

SYSTEMATIC REVIEW

Intervention to Improve Foot Care Behavior among Patients with Diabetes Mellitus Type 2 in Health Care Facilities: A Systematic Review

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ABSTRACT

Introduction: Suboptimum foot care can jeopardize the physical function and quality of life of people with diabetes. Various interventions to improve foot care behavior have been performed, albeit not yet ideal. This study aimed to analyze foot care improvement interventions reported in published literature. **Methods:** A systematic review was performed on articles published from 2014-2020 based on studies regarding foot care interventions that were retrieved from four databases: ProQuest, PubMed, CINAHL, and ScienceDirect. The quality of these studies was assessed using Prisma Flow Diagram and JBI Guideline. **Results:** Fifteen studies were examined and two categories of interventions were identified: online-based and direct interventions. **Conclusion:** Online and direct interventions are beneficial for patients, however online intervention is more practical for patients, especially those who live far from health facilities. Thus, this approach is suitable for Indonesia where there are many patients living far from health facilities when seen from the perspective of the continuous growth of IT technology in Indonesia.

Keywords: Diabetes mellitus type 2, Foot care behavior, Health Care Facilities, Intervention

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INTRODUCTION

The International Diabetes Federation (IDF) (1) declared Diabetes Mellitus (DM) as one of the most common chronic diseases in the world that poses a global health threat in the current era (1). Diabetes mellitus is considered a priority health problem that is under scrutiny of many global leaders as the prevalence of diabetes has almost doubled from 4.7% to 8.5% since 1980 (2). Data obtained by the IDF demonstrate that there are a total of 424.9 million people living with DM in 2017 with an estimated increase to 628.6 million in 2045. Indonesia is among countries with the highest number of DM cases with 10.3 million, and ranked sixth after China, India, USA, Brazil, and Mexico (3).

The World Health Organization (2) defined DM as a chronic metabolic disease or disorder with various causes characterized by high blood sugar levels (hyperglycemic) accompanied by carbohydrate, lipid, and protein metabolic disorders (2). Diabetes mellitus

leads to various complications, including short-term (acute) and long-term (chronic) complications. The most frequent complication experienced by DM patients is diabetic neuropathy (4-5). In the United States, about 60-70% of DM patients develop neuropathic complications (6). Diabetic neuropathy is a disease that affects sensory nerve function in the distal lower extremity, characterized by substantial pain or morbidity (7). Initial symptoms include paresthesia, tingling or numbness, and burning, especially at night. Loss of distal sensation is an important factor that carry a high risk for foot ulcers, which will increase the risk of amputation (8). Patients with diabetes mellitus will lose sensory sense and are not aware of the appearance of the wound. This may delay treatment for these patients as they do not feel the injury until it becomes severe. Wounds that are left untreated will trigger tissue damages that are difficult to heal, leading to ulcer formation (9).

One of the foot management approaches is self-foot care that can be performed by the patients which may include daily foot cleaning with water and soap, moisturizer/body lotion application, nail clipping, wearing appropriate size footwear (shoes/sandals), and treating any wound and cover it with gauze if there is a wound on the foot (10). Results of previous studies explained

that foot care practice is very important and effective to reduce risk factors for infections that potentially lead to diabetic ulcers, gangrene, and amputation when good and appropriate foot care behavior is adopted (11-13).

Interventions to improve foot care behavior are important to identify as a preventive effort against further complications that will impact people’s quality of life (14). Studies are needed to test foot care interventions across different health facility setting (15, 16). Nurses as health workers play an important role in designing innovations to develop new interventions that are more effective and efficient which will improve the quality of nursing care and provide increased satisfaction to patients. This study aimed to analyze interventions that could improve foot care behavior among patients with type 2 diabetes mellitus patients in health facilities.

METHODS

Protocols and Registration

This systematic literature review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram to evaluate and select studies (17), and the Center for Review and Dissemination and the JBI Guideline for assessing the quality of the study as adapted to the objective of this systematic review (18).

Eligibility Criteria

The inclusion criteria are articles published in English during the period of 2014 – 2020 on studies conducted in hospitals or clinics in peer reviewed journals. The search for literature was performed using four databases with high and medium quality criteria: ProQuest, Pubmed, CINAHL, and Science Direct.

