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THE IMPACT OF MOBILE HEALTH ON HEALTHY LIFESTYLE COMPLIANCE AND QUALITY OF LIFE OF DIABETES MELLITUS PATIENTS: A SCOPING REVIEW

Pengaruh Mobile health Terhadap Kepatuhan Gaya Hidup Sehat dan Kualitas Hidup Pasien Diabetes Mellitus: A Scoping Review

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ABSTRACT
Compliance with a healthy lifestyle and improving the quality of life of patients can be done through education with mobile health to prevent long-term complications in Diabetes Mellitus (DM) patients. Aims of the research this is to know the impact of mobile health on healthy lifestyle compliance and the quality of life of DM patients. In this research, these are PubMed, CINAHL, and Scopus. The search review uses the keywords "Diabetes Mellitus," "Mobile Health," "Healthy Lifestyle Compliance," and "Quality of Life" in the articles. Based on the results, 12 out of 305 articles were identified as feasible. Analysis showed that mobile health can be used for improving healthy lifestyle compliance, and improving the quality of life among DM patients. The time DM patients used mobile health application for education varies greatly. Mobile health has great potential to help improve compliance with lifestyle health, and quality of life for DM patients.

Keywords: *Diabetes Mellitus, Mobile Health, Healthy Lifestyle Compliance, Quality of Life.*

ABSTRAK
Kepatuhan terhadap gaya hidup sehat dan peningkatan kualitas hidup pasien dapat dilakukan dengan edukasi dengan mobile heath untuk mencehah komplikasi jangka panjang pada pasien Diabetes Melitus (DM). Tujuan penelitian ini adalah untuk mengetahui dampak aplikasi *mobile health* terhadap kepatuhan gaya hidup sehat dan kualitas hidup pasien DM. Sumber data dalam penelitian ini adalah PubMed, CINAHL, dan Scopus. Pencarian literature menggunakan kata kunci "Diabetes Melitus," "*Mobile Health*," "Kepatuhan Gaya Hidup Sehat," dan "Kualitas Hidup" dalam artikel. Berdasarkan hasil, 12 dari 305 artikel teridentifikasi layak. Analisis menunjukkan bahwa aplikasi *mobile health* dapat digunakan untuk meningkatkan kepatuhan gaya hidup sehat dan meningkatkan kualitas hidup pasien DM. Lama penggunaan aplikasi *mobile health* pasien DM untuk edukasi sangat bervariasi. Aplikasi *mobile health* memiliki potensi besar untuk membantu meningkatkan kepatuhan terhadap gaya hidup sehat dan kualitas hidup pasien DM.

Kata Kunci: *Diabetes Melitus, Mobile Health, Kepatuhan Gaya Hidup Sehat, Kualitas Hidup*.

INTRODUCTION

Diabetes Mellitus (DM) is a major cause of death and disability in more than 500 million people worldwide (Belsti et al., 2020). DM is a leading factor for stroke, cardiovascular disease, heart failure, chronic

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kidney disease, neuropathy, blindness, disability, and limb amputation (Soyoye et al., 2021). The International Diabetes Federation (IDF) reports that 537 million adults, or 1 in 10 people, live with DM, and that DM causes 6.7 million deaths, equivalent to 1 death every 5 seconds worldwide (Cho, 2017). In 2021, there were 536.6 million cases of diabetes mellitus (DM) among people aged 20 to 70. By 2030, this number is expected to rise to 642.8 million (Yao et al., 2023). Indonesia ranks fifth, with 19.47 million people affected and a prevalence rate of 10.6 percent (Rahman et al., 2017). Most cases of DM worldwide, about 90% to 95%, are Type-2 Diabetes Mellitus (T2DM) (Li et al., 2022).

