educational intervention there were eight people who had succeeded in achieving the target of controlling diabetes, after six months (three months after the education program ended) there were eleven respondents who achieved the target of diabetes control. The results of the Cochran test showed that there were significant differences in diabetes control in T2DM patients at baseline, three months and six months with ($p < 0.01$) (Table 6).

3.2. Discussion

The results of this study are inline to studies that use educational strategies based on the results of blood glucose examinations and adjustments to management patterns for people with T2DM. This educational method had an impact on increasing self-management behavior during the evaluation in the third month, but in the sixth month of evaluation there was a decrease in self-management behavior in people with T2DM [31].

A study that reviewed several studies in the Middle East on the effectiveness of diabetes self-management education also reported that in all reviewed studies there was a significant increase in self-management behavior in people with T2DM after receiving education about self-management in T2DM [32].

Other studies in Indonesia that are similar to this study also show an increase in self-management behavior after respondents receive education. Various methods and approaches used in providing education generally provide positive results in increasing self-management behavior in people with T2DM [33]–[38], but evaluations were carried out on the effectiveness of the educational methods provided only one to three months. There has not been found a single study that reports the effectiveness of education given in the long term (more than six months).

The results of this study indicate that diabetes control continues to improve in people with T2DM. Diabetes control that continues to improve is in line with drug adherence behavior which has improved after participating in the education program [43], [44], although dietary control, physical exercise, independent blood glucose monitoring and foot care behaviors have decreased slightly in the six-month measurement.

These data show that the educational model based on

HBM has proven effective in improving diabetes control in people with T2DM. The educational program which was conducted in eight sessions for eight weeks was able to reduce the average HbA1c level by 6.83 percent in six months. In other words, it can be concluded that the educational program based on HBM is effective in increasing the health resilience of people with T2DM in Pancur Batu District.

The results of this study support the diabetes resilience model, where controlled glycemic levels (reaching the target) are the main indicator of health resilience in people with T2DM. This model states that factors related to health resilience are behavioral resilience (diabetes self care), as well as risks and assets related to the protective process of forming resilience in people with [39].

A similar study conducted in North Sumatra also showed the effect of health education on reducing HbA1c levels. The intervention of the diabetes self-management education program which was carried out for eight weeks had an effect on reducing the average HbA1c level of people with T2DM from 8.66 to 7.88 percent at the Binjai Health Center, and 8.90 percent to 8.74 percent at the Johor Health Center [40].

Research conducted in Turkey and India also stated that there was an increase in knowledge, self-efficacy and foot care behavior in people with after receiving education about diabetic foot care. Evaluations were carried out one month and three months after people with received education about foot care. However, how effective education is after six months and beyond was not reported in this study [41], [42].

4. Conclusions

Risk factors that can be an obstacle to the resilience process in people with T2DM in Pancur Batu District are lack of knowledge, low self-efficacy and diabetes burnout syndrome, while asset factors that can support the process of resilience in people with T2DM are positive perceptions of disease threats, positive perceptions about the benefits of healthy behavior, family support and health workers (village midwives).

The educational model based on HBM is an educational program that aims to increase resilience with a strategy of increasing assets (supporting factors) and reducing risk (inhibiting factors) of resilience in people with T2DM.

There was an increase in diabetes self-care (dietary management, physical exercise, IBGM, adherence to medication, and foot care) after three months of participating in an HBM-based educational program. For evaluation in the sixth month (without assistance), there was a slight decrease in dietary management, physical exercise, IBGM and foot care while drug adherence behavior was getting better. There was an increase in diabetes control in people with T2DM after participating in HBM-based educational program, both at the three-month and six-month evaluations. It is concluded that educational program can improve the resilience of people with T2DM, so that the Health officers at the Health Center are expected to periodically hold an educational program based on HBM to maintain and increase the resilience of people with T2DM.

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