Article Selection

The strategy used to search for articles was the Population, Intervention, Comparison, Outcomes Strategy (PICOS) with the format of : (1) Population: patients with diabetes mellitus type 2, (2) Intervention: improvement of foot care behavior, (3) Comparison: no intervention, (4) Outcomes: improvement of foot care behavior and (5) Study design: Quasi-experimental, randomized control trial study (RCT). The search was conducted using the keywords of “diabetes mellitus type 2” AND “foot care behavior” AND “intervention” OR “treatment” AND “health services” OR “clinic” OR “hospital”. From the results of the search in the four databases, a total of four hundred and ninety (490) articles were obtained, 5 of which were duplicates. On assessment using PRISMA the total number of articles obtained were as follows: 3 articles from ProQuest, 5 articles from CINAHL, 5 articles from PubMed, and 2 articles from Science Direct. In the final assessment, 15 articles were identified to be analyzed in a systematic review. The result of the selection of articles is presented in Fig. 1 PRISMA 2009 Flow Diagram.

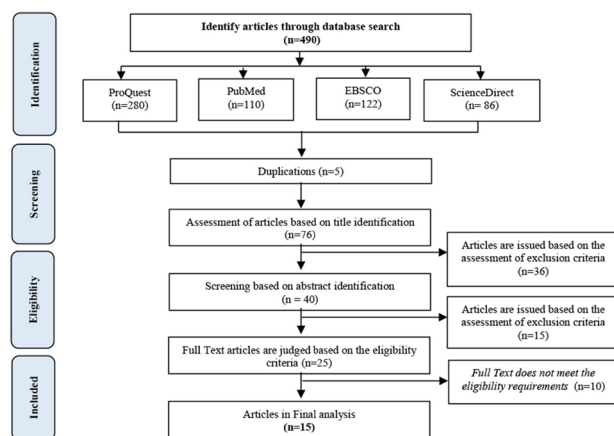


Figure 1: PRISMA 2009 Flow Diagram. Flow chart to summarise the selection of potent articles for the review

RESULTS

Article Quality and Risk of Bias

The quality of the 15-articles designated as the source of this systematic review was determined using the Prisma Flow Diagram assessment and JBI Critical Appraisal Tools. The results of the evaluation of Randomized Control Trials articles on the checklist presented a minimum score of 12 to 13 (Table I) while studies using Quasi-experimental design presented a minimum score of six to nine (Table II).

Characteristics Articles and Respondent

Studies in the articles included in this systematic review were conducted in hospitals and diabetes mellitus clinics in nine countries: six were conducted in Iran (19, 20, 22, 24, 25, 26), two in Turkey (28, 31) and one study in Australia (29), Vietnam (27), Morocco (23), India (30), Malaysia (13), Mesir (32), and US California (21). The total number of participants in this study was 1,541 participants with diabetes mellitus type 2. There were more women than men participating in this study (n=979, 63.5% vs. n=562, 36.5%). The lowest number of participants in a single study was 33 participants while the highest was 199 participants with the age range of between 30-70 years (Table III).

Study Results Analysis

The results of the 15 articles were analyzed into two predetermined themes: online-based foot care improvement method and direct foot care improvement method. There approaches were identified for the on-line based method: a short message education program via Telegram, a telephone-based education program, and a motivational interviewing (MI) intervention video conference. Meanwhile, approaches used in the direct

Table I: Study assessment results for systematic review using *The JBI critical appraisal tools Randomized Control Trials.*

Citation	Assessment Criteria													Results
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Young, Miyamoto (21)	√	√	√	√	√	√	√	√	√	√	√	√	√	13/13 (100%)
Seyyedrasooli, Parvan (24)	√	√	√	√	√	√	√	√	√	√	√	√	√	13/13 (100%)
Beiranvand, Fayazi (22)	√	√	√	√		√	√	√	√	√	√	√	√	12/13 (92.3%)
Baba, Duff (29)	√	√	√	√	√		√	√	√	√	√	√	√	12/13 (92.3%)
Beiranvand, Asadizaker (25)	√	√	√	√	√	√	√	√	√		√	√	√	12/13 (92.3%)
Bicer and Enc (31)	√	√	√	√	√	√	√	√	√	√	√	√	√	13/13 (100%)
Maslakpak, Razmara (20)	√	√	√	√	√	√	√	√	√		√	√	√	12/13 (92.3%)
Sharoni, Rahman (13)	√	√	√	√	√	√	√	√	√	√	√	√	√	13/13 (100%)
Rahaman, Jyotsna (30)	√	√	√	√	√	√	√	√	√	√	√	√		12/13 (92.3%)
Jeihooni, Khiyali (26)	√	√	√	√	√	√	√	√	√	√	√	√	√	13/13 (100%)

