

ORIGINAL ARTICLE

Improving Diabetes Condition Through Health Literacy: A Case Study From Cianjur, West Java, Indonesia

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ABSTRACT

Introduction: The global challenge in managing diabetes is the low level of patient health literacy. Health professionals have promoted the use of technology as an effort to improve patient health literacy. However, the data shows health literacy of urban area patients is higher than in rural areas. Also, many studies have focused on health literacy by using a quantitative approach and few studies have explored this issue more deeply to understand a patient's real story about health literacy after they use the diabetes application. **Method:** We conducted a qualitative approach by using in-depth interviews to assess ten patients' health literacy from one of the rural areas in Indonesia, before and after using the diabetes application. **Results:** The results showed that there was a change in the patients' habit to take care of themselves more independently through the diabetes application compared to when they were more dependent on their families before they utilized the diabetes application. **Conclusion:** This study proved that health literacy could improve by using the diabetes application for patients in rural areas.

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West Java are reported to have an increased number of diabetes patients 0.9% per year (6,7). Cianjur is one of the rural areas with the fifth most cases in the West Java region (8).

INTRODUCTION

Diabetes is still a global challenge that is difficult to overcome (1). In all countries, there is an increase in the number of people with diabetes. In developing countries, people with diabetes reach 463 million people and will continue to increase by 84% or reach 700 million people with diabetes in 2045 (2). Health costs for diabetes control are also high, estimated to account for 80% of a country's total expenditure or cost \$555.7 billion in lost national income in China, \$336.6 billion in India, \$49.2 billion in Brazil, and \$2.5 billion even in poor countries like Tanzania (3).

The same situation in the Global area, Indonesia is also facing the problem of the prevalence of diabetes which continues to increase. Until 2021, the prevalence of diabetes is 10.6% with a total of 19.47 million people (4). Currently, Indonesia places fifth position of the highest number of diabetics in the world (5). Almost all major provinces in Indonesia reported an increase in cases with diabetes during 2013-2018. The provinces which are Jakarta, Kalimantan, Gorontalo, Banten, and

Furthermore, the main source of this problem is associated with the prevalence of diabetes in rural areas increasing by 17%, higher than the incidence in urban areas (9). This condition is caused by limited health facilities in rural areas, the number of health facilities is not proportional to the volume of patients to be served, health workers are also limited, as a result diabetes cases are difficult to detect early (10). On the other hand, patients who have detected diabetes do not know diabetes self-care management, only about 50% of patients who have managed diabetes under control (11).

The challenge in the management of diabetes in rural areas is the patient's health literacy is still low (12). Health literacy is patient knowledge about diabetes and how to manage it independently. Health literacy is very critical to empower patients in diabetes self-management (13). Diabetic management activities require one's own abilities and skills in managing food, medication and physical activity to support, especially diabetic patients often hide their ignorance from other people who can help such as family,

friends, group members, or health professionals to manage diabetes self-management (14).

Various efforts have been made by healthcare professionals so that patients play an active role in self-management (15). Health professionals need to change strategies to increase diabetes health literacy through the use of technology (15,16). There are currently internet-based (mobile and web) diabetes apps available that contain a lot of important information about diabetes and how to manage it. Diabetic patients will very easily find out about their disease (17). In several studies, the use of diabetes application technology is known to have increased patient interest in managing diabetes independently (18,19). This is very encouraging because it means that the health literacy of diabetes patients has experienced a shift in a better direction. Increased health literacy can reduce the incidence of diabetes complications such as eyes, kidneys and heart which are at risk of death (20, 21).

Many technologies that continue to be developed by health professionals, diabetes applications can be accessed by rural communities in general. Demographic conditions are not a barrier to the use of technology in rural areas. Culturally, the habit of high dependence on family is shown in rural communities compared to urban communities which tend to be more independent (22). However, it has not been seen specifically how to increase knowledge in implementing diabetes self-management using diabetes applications for diabetes patients in rural areas. Therefore, this research is more suitable to measure changes in health literacy in rural areas in using diabetes applications.

Furthermore, health literacy is the optimization of the use of digital diabetes applications in glycemic control activities independently and continuously (23,24). So far, many studies have shown that the application of diabetes has a positive impact on diabetes self-management (18,19). However, it has not specifically been seen how diabetes self-management uses diabetes applications for patients in rural areas.

