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Structured educational app in improving self-care management in diabetes mellitus patients: systematic review

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ABSTRACT

Self-care management is a process that does not only develop over time but evolves along with the experience of the type of illness. Successful self-management of diabetes mellitus depends on self-care motivation and self-awareness, specifically designed to control symptoms and avoid complications. This systematic review uses telehealth intervention and smartphone-based applications for diabetes mellitus patients with randomized control trial, qualitative, and cross-sectional studies obtained from six databases. This review included inclusion and exclusion criteria established using population, intervention, comparison, outcomes and study (PICOS) framework, and then data were extracted, reviewed, and assessed using the Joanna Briggs Institute (JBI) tool. Seventeen selected articles that met the inclusion and exclusion criteria passed the selection through the selection process shown in the flow chart, which all research results show an impact on self-care management. The use of technology especially the applications, is very influential and effective in increasing knowledge and self-care management of diabetes mellitus patients. Besides that, it can also save operational costs in providing interventions for people with diabetes mellitus, but further research is needed to look at the sustainability of structured educational applications on health outcomes.

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1. INTRODUCTION

Self-care management is a process that does not only develop over time but develops in parallel with the experience of the type of illness it self and the emergence of a problem [1]. The problems that occur in the care of patients with diabetes mellitus are treated mainly by patients and their families [2]. The complication rate of people with diabetes mellitus tends to increase and worsen due to the inability of patients to manage their disease independently [3]. In addition, patients with Diabetes have a higher risk of premature death and functional disability than people who do not have diabetes [4], [5]. Therefore, reliable and valid steps are needed for self care management of diabetes mellitus [6].

Data from the International Diabetes Federation (IDF) revealed that people with diabetes mellitus worldwide were around 463 million people aged 20-79 years in 2019. It is predicted that this will increase to 700 million in 2045 [7]. In Indonesia, in 2018, the prevalence of people with diabetes mellitus increased by 8.5% of the total population of Indonesia. Cases of high blood sugar levels during pregnancy can affect about 1 in 6 pregnancies. Another worrying cause is 45% of the consistently high percentage of undiagnosed diabetics. Most of them are people with type 2 diabetes mellitus, unaware that they have diabetes. Provide

timely and appropriate care for all people with diabetes as early as possible care people with diabetes mellitus must be responsible for implementing self-care. They can be involved in making decisions for their health [8]. Self-care management of diabetes mellitus is successful depending on the motivation of care and self-awareness, specifically designed to control symptoms and avoid complications [9]. Patients with Diabetes mellitus require adequate self-control to prevent complications. Hence a structured educational application is needed so that they can effectively control diabetes mellitus through self-care management by adjusting diet patterns, physical exercise, regular monitoring of glucose levels, and management of diabetes mellitus with appropriate medicine [10].

The technological approach can be used as a public health benchmark to improve the quality of life of type 2 diabetes mellitus patients [11]. According to the findings of Mehbodniya *et al.* study, this technological approach can be used as a public health benchmark to improve the quality of life of type 2 diabetes mellitus patients. Similarly, Wang *et al.* research shows that mobile health smartphone applications support effective self-care management programs in improving patients' quality of life and self-care management behaviour [11]. According to the findings of Kumar *et al.* study's, this technological approach can be used as a public health benchmark to improve the quality of life of type 2 diabetes mellitus patients. Similarly, Wang *et al.* research shows that mobile health smartphone applications support effective self-care management programs in improving patients' quality of life and self-care management behavior [11], [12]. Structured diabetes education is also effective in increasing knowledge about the disease in adults. Integrated and intensive diabetes education is an effective method for increased knowledge and better metabolic outcomes. Patient education is considered an essential component of effective chronic disease care and health promotion [13]. Thus the mobile health smartphone application supports effective self-management programs in improving the quality of life related to health and self-management behavior in patients [14]. We looked at a systematic review of qualitative studies to see how people with diabetes use digital technologies and how their self-management strategies help them learn more about their disease, as well as a systematic quantitative review to see which self-management support interventions that use technology are effective.

2. METHOD

The literature search in this systematic review uses six central databases, including Scopus, Proquest, Science Direct, Springer Link, and SAGE. Some additional literature was obtained based on a Google Scholar search. The literature search in each database was carried out starting in early April 2022, where the keywords and subject titles used for literature searches were "mHealth", "Mobile Apps", "smartphones", "telemedicine", "self care management", and "diabetes mellitus" published in the last five years (2017-2022), full-text articles using English, and using Boolean Logic (and, or) in article search. The insertion criteria used were the population, intervention, comparison, outcomes and study (PICOS) framework as shown in Table 1, in which the population was people with diabetes mellitus. The intervention used focuses on the use of telehealth and mHealth interventions using randomized control trials (RCT), qualitative study, and cross-sectional methods. Articles without full text, abstracts, and articles that did not describe the intervention in detail were excluded from the Inclusion criteria. PRISMA 2020 literature searches were conducted using academic databases to find high-quality publications. The PRISMA 2020 statement, which supersedes the 2009 declaration, has new reporting standards that show advancements in techniques for locating, choosing, evaluating, and summarizing studies [15]. Based on the characteristics of the studies determined through the inclusion and exclusion criteria in the central database search as shown in Figure 1.