Table II: Study assessment results for systematic review using *The JBI critical appraisal tools Quasi-experimental.*

Citation	Assessment Criteria									Results
	1	2	3	4	5	6	7	8	9	
Bakhshian, Panahi (19)	√	√	√	√	√	√	√	√	√	9/9 (100%)
Adarmouch, Elyacoubi (23)	√	√	√		√	√	√	√	√	8/9 (92.3%)
Abdelhamid, Taha (32)	√	√	√	√	√	√	√	√	√	9/9 (100%)
Nguyen, Edwards (27)	√	√	√	√	√	√	√	√	√	9/9 (100%)
Toygar, Hanzerlioglu (28)	√	√	√		√			√	√	6/9 (67%)

method were interactive group discussion education, behavioral theory-based education, interactive education, and self-management support (Table III). Below are the details on these approaches:

Online-based intervention (n=3)

Short message education program via Telegram (n=1)

This intervention included a four week period of sending educational messages and had effectively increased the average value of foot care and self-care for patients with type 2 diabetes. Twenty eight letters were sent to the intervention group participants during the study based on relevant textbook: 1) Check your blood glucose daily. Fasting glucose should be 80-120. 2) Walk at least half an hour every day to better regulate blood glucose. 3) Consumption of fruits and vegetables every day helps control blood glucose. 4) Eat a meal with a salad to better regulate blood glucose. 5) Take care of your feet. Wash your feet every day and dry them. As an additional educational intervention, posters were also designed and provided by the researchers sent via Telegram. Educational message delivery interventions was shown to increase the average score of self-care in diet compliance, blood glucose self-monitoring, foot

care, and self-care of patients with DM (p> 0.05) (19).

2. Telephone-based education program (n=1)

This study compared the effects of face-to-face and telephone-based family-oriented educational programs on self-care behavior. The results explained that after nurses carried out the follow-up for 3 months, the self-care score was significantly higher in the intervention group compared to the control group. The average foot care scores were 29.93 ± 5.28, 28.06 ± 5.73, and 11.23 ± 8.57 in groups 1, 2, and 3 (P=0.0001). The potential value of telephone technology in providing more effective diabetes care is due to its lower cost (20).

3. Intervention motivational interviewing (MI) video conference (n=1)

Nurses conducted the study at six federally qualified Clinic health centers in Northern and Central California on 101 DM patients. The results of a 6-week follow-up showed that the MI/ telehealth training model was an effective intervention for diabetes self-management, based on DES at 9 months (4.03 versus 3.64, respectively; p<0.05) and the difference in estimation differences (0.42; p<0.05). The sustained effect on outcomes observed in the intervention group suggested