Prevention risk factors the occurrence of DM is actions that must be taken carried out by officers health (Budreviciute et al., 2020). Healthy Lifestyle Compliance are very important for DM patients to prevent complications, improve their quality of life, and improve their psychosocial status (Trombini et al., 2024),(Santosa, Nambiar, & Abdullah, 2024). DM patients must comply with good treatment to ensure good glycemic control and quality of life (Nabovati et al., 2023). Patients with diabetes mellitus are advised to consistently adhere to healthy lifestyle practices. These include maintaining optimal blood glucose control, increasing physical activity, managing stress, following a balanced diet, abstaining from smoking, and performing regular diabetic foot care. (Lael Monfared et al., 2020). The high prevalence of DM is very important in increasing the quality life patients. Inexpensive and practical self-management methods should be developed for DM patients (Masupe et al., 2022).

Mobile health can help DM patients who experience time constraints in obtaining information in their daily lives (Doupis et al., 2020). Mobile health can not only be used to improve adherence increase style life healthy , but also reduces the number of visits to health services (Kiyarosta et al., 2020). Mobile health- based applications provide good benefits for educating DM patients about their condition and allowing them to monitor their blood glucose independently so that quality life patient increase (Kshanti et al., 2021). However, most DM patients experience difficulties in using mobile health due to their advanced age, visual impairment, and unfamiliarity with this technology (Bopape et al., 2020). A 2019 survey in China across 30 provinces showed that about 10% of DM patients use mobile health applications. Number this mobile health user very low (Zhang et al., 2019).

Health workers face a challenge in handling DM patients because the number keeps increasing every day (Bukhsh et al., 2020). There are still many gaps in the review of literature related to mobile health, in compliance with the increasing healthy lifestyle compliance (Kurnia et al., 2024). With several disadvantages and benefits, mobile health can be utilized in a way to maximize increase quality of life of DM patients (Karingga et al., 2023). To reach the objective then we intend to identify the impact of mobile health on healthy lifestyle compliance and the quality of life of diabetes mellitus patients.

MATERIALS AND METHODS

Study Design

This study uses the scoping review method. Scoping reviews produce good information with a wide reach and carry out a comprehensive quality assessment to achieve the research objectives (Mak & Thomas, 2022). PRISMA extension with scoping review (PRISMA-ScR) is used to identify various articles that discuss the impact of mobile health on healthy lifestyle compliance and quality of life of diabetes mellitus patients (Tricco et al., 2018),(Page et al., 2021).

There are seven stages of article review: formulating research questions, identifying keywords in article searches, identifying relevant sources, article search strategies, article extraction, article mapping, and reporting research results (Bradbury-Jones et al., 2022).

Search Strategy

Literature review search using electronic data includes: CINAHL, Scopus, and Pubmed. The selection of article data consists of inclusion and exclusion criteria con-

sisting of checking for duplicate articles, filtering exclusion articles based on titles that are excluded for deletion, researchers exclude patients other than T2DM, self-care intervention, original research, articles are assessed according to their eligibility, study results are displayed in the review, and selected articles in the English version. The hyphen used to search for articles uses 'AND' and 'OR'. The search keywords for the article are 'Diabetes Mellitus', 'Mobile Health ', ' Healthy Lifestyle Compliance ', 'Quality of Life '.

Study Selection

The selection of research articles was conducted independently. Researchers reviewed and screened articles sourced from the CINAHL, Scopus, and PubMed databases. The literature review results were compiled using a reference management tool to ensure efficient data handling. Researchers assessed and verified the remaining articles separately after removing duplicate entries using Mendeley. Researchers initially screened articles by evaluating their relevance to the title. Articles that did not meet the title criteria were excluded at this stage. A reference management application was used to document articles that met the title, abstract, and full-text requirements. Before full-text entries were entered into the data extraction table, all researchers evaluated their methodological integrity. Researchers compiled relevant articles, including information such as author names, year of publication, study location, methodology, sample size, design, mobile health education on healthy lifestyle adherence, quality of life in DM patients, and study outcomes.

Literature Identification and Mapping

This study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). Systematic search using PRISMA, Literature review to determine the findings of articles that are appropriate to the systematic purpose of the literature (Page et al., 2021). The tool used to conduct a critical articles is the Joanna Briggs Institute (JBI) to assess the quality of the article. To assess the quality of the article, the minimum score is 75% calculated from all statements (Penedones et al., 2019).