Table 1. Intervention criteria based on PICOS

No	Methods	Author
1	Social media	[16]
2	Platform aplikasi	[11], [17]-[26]
3	Call and short message (SMS)	[27]-[30]

This systematic review uses JBI tools to select articles. The JBI tools for critical appraisal aim to evaluate research methodology and identify the scope to which research has overcome potential biases in its design, implementation, and analysis [31]. The results after the JBI assessment stated that a total of seventeen articles were declared to have met the JBI critical appraisal checklist for the next stage in this systematic review. Data extraction was done using Microsoft Excel spreadsheets after doing a literature search. From the studies that were found to meet the inclusion criteria, the author's team took data on the study design, subjects, kind of intervention, inclusion of the control group, and critical study findings. Other co-authors checked the extracted data to ensure its accuracy.

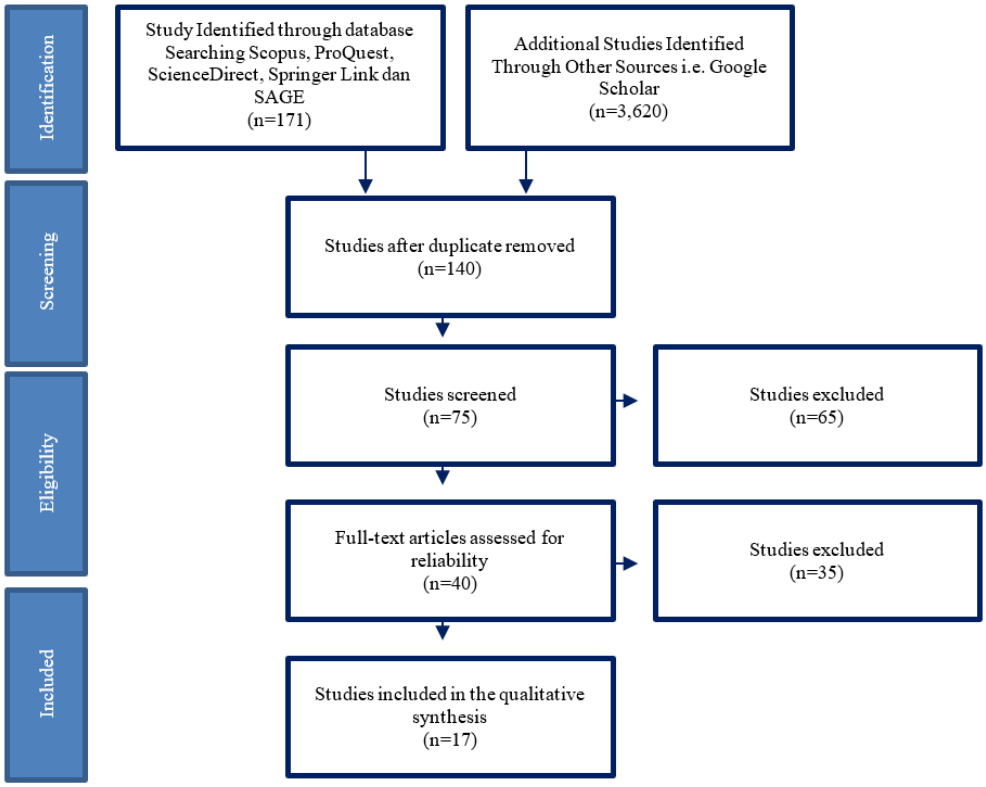

Figure 1. Flow diagram of the study selection process

3. RESULTS AND DISCUSSION

Based on the research characteristics determined based on inclusion and exclusion criteria, searches in the main database totaled 171 articles, and based on additional databases, 3,620 articles were obtained, bringing the total to 3,791 articles which were then deleted by duplication, the remaining 140 articles. A screening study was carried out based on the publication of the last five years, the type of research, and the English language required to delete 65 articles leaving 40 articles. In the next stage, sorting was carried out based on the full text of the articles. Figure 1 depicts the selection process used for the seventeen articles that met the inclusion and exclusion criteria. A more in-depth investigation would then be conducted.