Many studies have focused on quantitative health literacy outcomes, but only a few studies have explored this issue with a qualitative approach (25). Only a few studies explore true stories of how they improved their health literacy after using diabetes applications. To fill this gap, we conducted this study to explore the real stories of patients about health literacy after they used the diabetes application. This study will evaluate the effectiveness of the application of diabetes on the health literacy of type 2 diabetes patients. This model can be considered to increase the health literacy of patients to create good habits for their lives and be used as a solution to change the

health literacy of patients with diabetes as part of a diabetes self-management intervention effective in the future.

MATERIALS AND METHODS

Design and Ethics

This study used a qualitative approach by Craswell (2014) with in-depth-interview to diabetes type 2 patients at one of the hospitals in Cianjur, West Java, Indonesia (26). Ethical consent of the participants for this study was provided by Dr. Hafiz (RSDH) Cianjur Hospital. Patients signed informed consent as evidence of consent to be involved in the study. We did an in-depth interview of ten participants for one hour for each person before and after they utilized the diabetes application.

Ethical Approval

The approval and ethical clearance were obtained from Health Research Commission Ethics Universitas Indonesia Maju (Reference No: 2912/Sket/Ka-Dept/RE/UIMA/XI/2022 Date: 25th November 2022).

Study Participants

The number of participants was 10 people selected with inclusion criterias such as type two diabetes patients, patients who have mobile phones, patients who can read and write and are willing to take part in this study. With this sample size, we believed it could represent the diabetic patients in this rural area. We selected participants by using purposive sampling technique (26).

Data Collection

We conducted in-depth interviews with ten participants for one hour for each person before and after they used the diabetes app. Interviews were conducted face-to-face in the outpatient polyclinic room. The interview aims to determine the literacy of diabetic patients on diabetes self-management on a daily basis before and after using the diabetes application. Then, patients are taught how to fill out and use the application. After that, our patients monitored the use of the diabetes application at home independently. One month later, the patients were re-interviewed after using the diabetes app, changing their diabetes self-management. We recorded and transcribed all the answers from the participants during the interview.

We adapted the questions of diabetes health literacy from Ankara Numune Education and Research Hospital, 2011 (27) by considering the tendency and culture of diabetes patients with type 2 in the local area. Finally, we asked 15 questions regarding health literacy for participants, for example, do you know what physical activity you can do when you have diabetes? And did you smoke before diabetes?

Data Analysis

This qualitative by using thematic analysis from Craswell (2014) with five stages (26). First step, preparing interview data. The author prepares interview data from ten respondent type 2 diabetes patients that have been recorded previously. Then, the author classifies the interview data into demographic data of type 2 diabetes sufferers such as patient identity, age, education, economic status and employment. Diabetic characteristic data such as duration of diabetes, comorbidities and HbA1C, were also grouped.

Second step, identification of thematic frameworks that generate ideas, concepts, or themes that are made. The data collected from the statements submitted by the respondents are grouped according to the emerging themes. There are three themes that emerge in this study, which are diabetes control, information, supporting and motivation.

The third step, Indexing transcripts according to the thematic framework. Any information that the patient describes is coded according to the theme during the interview.

The fourth stage, taking and synthesizing the data from the interviews, then mapping it to the characteristics of the respondents. It is easy for the writer to analyze the answers from the interviews. From each respondent's answer to the question, the authors mapped the answers and compared them between

the first answer before using the diabetes application and the second answer after using the diabetes application. The synthesis of the respondents' answers is needed by the writer in making the final conclusion.

The fifth stage, data mapping and interpretation. We analyzed interview data for three themes, which are diabetes control, information and support and motivation towards patient identity or characteristics of diabetes.

RESULTS

In-depth interviews were conducted with a total of 7 males and 3 women. Age ranged from 33-66 years. One woman was reported to have no partner, while the other 9 respondents were reported to be married. Educational background: as many as 7 junior high school people, one senior high school, and 2 university people. Of the 10 patients, a total of 7 respondents reported working full or part-time, while the rest did not work. A total of 5 respondents with low income, 3 are middle-income people and 2 are high-income people. The 10 responders' average length of time since receiving a type 2 diabetes diagnosis was 1 year. A number of health conditions have been reported to accompany diabetes such as hypertension, foot ulcers, dry skin, eye complications, nephropathy, cholesterol, and heart failure. Average HbA1c 8.9 to 10.6. Health status during hospitalization in the last 1 year due to diabetes and other treatment reported due to cholesterol and hypertension (Table I)