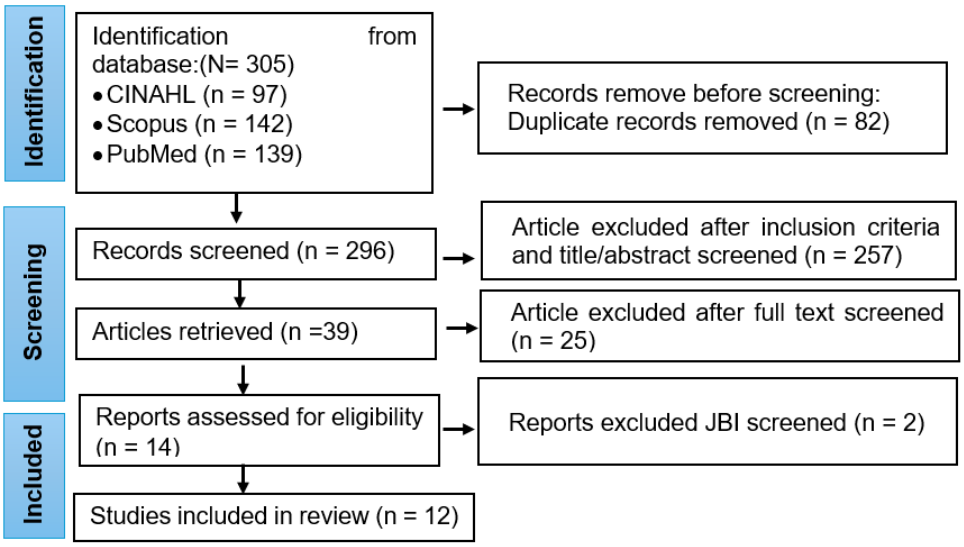


Figure 1. Prisma Flowchart

Table 1. JBI Critical Appraisal Result

Author, Year	Design	JBI Critical Appraisal
Yasmin, 2020	RCT	12/13 (92%)
Yu et al, 2020	RCT	12/13 (84%)
Turkan, 2020	Quasi-Experimental	8/9 (88%)

Author, Year	Design	JBI Critical Appraisal
Zhai Yang Kui, 2019	RCT	11/13 (84%)
Gosak, 2021	RCT	10/13 (77%)
Kusnanto, 2019	RCT	10/13 (77%)
Guo mengna, 2021	RCT	12/13 (92%)
Kym, 2019	RCT	13 /13 (100%)
Amir S, 2018	RCT	12/13 (92%)
Pamungkas Rian Adi, 2022	RCT	12/13 (92%)
Owolabi, 2020	RCT	11/13 (84%)
Lipilekha Patnaik, 2021	RCT	11/13 (84%)

RESULT AND DISCUSSION

Result

There is a number of educational programs using mobile health to increase healthy lifestyle adherence and improve quality of life in DM patients. Researchers do data extraction when all data meet condition appropriate conditions for classification to avoid risk of bias. The data used for extraction includes author and year, sample size, design, country, type of mobile health, and research results.

Table II: Results of Systematic Review

No	Author and year	Sample size	Design	Country	Type of Smartphone Application	Result
1	[(Yasmin et al., 2020)]	320 T2DM patients consisting of 160 patients in the intervention group and 160 patients in the control group were treated as outpatients at the Bangladesh Institute of Health Sciences Hospital, India.	RCT	India	Mobile health education via telephone in the form of a reminder system through interactive voice calls and reminder calls and call center services within 24 hours/week. Education consists of medication, diet, physical exercise, hospital visits, and other lifestyle modification actions such as stopping using tobacco and betel nuts.	Healthy lifestyle compliance improves with mobile health education, such as diet, with a P-value < 0.001. Tobacco and betel nut use decreased from 24% to 8%, with a P-value < 0.001. Physical activity increased with a P-value < 0.001. Blood glucose control compliance also improved, with a P-value < 0.001. Patients with T2DM show improved quality of life after receiving education through health reminders on a mobile phone.
2	[(Yu et al., 2020)]	97 T2DM patients who were treated as outpatients at Tzu Chi Hospital, Hualien, Taiwan.	RCT	Taiwan	MHealth Intervention Intergenerational Mobile Technology Opportunities Program (IMTOP apps) on diabetes mellitus education, recorder, medication reminder, and self-management of T2DM.	Improving healthy lifestyle compliance within 4 months and 8 months follow-up, namely compliance Diet 1.78-2.64, P-value < 0.0001. Exercise compliance 0.14-1.22, P-value < 0.05. Decline in consumption of cigarettes -0.76-0.13, P-value 0.01. Blood glucose control 0.75-1.76, P-value 0.0001. Use of technology mobile