Table III: Study analysis results

No	Author, Year & Country	Title	Method Sample	Instrument	Type of Intervention	Inter- venter	fol- low-up	Results	Effectiveness	Benefit
1	Young, Miyamoto (21) California	Sustained Effects of a Nurse Coaching Intervention via Telehealth to Improve Health Behavior Change in Diabetes	Method : RCT Sample (M/F): 101 (68/53) Participants from six federally qualified clinics in Northern and Central California	Instruments: Diabetes Empowerment Scale (DES)—Short Form (DES-SF)	control group maintenance Intervention group via telephone and video konferen method (motivation for tional interviewing / MI)	Nurse	16 weeks	- Self-efficacy scores were significantly higher in the intervention group compared to the control group after 9 months (p < 0.05). - Based on DES at 9 months (4.03 versus 3.64, respectively; p<0.05) and the difference in estimation differences (0.42; p<0.05).	- Effective interventions for diabetes self-management in rural communities. - Sustained effects suggest that this model could be a viable intervention for long-term behavior change.	- Can change self-management behavior in the long term.
2	Béiranvand, Fayazi (22) Iran	Effect of Educational Programs on the Knowledge, Attitude, and Practice of Foot Care in Patients With Diabetes	Method : Randomized Controlled Trials Sample (M/F): 69 (37/32) Participants in Diabetes Clinic Colestan Hospital – Iran	Instrument: Questionnaire Summary of Diabetes Self-Care Activities	control group - (n = 34) received regular training at the clinic Intervention group - (n = 35) Health education program on how to take care of feet with lecture methods, group discussions, power point media and practice	Nurse	4 weeks	- There was a significant increase in knowledge, attitude, and foot care practice of the intervention group compared to the control group (p < 0.05). - the mean practice scores in the intervention and control groups changed from 16.32 and 17.76 to 19.32 and 18.96 before and after intervention.	-Effective on foot care performance of diabetic patients.	- Improve the score of knowledge, attitude and practice towards foot care.
3	Baba, Duff (29) Australia	A comparison of two methods of foot health education: The Fremantle Diabetes Study Phase II	Method : Randomized Controlled Trials Sample (M/F): 154 (92/62) Participants at Fremantle Hospital in Western Australia.	Instruments: - Nottingham Assessment of Functional Foot Care (NAFFC) - 6 item attitude survey	control group - (n = 78) get information through booklet media Intervention group - (n = 76) interactive education through audio-visual	Nurse & Podiatrist	3 months	- There was a significant change in Foot Score from baseline after 3 months (p<0.001). - foot score from baseline to 3 months in Group A (8.3±3.6; 1.8(95% CI:2.4 to 1.2) vs Group B (6.8±2.6; -0.1(-0.7 to 0.4); (p<0.001).	-Increase patient understanding of preventive measures, and demonstrate that a combination of illustrated booklets and interactive education provides the best approach to foot care education	- Increase knowledge and prevention of foot complications
4	Seyyedrasooli, Parvan (24) Iran	Self-Efficacy in Foot-Care and Effect of Trainings: A Single-Blinded Randomized Controlled Clinical Trial	Method : RCT Sample (M/F): 150 (74/76) Participants in the West Iran Nader Kazemi Shiraz diabetes center facility .	Instruments: Diabetic foot care self-efficacy questionnaire	control group - (n = 50) Foot care training program intervention group - (n = 150) Collective group - (n = 150) Group of individuals	Nurse	1 month	- There was a significant difference after being given a group and individual training intervention, the patient's self-efficacy increased (p=0.005).	-Can effectively increase the self-efficacy of foot care	- Increase confidence in foot care
5	Bakhshian, Panahi (19) Iran	The Effect of Education via Mobile Text Messaging on Self-care amongst Patients with Type 2 Diabetes	Method : Semi-experimental controlled study Sample (M/F): 74 (32/37) Participants of a Health care center in Chabahar, Iran.	Instruments: self-care questionnaire	control group maintenance Intervention group - (n = 37) Educational program sending short messages via telegram every day and giving educational posters	Nurse	4 weeks	- Total self-care score and foot care dimensions were positive, and significantly increased in the intervention group (p>0.05).	- Effectively improve self-care in foot care	- Improved self-care for DM patients
6	Bicer and Enc (31) Iran	Evaluation of foot care and self-efficacy in patients with diabetes in Turkey: an interventional study	Method : RCT Sample (M/F): 90 (7/47) Participants at Cerrahpasa Faculty of Medicine, Istanbul University, Turkey	Instruments: - Diabetic foot care self-efficacy scale (DFCSSES) - Foot self-care behavior scale (FSCBS) - Diabetic foot knowledge sub-scale (DEKS)	control group - (n = 45) usual routine care and routine lab follow-up Intervention group - (n = 45) Foot care education program with methods lectures, questions and answers, demonstrations, practices, and booklets	Nurse	6 months	- The experimental group pre-intervention foot care self-efficacy increased from 56.96 to 75.20% in the sixth month. - for the experimental group was significant while it was not in the control group (F (3, 264) = 55.53, p = 0.0001)	- Effective in raising awareness of foot care	- Increase awareness of foot care behavior.

Table III: Study analysis results (continued)

