

REVIEW ARTICLE

Internet-Based Self-Care Monitoring Among Diabetes Mellitus Patients During The Covid-19 Pandemic: A Systematic Scoping Review

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ABSTRACT

The COVID-19 pandemic affects blood glucose control in patients with type 2 diabetes mellitus (type 2 DM). Internet-based interventions show great potential in type 2 DM patients care. The aim of the study is to identify internet-based self-care monitoring interventions in type 2 DM patients during the COVID-19 pandemic. Using a systematic scoping review of PubMed, CINAHL, SAGE Journals, and ScienceDirect spanning 2019-2022, full-text articles, and randomized controlled trials. Study quality was assessed using the Joanna Briggs Institute (JBI) appraisal tool. Overall, 12 studies revealed that the internet was effectively used for self-care monitoring in type 2 DM patients during the COVID-19 pandemic such as to monitor blood sugar, diet, physical activity, drug use, problem solving, and dealing with stress, including mobile health (applications), web, telephone, and SMS (Short Message Service). Our finding highlights internet-based self-care monitoring can be a model of nursing intervention to prevent and increase the quality of life in DM patients.

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INTRODUCTION

COVID-19 was declared a pandemic in March 2019 and increased worldwide in early 2020 (1). At the global level, there were 418 million confirmed cases of COVID-19 with 5.8 million deaths as of February 18, 2022. Meanwhile, in Indonesia, there were 4.9 million cases of COVID-19 and 145 thousand deaths as of February 16, 2022 (2). Indonesia is fifth in the world, with 19.5 million diabetics in 2021 (3). A person with a chronic disease, such as type 2 DM, has a higher risk of exposure to COVID-19 and death (4).

Diabetes mellitus is a risk factor that exacerbates clinical symptoms in COVID-19 patients, resulting in a significant risk of complications, prolonged hospitalization, and death in COVID-19 patients (5). Maintaining reasonable glucose control has been shown to boost the immune system and help prevent the risk of complications from COVID-19 (6). However, the COVID-19 pandemic has become one of the obstacles for people with type 2 DM

to go to health services regularly (7).

The COVID-19 pandemic has significantly affected blood glucose control in patients with type 2 DM. The impact of social distancing and quarantine on lifestyle has resulted in uncontrolled glucose and eating patterns, limited physical activity, and constraints in obtaining anti-diabetic drugs, insulin, and controls to health services (7). In line with other studies, which revealed that during the COVID-19 pandemic, type 2 DM patients experienced worsening glucose control, such as untreated high blood levels, the consequences of which could result in prolonged and worsening hyperglycemia (4).

Regular check-ups and self-management are essential to prevent negative consequences for people with diabetes. In adapting to COVID-19 restrictions, national and international healthcare systems have shifted from in-person to remote consultations (8). Internet-based interventions show great potential for self-management in patients with diabetes mellitus (9, 10). In addition, internet-based diabetes management effectively increases adherence and lowers healthcare costs by reducing the number of clinic visits (12, 13). Despite the potential benefits, internet-based interventions have not

been widely applied (13).

The variability of conclusive information on diabetics during the COVID-19 pandemic requires additional study. Our study aims to identify internet-based self-care monitoring interventions in diabetics during the COVID-19 pandemic.

METHODOLOGY

Study Design

This study uses Arksey and O’Malley’s systematic review framework to present comprehensive research (14) and report study results using PRISMA-ScR. This systematic scoping review methodology is suitable for the subject of this study because it allows for thorough research in a short time on the domain of internet-based self-care monitoring in type 2 DM patients during the COVID-19 pandemic

Search Strategy

In this study, four databases are used for publication search: PubMed, CINAHL, SAGE Journals, and ScienceDirect. Medical Subject Heading (MeSH) was used in the search for articles using Boolean operators OR and AND include: “diabetes mellitus” “hyperglycemia” “glucose intolerance” “blood glucose” “self-monitoring” “internet-based intervention” “web-based intervention” “online intervention” “telehealth” “telenursing” “COVID-19” “SARS-Cov-2”.

Eligibility Criteria

The criteria in this study used research questions the PICO question framework, namely:
 Population: Patient with type 2 diabetes mellitus
 Intervention: Internet-based
 Comparison: No comparison
 Outcome: Self-care monitoring

The included articles were published from 2019 to 2022; full-text articles, randomized controlled trials, and studies were excluded if not in English. All researchers (TE, AMM, SP, IS, NMF) completed the study selection process using the PRISMA flow chart: (1) duplicate screening; (2) screening of topics, titles, and abstracts; (3) identification of the availability of full text and English; (4) article quality assessment; (5) and article preparation.

Quality Assessment

Study quality assessment used critical appraisal checklist tools for RCT research from the Joanna Briggs Institute (JBI). The evaluation was consistent with 13 questions and four categories: yes, no, unclear, and not applicable. Score 0 for if “No” and 1 for “Yes”, for a total score of 0-13.