Table I : Distribution of Some Socio-Demographic Characteristics of Participants

Code	Sex	Age	HbA1c (gr/dl)	Educational Background	Marital Status	Working status	Economic status	Duration of Diabetes (years)	Complication of diabetes
P1	F	66	9,2	Junior High School	Widow	Non-employed	Low-income	3	hypertension, foot ulcer
P2	M	33	10,6	Junior High school	Married	Employed	Middle Income	20	Hypertension, eye complication, nephropathy, heart failure, cholesterol, dry skin, foot ulcer
P3	M	61	10,4	Junior High School	Married	Employed	Middle Income	5	Hypertension, eye complication, foot ulcer
P4	M	56	9	Junior High School	Married	Employed	Low-income	5	Hypertension, foot ulcer
P5	M	51	10,5	Senior High School	Married	Employed	Low-income	4	Hypertension, foot ulcer
P6	M	59	10,5	Senior High School	Married	Employed	Middle Income	8	Hypertension, foot ulcer
P7	F	58	9,8	Junior High school	Married	Non-Employed	Low Income	5	Non-complication

P8	F	38	9	Senior High School	Married	Non-Employed	Low-income	1	Foot ulcer
P9	M	47	8,9	University Graduate	Married	Employed	High Income	9	Hypertension
P10	M	63	8	University Graduate	Married	Employed	High Income	11	Hypertension

Table II : Code of Question and Theme

Code of Question	Theme
How do you control diabetes every day?	Controlling of diabetes
How much blood sugar should you control now?	Controlling of diabetes
What foods to eat when you have diabetes?	Controlling of diabetes
What physical activity can you do when you have diabetes?	Controlling of diabetes
Relationship between inputs, for example, insulin, BG, food, physical activity	Controlling of diabetes
What medicines of diabetes are you currently taking?	Controlling of diabetes
When you have diabetes do you change your smoking habit and drink alcohol?	Controlling of diabetes
Where did you find information about diabetes management?	Information
Monitoring diabetes with family, HCP and patient community	Supporting and motivation

Participants were interviewed in depth using prepared questions describing their knowledge of diabetes, barriers, and supports in diabetes self-management. These three characteristics became the main themes in in-depth interviews with participants before and after using the diabetes application (Table II).

Theme

Participants who were interviewed before they used the diabetes application, gave varied answers about how they carried out controlling diabetes according to their knowledge. From several respondents' answers recorded by the researcher, most of the respondents (6/10) people do not have good literacy about controlling diabetes "I did not know what diabetes is and how to control my blood glucose. There was no difference in the food and physical activity I did before and after I had diabetes. The important thing is that I regularly take medicine from my doctor and check it out at the hospital" (P1).

Another participant said that "I did not know about this disease before, it's just that I've been suffering from this disease for 20 years and it causes many other diseases in my body, and my body is weak". (P2)

When it comes to controlling diabetes when consulting a doctor, it is usually a return to usual or normal routine, they back to habits' before.

"I found out I had diabetes from the doctor, and after that, I routinely went about my daily activities by working. I still smoke and regularly use insulin when my glucose is high." (P4)

"I think there is a relationship between insulin, food, and exercise. However, because I haven't done it well, I haven't been able to prove it myself, but I have discussed it with my doctor" (P9)

"In the beginning, I managed to eat and exercise regularly, but since this disease has been around my whole life, I finally got back to my normal routine. My family, also because they are busy with their own business, is no longer involved in my diabetes care" (P7).

Participants also reasoned that especially when sick was a family matters, they helped usually.