No	Author and year	Sample size	Design	Country	Type of Smartphone Application	Result
						IMTOP increases the quality of life of T2DM elderly, and an intergenerational training program is a component innovative yet has been done previously.
3	[(Corbett, 2022)]	101 T2DM patients at FHC Istanbul, Türkiye with 50 intervention groups and 51 control groups.	Quasy Experimental	Turki	Diabetes education SMS reminders in the form of educational messages about a controlled diet, drinking enough, physical activity for 30 minutes, controlling blood sugar, avoiding smoking, and staying away from places full of cigarette smoke.	Significantly, educational SMS reminders can control style life health, which includes HbA1c P-value 0.001, control BMI P-value 0.001. As results from a meta-analysis that assessed the effect of SMS intervention on the control of glycemia in DM patients. This increases their quality of life and reduces risk complications.
4	[(Zhai & Yu, 2020)]	120 T2DM patients consisting of 60 intervention groups and 60 control groups at Tianjing Central Hospital China.	RCT	China	The Mobile App Education developed by Beijing Aihe Health Technology includes reading blood glucose values, self-management support such as diet, emotion management, appropriate medication guidance, and routine care combination education.	Increased healthy lifestyle compliance, Healthy after six months obtained results: dietary compliance 13.41 ± 3.15, medication compliance 24.51 ± 2.87, blood sugar monitoring 14.01 ± 3.24, physical activity 14.11 ± 3.67, foot care 22.26 ± 2.57, and lifestyle compliance life in a way overall P-Value < 0.05. Education through mobile applications improves trust self patients and the skills they need to handle diabetes complications and events dangerous, which can prevent complications and increase quality of life.
5	[(Gosak et al., 2022)]	380 T2DM patients treated in family medicine practices in Slovenia.	RCT	Slovenia	Using Android and iOS phones with education about healthy lifestyle compliance, including physical activity, diet, medication, and blood glucose meters during the study period.	Android and iOS apps play a role in improving healthy lifestyle compliance in T2DM patients, patient knowledge, increased awareness of weight loss, and increased quality of life.

No	Author and year	Sample size	Design	Country	Type of Smartphone Application	Result
6	[(Kusnanto et al., 2019)]	30 T2DM patients in primary health care in Bali, Indonesia	RCT	Indonesia	DM-Calender Android-based intervention app used for diabetes self-management education installed on respondents' mobile phones contains nutritional therapy, physical activity, blood sugar control, and diabetes mellitus education programs.	The DM-Calender App can influence the adherence to a healthy lifestyle, including glycemic control, physical activity, and diet, with a P-Value <0.001. The study's results show that the DM Calendar App is essential for DM sufferers because it can increase quality of life.
7	[(Guo et al., 2023)]	68 T2DM respondents were divided into an intervention group consisting of 34 respondents and a control group consisting of 34 respondents	RCT	China	The mHealth application consists of a platform of four functional modules that include diabetes mellitus health information, blood sugar control education, communication with doctors regarding patient health, and diabetes mellitus intervention programs.	mHealth management shows increased healthy lifestyle compliance, namely diet P-value 0.021, Exercise P-value 0.001, Blood glucose monitoring P-value 0.001, Foot care P-value 0.001, and reducing consumption of cigarettes P-value 0.001. There is a relationship using the mHealth Application to quality of life for patients with P-value 0.001.
8	[(Kim et al., 2019)]	172 T2DM patients consisting of 90 intervention groups and 82 control groups	RCT	Korea	Mobile Diabetes (mDiabetes) contains modules for monitoring blood glucose, diet, physical activity, and clinical decision support systems.	There was an increase in healthy lifestyle compliance including: diet, exercise, and glucose monitoring. After 24 weeks of intervention, mDiabetes patients significantly increased their quality of life overall compared to the group with their initial condition, according to the WHOQOL-BREF score.
9	[(Sarayani et al., 2018)]	100 T2DM patients who were treated as outpatients in Tehran, Iran	RCT	Iran	Telephone-based intervention on self-care, diabetes mellitus treatment, HbA1c, and lipid levels.	Improving healthy lifestyle compliance, which includes diet compliance, exercise, glucose monitoring, foot care, and smoking with a P-Value < 0.01, so that T2DM patients experience improvement in quality of life.