Data Extraction

Data extraction was displayed using the manual tabulation method and included identified items,

namely author, year of publication, country, research objectives, research design, research sample, type of intervention, and results.

RESULTS

Description of Study Selection

The search results from the four databases obtained 1.033 studies. At the first screening, based on the suitability of the topic, title, and abstract criteria, 994 studies were excluded. Furthermore, screening based on full text and language, 12 studies were included in this scoping review. An overview of the flow of the study selection process carried out in this scoping review in Fig. 1.

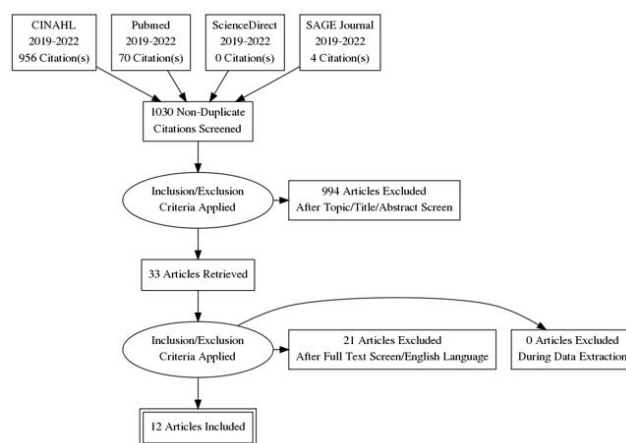


Figure 1: Study Selection Process Flow

Study Characteristics

The designs used to identify this study include the feasibility of the study assessed using appraisal tools (JBI), a randomized controlled trial study design including the 2019 and 2022 publication ranges. America (n=4), Iran (n=2), Turkey (n=1), England (n=1), Malaysia (n=1), Italy (n=1), South Korea (n=1), and China (n=1), with a total sample of 3,278 patients with type 2 DM (Table I and II).

Self-care Monitoring in Patients with Type 2 Diabetes Mellitus

Theme 1: Self-care Monitoring of Blood Sugar

The combined findings of eight studies reveal that self-care monitoring of blood sugar can use smartphone apps, websites, telehealth, and mHealth. Internet use in patients with type 2 diabetes mellitus can improve glucose control, decrease the number of FBS and HbA1c in elderly diabetics, reduce HbA1c, promote patient-nurse communication, and increase A1C values. Self-care management of type 2 DM patients using mHealth, including glucose sensors and applications, can help increase positivity and clinical improvement in glycemic, average BMI, FBG, 2hPG, HbA1c, and quality of life. However, there is only an additional benefit if the intervention is regular.

Table I: Quality Assessment of Article (n=12)

Ref	JBI Critical Appraisal Checklist (The Joanna Briggs Institute) %	Literature Quality
(25)	76.9%	10/13
(26)	100%	13/13
(27)	84.6%	11/13
(28)	76.9%	10/13
(29)	76.9%	10/13
(16)	76.9%	10/13
(30)	76.9%	10/13
(31)	84.6%	11/13
(32)	76.9%	10/13
(33)	76.9%	10/13
(34)	76.9%	10/13
(35)	76.9%	10/13

Theme 2: Self-care Monitoring of Eating Patterns

The combined findings of eight studies suggest that short-term web interventions can assist in nutritional monitoring patients with type 2 diabetes mellitus or IGR during the COVID-19 pandemic. For example, the application asks patients to upload photos of food or diet after which the user gets feedback regarding the results of checking blood glucose. In addition, another intervention is a telephone discussion giving patients access to a 10-20 minute discussion with a professional nurse about self-monitoring results, such as appropriate eating patterns.

Theme 3: Self-care Monitoring of Physical Activity

Physical activity is needed to monitor blood sugar in patients with type 2 DM. Two studies have found that monitoring apps via Google Fit can instruct patients

Table II: Summary of Findings (n=12)