"This is my most severe diabetes. I have a wound on my leg. I have to manage my food because I have

hypertension too. It all depends on my child who helps remind me". (P5)

The second theme that was asked of the participants was the information the participants obtained about diabetes, it has been explained that before using the diabetes application, participants explained where they got information about diabetes management. Participants whose work and work environment are limited, usually get information about diabetes from the experiences of others who they have heard of and have successfully carried out diabetes self-management, "My friend has regular treatment for his diabetes. He ate, as usual, and there was no particular sport he did. Until now, diabetes has not recurred". (P4)

Participants were informed when they consulted a doctor, "Every time I consult with HCP, there is no program for diet and exercise. I only get medication and insulin for one month". (P8)

There are also participants who believe in information that comes from the experience of family or co-workers and even neighbors who have had diabetes, "I'm too lazy to find information about my illness, but my partner has heard from other diabetic patients. I have to control my glucose every day". (P6)

Another interesting theme in the findings is motivation. Participants felt that there was a lack of motivation, the longer duration of diabetes, the lazier they were to manage the disease, because of continuous blood sugar and insulin. Participants described that the support they received from their families, HCPs, and fellow diabetics were minimal. "The last five years I had diabetes, sometimes my glucose was stable, and sometimes my glucose was unstable. I did not pay attention to my food. I also do not exercise enough". (P3)

"When there is a family event, there is no difference in what I can eat. There is no special prohibition from my family to try all the available foods". (P5)

The patient also is not confident with diabetes. They depend on their families to help remind them to do diabetes control activities. "Still not confident with this diabetes, my daughter is busy working" (P3). "I found out I had diabetes from the doctor, and after that, I routinely went about my daily activities by working. I still smoke and regularly use insulin when my glucose is high. It all depends on my child who helps remind me". (P4)

After using the diabetes application participants reported changes in their eating and exercise habits

with the help of the diabetes application. A male participant who had 20 years of diabetes felt how changes in food choices became more selective. He demonstrated his success in achieving a food calorie target of up to 1500 calories by managing good meal times.

"I followed the target written on the diabetes application. I managed to get through a month with the discipline to reach my daily calorie target to meet my caloric needs. I try to keep my blood glucose stable. Yes, by reaching my ideal calories and I walk lightly every day for 10 minutes which was heavy for me at first. The time is lower than the target that the app is showing. But I did. Now I feel less weak, my blood sugar is stable, and I can't wait to see my HbA1C and report it to the doctor". (P2)

Another participant felt that by using the diabetes application, he could make decisions for himself without bothering his family. The participant provided information that he could independently do it himself, choose food and prepare his own needs. The information she needs about what to eat and what is good for her diabetes is all in the app.

"After using this diabetes application, I began routinely checking my blood sugar before eating. After that I will choose foods that are safe for my blood sugar. The number of servings I eat is adjusted so that in one day my blood sugar remains under control. Everything is already in the diabetes application". (P4)

Participants felt that they had received the information they needed so far. Information for controlling blood glucose, proper diet, and guidelines for carrying out physical activity as needed. Participants report interest in the information displayed on the diabetes application, but there are also those who get information from family or other health workers. A patient reported positive changes in himself, his blood glucose was stable, his diet was as recommended, and his insulin was maintained. He is no longer worried about his condition.

"I do not leave important information about sports in this application. Cycling and jogging became my routine, but not for a while. Diabetes application helped me maintain my exercise routine, and I'm happy now" (P7).

Other participants had limited time consultation experience with healthcare professionals. Participants indicated medication changes in their consultation with health care professionals. Health care profession for diabetes. "See your HbA1C is stable now, what have you done?" I follow the eating guide on the application, and I target exercise every day, I follow t

he dosage". (P8)

There is a change in motivation after using the diabetes application. One participant reported how motivated he was to control diabetes. He felt encouraged to continue practicing diabetes control measures because of his success in achieving his daily targets. He is motivated to go on and, every day, trying to achieve his daily calorie goals. All recorded foods are directly fed back as calorie achievements.

"Everywhere I am at family events with a variety of foods served, and I find no difference in food for me who has diabetes. The application provides "real-time" results of my food records. It helps me to stay on top of my calorie count and I am really motivated to achieve the calories target.". (P5)

Other participants felt motivated to maintain a daily physical activity routine. The diabetes application can help participants to achieve their daily exercise goals. He can choose the type of exercise according to his needs. "I am very happy to be able to choose the physical activity according to my needs. This motivates me to keep doing it every day. I will of course take the time to reach my training target". (P3)

Changes in self-efficacy. The previous changes depended on the family, however after using the diabetes application, participants became more independent in controlling diabetes and they can change their habits quickly and independently, "I have earned my trust to regulate my own blood sugar, and my son is not worried anymore. I am more dependent on this application". (P3)

Therefore, they are more confident in making decisions about their health "I think there is a connection between insulin, food, and exercise. Now that I have done well, and I have proven it myself, I will discuss it with my doctor, now I am confident that I believe that diabetes can be controlled". (P9)

DISCUSSION

The number of cases of diabetes continues to move up and has opened an understanding that this case is a global problem that is of common concern. In particular, cases of diabetes in rural areas tend to be late detected (28). The limited access of diabetic patients to health facilities also limited their opportunities for early diagnosis of diabetes (10). Limited resources and health care professionals who are experts in diabetes, general practitioners and nutritionists, conditions that cause the limited ability to pay for health services, and especially the low level of health literacy of diabetic patients in rural areas (22, 29).