No	Author and year	Sample size	Design	Country	Type of Smartphone Application	Result
10	[(Pamungkas et al., 2022)]	60 DM patients were divided into 30 intervention groups and 30 control groups at a community health center.	RCT	Indonesia	Smartphone applications are provided to T2DM patients regarding diabetes mellitus updates, diet control, foot care, physical activity, medication, blood sugar level monitoring, and online consultation.	After health education intervention, there was a relationship between dietary control SD±8.83, P-value 0.000. Physical activity SD±6.87, P-value 0.000. Medication adherence SD±4.97, P-value 0.000. SMBG SD±10.23, P-value 0.000, and DM complication screening SD±6.27, P-value 0.000. Consistent mobile health education can improve patients' health and quality of life.
11	[(Owolabi et al., 2020)]	216 DM patients in Buffalo City Metropolitan Municipality and Amathole Health District, South Africa.	RCT	South Africa	Mobile phone text messaging interventions include reminders, motivational messages, support, lifestyle behaviors such as physical activity, diet, medication, smoking cessation, alarms, and blood sugar control.	There is increased compliance with diet 1.52±1.62 and physical activity 1.48±1.58 were not too large from baseline to the follow-up period. Significant increase in adherence in treatment after using mobile phone text 6.90 (SD±1.34), P-Value 0.02. DM disease increases the burden for patients, reducing their quality of life related to health they. Intervention via SMS has proven effective in increasing the quality of life patients.
12	[(Patnaik et al., 2021)]	66 T2DM patients were divided into two groups, namely the intervention group of 33 patients and the control group of 33 patients.	RCT	India	Mobile health contains education about blood glucose control, physical activity, quality of life motivation, diet, problem-solving skills, and the importance of using health services.	After being given mobile health education, there was an increase in the average diet score of 1.91±0.63 and compliance. treatment 12.94±2.9. The overall quality of life of T2DM patients increased by 70.26±16.51.

Discussion

Research results show increased adherence to a healthy lifestyle. Using mobile health technology has been significantly helpful in managing disease in the modern era (Tang et al., 2023). With mobile health technology, T2DM patients can independently monitor their condition at home, receive medication reminders, receive health information anywhere, and stay

connected with medical professionals (Santosa., 2024).

The research results show that patients with DM may benefit from improved healthy lifestyle compliance through mobile health education. Existence healthy practices include blood glucose regulation, diet motivation, physical exercise, medication adherence, foot care, and cigarette cessation. Patients with DM may experience fewer problems and have a higher quality of life as a result. According to the aforementioned research, by lowering the frequency of hospital stays, mobile health can lower healthcare expenses for individuals with DM.

In the healthcare sector, the impact of mobile health in lifestyle compliance management life healthy increasingly attracting attention, especially due to the rapid development of digital technology (Shahmoradi et al., 2022),(Santosa, 2024).

Many mobile health apps offer community or social support features where patients can interact with other T2DM sufferers (Ahmed, 2019). Mobile health apps allow patients to share experiences and encourage each other through forums or support groups (Tan et al., 2022). Apps also often include gamification or reward features to encourage patients to adopt a healthy lifestyle and be disciplined in managing their diabetes (Forsyth et al., 2021).

Regular blood sugar monitoring is an important part of T2DM management (Belete et al., 2023). The mobile health SMART Finder is easier and more effective, allowing patients to record and monitor their daily glucose measurements (Mueller et al., 2023). Patients can identify blood sugar changes that may require additional medical care through lifestyle-based mobile health features (Umar et al., 2024). The mobile health Smart Glucose Manager can improve DM self-management and demonstrate long-term improvements in increasing compliance of patients in undergoing during sick in Sri Lanka (Gunawardena et al., 2019).