Ref	Country	Research purposes	Study design	Study sample	Type of intervention	Results
(25)	American Chinese	Evaluate the effectiveness of mHealth management with an implantable glucose sensor and mobile application in type 2 diabetes mellitus (T2DM) patients in China.	RCT	68	mHealth	After health management using mHealth, the mean BMI, FBC, 2hPG and HbA1c of intervention group patients were lower than the control group, and quality of life and management improved compared to control group patients.
(26)	America	To evaluate whether peer coaching interventions were more effective in improving clinical outcomes in diabetes when enhanced with e-health education tools than peer coaching alone.	RCT	290	web	Participants in both groups increased their A1C scores at 6 months and maintained these gains at 12 months follow-up. Diabetes social support increased at both 6 and 12 months.
(27)	Italy	Comparing web-based nutrition interventions versus traditional interventions, before and during the 'lockdown' period in Italy due to the COVID-19 outbreak, in overweight and obese people affected by type 2 diabetes or impaired glucose regulation (IGR)	RCT	36	Web	The web arm can detect a progressive decrease in body weight and body mass index (BMI) from baseline to T6 and a minimal increase in both parameters during the lockdown. PREDIMED scores improved at T6 compared to baseline values in both arms. Results indicated body weight ($p < 0.001$), BMI ($p = 0.001$) and PREDIMED scores ($p = 0.023$) over time. These results demonstrate the effectiveness and feasibility of a short-term web-based nutrition intervention in type 2 diabetes mellitus or IGR patients during the COVID-19 Pandemic
(28)	South Korea	To compare the efficacy of a personalized lifestyle intervention based on a mobile phone application with usual routine care in patients with T2DM.	RCT	282	iCareD app	The results from this study provide more robust evidence of the usefulness, efficacy, and cost-effectiveness of cellular-based technologies for managing chronic health conditions such as T2DM.
(29)	America	To determine the effectiveness of a comprehensive telehealth intervention for patients with poorly-controlled diabetes mellitus (PPDM) that combines telemonitoring, self-management support, diet/activity support, medication management, and depression support – 5 evidence-based approaches that target key factors underlying PPDM	RCT	200	PRAC-TICE-DM	The PRACTICE-DM intervention is a novel and comprehensive telehealth approach that seeks to improve glycemic control for PPDM patients, representing a special high-risk and high-cost diabetes population. The PRACTICE-DM intervention may be suitable for reducing the complications and costs of PPDM in routine practice.
(16)	America	To assess the impact of social determinants of health on the efficacy of digital health interventions as adjunctive therapy for reducing HbA1c and fasting blood glucose (GDP) among patients with type 2 DM.	RCT	65	Phone	EpxDiabetes helps reduce HbA1c in patients with uncontrolled T2DM and promotes patient-provider communication; EpxDiabetes has definite benefits as an adjunct therapy in diabetes management.
(30)	Malaysia	Evaluated the effects of remote telemonitoring with team-based management in people with uncontrolled type 2 diabetes mellitus.	RCT	1.388	Phone	The telemonitoring group reported more significant improvement in glycemic control compared with the control group at the end of the study (week 24) and follow-up (week 52). Similarly, no differences in other secondary outcomes were observed, including the number of adverse events and health-related quality of life

Table II: Summary of Findings (n=12)

Ref	Country	Research purposes	Study design	Study sample	Type of intervention	Results
(31)	America	Evaluated self-monitoring intervention Impact of monthly A1C values obtained at home on glycemic control in patients with type 2 diabetes	RCT	307	Telehealth	After six months of intervention, participants experienced a decrease in HbA1c in the control group was 0.3%, and the intervention group was 0.5%. Self-monitoring of HbA1c at home can improve glycemic control. In addition, telehealth interventions performed by nurses and health educators showed a decrease in HbA1c values.
(32)	Iran	To determine the effect of telenursing on blood glucose control in the elderly with diabetes.	RCT	80	Telenursing (phone) month.	Before the intervention, the mean FBS and HbA1c of the two groups showed no significant difference; however, there was a sizeable difference after the intervention. Paired t-test showed that after the intervention, the number of FBS and HbA1c decreased to 33.92 ± 21.51 and 1.51 ± 0.86 , respectively. The results showed that using telenursing in elderly patients with diabetes is an effective strategy for improving self-care and its consequence on blood sugar control.
(33)	English	Testing the impact of self-monitoring blood glucose with or without TeleCare support, on glycemic control in people with uncontrolled type 2 diabetes.	RCT	446	TeleCare.	Blood glucose self-monitoring intervention improved glycemic control in type 2 diabetics. However, there was no additional benefit from the once-monthly Telecare self-monitoring blood glucose intervention. This study showed a decrease in HbA1c using self-monitoring blood glucose with TeleCare.
(34)	Turkey	Knowing the effect of telerehabilitation (TR) program on glucose control, exercise capacity, physical fitness, muscle strength and psychosocial status in type 2 DM patients	RCT	50	telerehabilitation (TR)	TR interventions in type 2 DM patients can lead to improvements in glucose control, exercise capacity, physical fitness and further reductions in depression.
(35)	Iran	To assess the effect of telephone-based telenursing on glycated haemoglobin (HbA1c) in older adults with type 2 diabetes in Iran.	RCT	66	telenursing (telephone)	Telephone-based telenursing can help increase the effectiveness of interventions to control disease, as demonstrated by this study's significant reduction in HbA1c.

Abbreviation: Randomized Control Trial (RCT), diabetes mellitus (DM)

to be physically active. Meanwhile, other applications provide telerehabilitation interventions in the form of training and monitoring of sports activities through interactive seminars, video conferences, and telephone calls.