Health literacy has been described as two different sides, 'risk factor' and 'asset' (12). On one side, health literacy is considered a 'risk factor' where low health literacy is associated with poorer health outcomes. On the other hand, health literacy is considered an 'asset' where health literacy is a tool or means to empower patients and the wider community to exercise greater control over their health and over various social and environmental determinants of health. Therefore, health literacy is one of the approach strategies used by healthcare professionals to control diabetes self-management with diabetes applications (14, 29).

Health literacy is the ability of diabetic patients to get knowledge, process, and understand basic health information and services needed to make informed health decisions (24) and furthermore, health literacy is the optimization of the use of diabetes applications for independent and sustainable glycemic control (23). This study shows the main findings describing patients' dependence on diabetes management to be very high on their families, but their health literacy is also inadequate. Other factors that affect health literacy, such as age, gender, education, economic situation, and duration of diabetes are not enough to improve the health literacy of diabetes patients. This is in line with Guos' research (2020) factors like age, education, and duration of diabetes are not positively correlated with health literacy.

The findings in this study show that diabetes applications evoke the health literacy of diabetic patients. Diabetes applications have increased patient knowledge of diabetes control, blood sugar targets, insulin use, food control, and physical activity. This is in line with the study that diabetes applications designed based on the theory of health belief systems will have an impact on changing the patients' knowledge and patients' perceptions of health (30, 31).

In line with the theory of the health belief system that the efficacy of a diabetes application improves the health literacy of diabetic patients, it changes the behavior of diabetic patients, including changes in diabetes control behavior where there is a change in eating habits, changes in physical activity habits, and adherence to medications. Although this behavior changes in the long term as an interaction of the emergence of motivation and encouragement for the patients' confidence to assess and read blood sugar patterns and the achievement of daily targets in diabetes application (32, 33).

The information displayed in the diabetes application contains more displays about diabetes, raises the patient's confidence in their own abilities in controlling

diabetes, this then encourages internal motivation which is autonomously personalized and there is a continuous change in behavior to control diabetes (32, 34). This study, in line with the Information-motivation-health behavior (IBM) theory, shows that changes in health behavior are supported by (1) excellent behavioral information; (2) very driven to engage in the behavior; and (3) capable of performing the behavior (33, 35, 36). The association between all three and healthy behavior, which has been demonstrated to be a useful predictor of glycemic control, is an indication of changes in patient health literacy (37).

Another interesting finding in this study is that patient motivation is ultimately formed. The autonomic motivation shown by the patient is an internal motivation for achieving success in achieving the glycemic target, calorie target, and physical activity target. In this situation, a person will perform diabetes control tasks because of the expectations of others or targeted stimulation to the patients (38). Internalized autonomic motivation in diabetic patients and its association with health literacy. Knowledge is an important aspect of moving the ability. Increased knowledge about diabetes then increases the patient's ability to control diabetes and a strong internal drive to achieve glycemic targets (34, 38).

Finally, changes in the patients' health literacy increase the self-efficacy of diabetic patients in controlling diabetes. There is a change in habits in a positive direction, more disciplined and especially more independent. Type 2 diabetes patients are more independent in making decisions about actions for better health. This is in line with that good health literacy is a major mediator of self-efficacy that drives changes in diabetes control to be more independent (39,40).

CONCLUSION

This research is significant in that diabetes application can motivate patients to control diabetes independently. There was an improvement in patients' habits in taking care of themselves more independently through the diabetes application. In real situations, the experience gained by the patient has added to health information about diabetes, has changed the ability to control diabetes, and especially has given the patient confidence in making decisions for himself.

Limitation

This study is to analyze changes in the health literacy of type 2 diabetes patients before and after using the diabetes application. Changes in health literacy were monitored within one month. Need to be tested within three months' time.

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