Diabetes education encourages people with diabetes mellitus to take better care of themselves, which helps prevent further complications. Patients with diabetes mellitus who have self-care management knowledge can effectively manage their care. Diabetes self-management knowledge is necessary for patients because patients play an essential role in managing their disease [32]. Mobile or digital educational interventions may move nursing and care management out of hospitals and into people's daily lives. Several types of telehealth and mHealth, including social media, application platforms, SMS, and website-based internet access, were discovered from research published in several journals as shown in Table 1.

3.1. Social media

In their study, Leong *et al.* [16], the researchers made advantage of the social media platform LINE's messaging capabilities to transmit instructive movies and conduct voice, text, and video chats with patients. Patients can also access the program website by clicking one of the six icons in the menu. Patients can express inquiries using the LINE messaging tool, and pharmacists can respond by text message or phone call using social media channels. Two or three movies were sent out weekly, and treatment messages were sent out every two weeks, to patients in the intervention group, during the study's three months (or 12 weeks).

Except for those concerning treatment, all patients watched the same videos. Six nutrition care videos were scheduled over six separate weeks, along with videos on basic diabetes comprehension, daily care, and five weeks of weekly care. Each patient received a digital video disc or DVD for treatment at weeks 4, 6, 7, 11, and 12. There were supposed to be four tests at weeks 3, 6, 9, and 12. All films are accessible to patients via social media sites anytime they want. The findings showed that social media-based education

campaigns during the coronavirus disease 2019 (COVID-19) pandemic boosted patients with type 2 diabetes knowledge, attitudes, and self-care behaviors, particularly in patients with low literacy.

3.2. Application platform

Based on existing research, diabetes mellitus is one of the most expensive chronic diseases in the world [33]. Still among the top diabetes problems is diabetes prevention and improving self-management among those with the disease by addressing modifiable diabetes risks factors, such as lack of physical activity and poor dietary control, and hopefully can stop diabetes from occurring. Increase in diabetes and obesity. Some of the essential but complex parts of diabetes management for diabetes patients include adherence to the type of physical activity and dietary recommendations, as well as improving the accessibility and availability of insulin. A growing body of data shows that mobile health integration has helped address lifestyle, adherence, and self-management issues in diabetes care [34].

Self-management is critical to the proper management of the three chronic conditions. Treating obesity requires a systematic lifestyle intervention program that includes a healthy diet, regular exercise, and behavioural changes. Management of hypertension and type 2 diabetes mellitus also relies heavily on lifestyle changes and self-monitoring self-management [35]. However, in face-to-face outpatient treatment, healthcare professionals need more time to educate patients on self-management skills and motivate them to make lifestyle changes. E-Health technologies such as SMS to patients, social media or service providers, and smartphone-based applications (Apps) are being developed in the future to improve communication between patients and nurses, doctors, and other health workers [36]. The user-friendliness and mobility of mHealth technology are just two of the potential benefits of disease screening, early prediction, diagnosis, and rapid treatment, which can help to avoid the negative consequences of disease and improve cost-effective access to healthcare [37]. In addition, this technology can be a solution for patients to save money by reducing trips to visit health facilities and can lead to a decrease in overhead costs and health care administration [38].

Cell phone technology has been shown in numerous studies to improve glycemic control [39]. The development of mobile technology and a diabetes prevention smartphone app can serve as a model for translational research and implementation. According to the study's main findings, only about 16% of participants do not use the internet every day, while more than 95% use cell phones and the internet on a daily basis. As a result, most people use mobile applications to plan their meals, monitor their blood glucose levels, and communicate with health professionals [40]. As a result, younger diabetes patients are more interested in using smartphone applications and have a greater desire and confidence to use them in the future, particularly diabetes patients with higher education (graduates), who have a more positive attitude and confidence in using them. Smartphone applications and the possibility of increased use of cell phones and the internet in daily life [41], [42]. So with so many different types of applications that provide information about Diabetes, many people can access and gain knowledge about this disease. This has a significant impact on improving self-care management built by sufferers.

According to most studies on the adoption or use of app platforms, including Alqudah *et al.* [17], stated that more than 70% of women have used smartphones on their cellphones to carry out activities related to health. In this case, it also provides an explanation that 8.8% have used their smartphones in their diabetes or health management activities and interestingly, more than 40% of women are waiting to record results after checking their blood sugar levels. It is estimated that between 78% and 90% of women feel they can operate a smartphone in their health management during pregnancy. The study of Gonzalez-Sanchez *et al.* [18] stated that the use of smartphone applications is less visible if only done for a short time on the cardiovascular risk (CVR) but provides suggestions to be tested on other substances, such as hypertension or diabetes. According to research by Zhang *et al.* [22], patients in the application interactive management group had significantly lower HbA1c levels at six months than those in the application self-management group. Based on other studies reviewed, there were also less significant changes in the application use group. Still, it states a slight difference from the update or improvement achieved, even if not widely visible.