Theme 4: Self-care Monitoring of Diabetes Drug Use

Drugs are one of the determinants of success in maintaining blood sugar in patients with type 2 DM. Based on the findings, a web-based peer-coaching intervention can improve self-management by asking patients to take a diabetes medication class (oral and insulin), review their medications and identify any barriers they might experience in their treatment. As a result, treatment, medication management, reduced complications and cost of care in diabetic patients can be identified. In addition, interventions also provide education review of medication with pharmacists and monthly communication to increase motivation to use diabetes medication.

Theme 5: Self-care Problem-solving Skills Training

Peer coaching interventions combined with web-based tools can improve the self-management decisions of patients with Type 2 DM. The interventions include participating in peer coach training with a primary focus

on motivational communication skills, helping other participants define behavioral goals for long and short-term treatment planning, and patients have to set goals and develop specific action plans discussed with the doctor.

Theme 6: Self-care Monitoring Coping Stress

The PRACTICE-DM telehealth intervention is comprehensive and suitable for reducing depression due to complications and treatment costs in patients with Type 2 DM. Meanwhile, telerehabilitation interventions can help monitor psychosocial status in patients through interactive seminars, video conferences, and telephone calls, thereby helping to improve stress coping in Type 2 DM patients.

Overall, the findings of internet-based interventions that can be used for self-care monitoring diabetes mellitus patients include mobile, web and telehealth applications such as phone calls and SMS. Several internet-based self-care monitoring interventions were identified, including mHealth, iCareD applications, telehealth, EpxDiabetes, telenursing, and telerehabilitation. The internet is effective in helping improve the ability of Type 2 DM patients to carry out self-care in monitoring blood sugar, good diet, physical activity, drug use, finding solutions to problems, and coping with stress.

DISCUSSION

During the COVID-19 pandemic, people with Type 2 DM have a higher risk of infection and worsening of the disease, primarily if the glycemic level cannot be controlled. So social restriction is one way patients with diabetes mellitus must enact (15). Reducing the patient's blood sugar level is the goal of self-management of diabetic patients (13). Self-care activities in diabetes mellitus patients include following a diet plan, increasing exercise, self-monitoring glucose, and taking care of the feet (16, 17). Internet-based self-care monitoring interventions must be carried out with a self-monitoring approach to help diabetes patients maintain optimal health.

Our findings suggest telehealth interventions can be effective at self-care monitoring among patients with Type 2 DM. The findings are consistent with previous study that found telehealth can improve access to quality care such as counseling and monitoring related with glycemic control, medication adherence, and knowledge (18, 19, 20). Self-care monitoring intervention with a self-report approach is needed, and is considered the most practical and cost-effective self-care assessment (7). However, the Covid-19 pandemic has led to significant changes in the delivery of telehealth, which may improve access to care for patients with Type 2 DM. The use of telehealth is increasing to assist the management and provide the care needed for Type 2 DM during the COVID-19 pandemic (21). The capacity and capability of mHealth technology are growing, along with the widespread use of smartphones and mobile applications, thus providing opportunities to be integrated into diabetes care (22).

The findings from this study indicate that the application of internet-based self-care monitoring is increasing, especially during the COVID-19 pandemic. However, there are still several constraining factors in implementing internet-based self-care monitoring, including the elderly group, participants' lack of activity in counselling sessions, participants not interested in self-monitoring, and barriers to internet access and electronic devices. This study is different from study (23) which showed the feasibility of telenursing in lung cancer patients, even in rural areas. However, data privacy needs critical attention. Legal and ethical issues should not be underestimated and maximum protection of patient data must be ensured (23). The remote healthcare regulatory, including telenursing activity, is unpredictable (24).

The literature search in our scoping review excluded non-English reports because all studies were from developed countries, and self-care in type 2 DM patients during the COVID-19 pandemic in the least developed countries may differ. However, to the best of the writer's knowledge, this study is the first scoping review to look at the potential of remote nursing care and reveal new findings regarding the effectiveness of the internet in

self-care monitoring of diabetes mellitus patients during the COVID-19 pandemic.

CONCLUSION

Overall, 12 studies revealed that the internet was effectively used for self-care monitoring in type 2 DM patients during the COVID-19 pandemic such as monitoring blood sugar, diet, physical activity, drug use, problem solving, and dealing with stress, including mobile health (applications), web, telephone, and SMS (Short Message Service).

Our finding highlights internet-based self-care monitoring can be a model of nursing intervention to prevent and increase the quality of life in type 2 DM patients. Internet-based self-care monitoring can be applied in developed and developing potentially reducing healthcare time and costs. However, further investigation on the benefits of the internet as a nursing intervention model is urgently needed to prevent problems in the improvement of quality of life in type 2 DM patients.

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