Mobile health serves as an educational resource for DM patients. This application offers advice on a healthy lifestyle, such as a healthy diet, the importance of physical activity, and how to properly manage stress (Crespo et al., 2020). Mobile health application education influences improvements. style life healthy T2DM patients, such as FBS control, physical activity, and diet with P-value < 0.001 and HbA1C reduction < 7% with P-value < 0.001 (Chai et al., 2022).

T2DM patients can make better decisions about managing their condition by receiving accurate and reliable education through the Diabetes Self-Management Behaviors among older adults (DSMB-O) application (Ji et al., 2024). Participating in physical activity and controlling diet are very important for T2DM patients to improve the quality of life (Zheng et al., 2019). Compliance with doing physical activity for 30-45 minutes every day can reduce HbA1C and blood sugar levels (Kato et al., 2020). After 24 weeks, the novel smartphone game significantly increased self-care daily physical activity by an average of 3,998 (SD 1,293), and can improve the quality of life. life with a P-value <0.001 (Königstein et al., 2020).

Several smartphone apps can monitor food types, meal times, calorie intake, and medication reminders (AlShayban et al., 2020). By recording the types of food they consume and calculating the amount of carbohydrates contained in them, patients can adjust their food consumption according to the needs of their T2DM body (Benrazavy & Ali, 2019). Mobile health can help patients plan and track their step count and provide them with reminders to stay active (Yee et al., 2020).

Mobile health has a reminder feature that is very helpful for diabetes mellitus patients to improve their health. compliance in taking their medication according to the prescribed dosage (Duffy et al., 2020). The DM app can remind patients about doctor's appointments and foot care reminders (Dwi Yuni Lestari et al., 2024). With app reminders, patients become more prepared to live their lives and help increase the quality of life (Xiao et al., 2024).

Through mobile health, patients can communicate directly with medical personnel, such as doctors or nutritionists, through messaging or online consultations (Yang et al., 2020). Mobile health applications can help patients receive medical care more quickly and tailored to their needs (Putri et al., 2022).

Patients can monitor their health independently, such as blood glucose, weight, and increase knowledge about diabetes mellitus, and other health issues over time through mobile health (Kir'APP) (Kabeza et al., 2019). Some applications allow the connection of medical devices, such as digital glucometers to the application (Saidi et al., 2023). Mobile health can measure the patient's blood sugar level and directly send the data to the application, which can then be analyzed to provide feedback on trends or changes that need to be considered by the patient (Trombini et al., 2024).

Mobile health allows medical professionals to monitor a patient's health status remotely, allowing for more effective monitoring without having to visit the patient in person (Fisher et al., 2024). Medical professionals can provide feedback to patients connected to this system on what to do based on the data they send through the app (Karim et al., 2024).

Implications For Multidisciplinary Practice and Future Research

This study provides important insights into the potential of mobile health to improve healthy lifestyle adherence, quality of life, and clinical decision-making in DM patients. Further research is needed to develop and implement mobile health interventions that are efficient, affordable, and accessible to all patients.

Strengths and Limitations

Mobile health is a relevant issue in today's digital era and can help improve compliance change style a better life good and quality Life expectancy in DM patients . A scoping review approach provides an overview of previous studies, including application features and relevant research findings. A limitation of the study is the lack of direct empirical data from application users, thus limiting the subjective evaluation of user experience.

CONCLUSION

Mobile health can play a significant role in improving healthy lifestyle adherence for a better life. Mobile health is used for blood glucose monitoring, education, weight management, increased physical activity, medication adherence, and medical consultations, all of which improve the quality of life patients. When used in conjunction with conventional health interventions, T2DM disease management can be more effective, helping patients manage their condition in a more structured and independent manner. While there are a number of challenges to overcome, the use of mobile health as a tool in diabetes management has great potential to improve the quality of life patients and reduce the risk of long-term complications. Further research is needed to determine the long-term effectiveness of these applications and to develop more user-friendly applications.

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