Content from several android applications was developed to provide feedback, collect participant lifestyle data and information about health, and improve adherence to their medication. An android application has four functions: sports evaluation, nutritional care, blood pressure monitoring, self-glucose levels, and monitoring of health levels. Items of nutritional care in the application are total calorie calculations and macronutrient ratios that can be recommended to each user. Users can take advantage of built-in voice recognition technology to record their food intake using the keyboard or voice on a smartphone. By analyzing food intake records, the app can estimate an intake of 14 nutrients (total calories, sodium, protein, fat, carbohydrates, phosphorus, potassium, iron, vitamin A, riboflavin, thiamine, vitamin C, calcium, and niacin) and report whether of one of these points has been fulfilled or needs to be improved, even more than what is needed. Users can also note the type and duration of exercise using the exercise evaluation feature on the smartphone application, then calculate the total calorie consumption and create and

provide a report to the user. Applications can make and record blood pressure through data input, and even developers can receive blood pressure reports via the Bluetooth feature, making it easy for users to view graphs of their blood pressure records. The app's health monitoring feature provides visual feedback on the user's health by providing trending graphs for weight, blood pressure, glucose, and calorie consumption [20], [22], [26], [39], [43]–[45].

Smartphone applications that contain self-management and diabetes management are widely available in major app stores, namely, the Apple App Store or Google Play, and can be downloaded publicly [46], [47]. Furthermore, several applications are available, such as a system based on collecting health data, an information system in clinical decision-making, and a system to help improve medication adherence [48]. mHealth interventions can benefit the treatment and management of diabetes [49]. Also, there is strong evidence of the efficacy of the application for lifestyle modification of patients with type 2 diabetes mellitus [50] and self-administration in improving health status [44]. The application is considered effective in increasing medication adherence in patients, including patients with various conditions, namely human immunodeficiency virus (HIV), hypertension, asthma, and heart failure [45]; medication adherence such as in patients with Parkinson's disease, depression, cardiovascular disease, multimorbidity, and hypertension [51] or older adults with coronary heart disease [52]; and essential hypertension [43]. However, several recent assessments assess individual treatment adherence in patients with diabetes [24], [53].

But at this time, E-Health, especially mHealth, has yet to be widely adopted even though it has the potential for positive effects and increasing interest [54]. One crucial factor that contributes significantly to the successful completion of mHealth therapy is the patient's positive attitude towards adoption; however, there needs to be a significant knowledge gap regarding patient attitudes in this area [55]. In a review of the literature and studies looking at cellular health, there is much hope for encouraging self-management in people with chronic diseases. By working with IT professionals, the next writer wants to make an application that fits the needs and difficulties and is easy for patients to understand.

3.3. Call and short message (SMS)

Where there is sufficient opportunity and willingness to receive mobile-based health services, especially those based on short messages, significant factors include educational status, transportation mechanisms, treatment routes, service time, use of cell phones as appointment reminders, and cell phone password locks. The mHealth intervention is potentially beneficial, considering the high percentage of patients who have access and are willing to take advantage of short message-based health services [27]. A text message package distributed for three to nine months in addition to the standard of care was the intervention planned for almost all of the studies' intervention groups. Regarding diabetes self-management and lifestyle behaviors, text messages offer advice, motivation, support, and reminders. Standard care was given to the control group. A customized automated content management system was used to send messages. Studies' findings ranged widely, showing significant improvements in foot care practices [28], changes in body mass index (BMI) and hemoglobin A1c (HbA1c) [29], willingness to receive mobile-based diabetes health services [27], and based on Chen *et al.* study [30] can improve adherence, knowledge of, and satisfaction with, care. To increase compliance, more measures are required.

4. CONCLUSION

Our findings in this study are that the use of digital media or technology, especially the use of applications, is very influential and effective in increasing knowledge and self-care management of patients with Diabetes mellitus while also saving operational costs in providing interventions for people with Diabetes mellitus. We can provide recommendations for the use of digital technology in providing interventions for diabetes mellitus patients. Further research and development of structured educational applications are needed to see effectiveness at a deep level.

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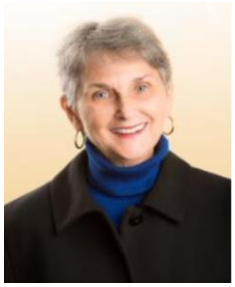

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