No	Author, Year & Country	Title	Method Sample	Instrument	Type of Intervention	Intervener	Follow-up	Results	Effectiveness	Benefit
7	Beiravand et al. (25) Turkey	Efficacy of an Intervention Based on the Theory of Planned Behavior on Foot Care Performance in Type II Diabetic Patients	Method : RCT Sample (M/F): 69 (38/52) Participants from Diabetes Clinic in Ahvaz Colestan The main referral hospitals in Iran.	Instruments: -TPB Questionnaire -Summary of He - bates Self-Care Activities-Revised and Expanded (SDSCA-Rande)	control group - (n= 50) routine training in clinic Intervention group - (n= 50) education program based on the theory of planned behavior (TPB)	Nurse	4 weeks	- The intervention group had a higher score than the control group (p < 0.05).	- Effective in improving foot care in diabetic patients.	- Improve foot care behavior
8	Maslakpak Razmara (20) Iran	Effects of Face-to-Face and Telephone-Based Family-Oriented Education on Self-Care Behavior and Patient Outcomes in Type 2 Diabetes: A Randomized Controlled Trial	Method : RCT Sample (M/F): 90 (51/39) DMT2 participants enrolled in Urmia Diabetes Iranian Association	Instrument: Summary of Diabetes Self-Care Activities (SDSCA)	Control Group - (n= 30) received education as usual with pamphlet Intervention Group - (n= 30) family - based face-to-face education - (n= 30) telephone-based education	nurse	3 months	- The overall self-care score of the intervention group was significantly higher than that of the control group (p = 0.0001). - The average foot care scores were 29.93 ± 5.28, 28.06 ± 5.73, and 11.23 ± 8.57 in groups 1, 2, and 3 (P=0.0001)	- The potential value of telephone technology in providing diabetes care more effectively because it is less expensive.	- Improve self-care behavior
9	Adarmouch, Elvacoubi (23) Maroko	Short-term effectiveness of a culturally tailored educational intervention on foot self-care among type 2 diabetes patients in Morocco	Method : Quasi-experimental Sample (M/F): 199 (0/199) Participants in 4 primary care clinic facilities in South Marroco	Instruments: Summary of Diabetes Self Care Activities (SDSCA)	Intervention group - (n= 133) interactive group discussions using: narrative videos, PPT presentation media and guidebooks .	A diabetologist	1 month	- The mean foot care score significantly increased after 1 month (p < 0.001). - mean variation was 2.4 ± 3.1 days; (p < 0.001)	- this intervention is effective and simple, where this intervention focuses on foot care.	- Improve self-care behavior.
10	Rahaman, Jyolsna (30) India	Effectiveness of a Patient Education Module on Diabetic Foot Care in Outpatient Setting: An Open-label Randomized Controlled Study	Method : RCT Sample (M/F): 127 (0/127) participants were outpatients in new delhi institute of medical science.	Instruments: The National Diabetes Education Program (NDEP)	control group - (n= 63) regular routine maintenance Intervention group (n=64) foot care education module (audiovisual & pamphlet).	Endocrinology Doctor	3 months	- Foot care practice scores also increased significantly (p < 0.001) in the intervention group. - There is a difference in scores in the two groups - The knowledge scores of the intervention group at the first, second, and third visits, respectively, were 9.8 ± 1.8, 10.2 ± 1.6, and 11.0 ± 1.7. - Knowledge scores in the control group at the first, second, and third visits, respectively, were 9.9 ± 1.7, 9.8 ± 1.6, and 10.0 ± 1.8.	- effective for improving knowledge and practice of foot care	- Increase knowledge and practice regarding DM foot care.
11	Sharoni, Rahiman (13) Malaysia	The effects of self-efficacy enhancing program on foot self-care behavior of older adults with diabetes: A randomized controlled trial in elderly care facility, Peninsular Malaysia	Method : RCT Sample (M/F): 76 (54/22) Participants in a general care facility clinic for the elderly in Peninsular Malaysia.	Instruments: -Diabetes Foot Self-Care Behavior Scale (DFSBS) - Foot Care Confidence Scale (FCCS) - Neuropathy and Foot Ulcer Specific Quality of Life (FS-QoL)	control group - (n= 38) usual care Intervention group - (n= 38) Foot care education program based on Albert Bandura's theory of self efficacy	Specialist nurses & doctors	12 weeks	- Foot self-care behavior, foot care self-confidence, and knowledge of foot care increased in the intervention group compared to the control group (p < 0.05).	- This exercise program is effective in improving foot care behavior in adults with diabetes.	- Increase knowledge and self-confidence of DM patients in treating feet.

Table III: Study analysis results (continued)

No	Author, Year & Country	Title	Method Sample	Instrument	Type of Intervention	Inter- venter	Follow-up	Results	Effectiveness	Benefit
12	Abdelhamid, Taha (32) Mesir	Effect of Self-Management Support Program on Improving Diabetic Foot Care Behaviors	Method : Quasi-experimental Sample (MF): 70 (39/31) Participants at Zagazig University Hospitals Diabetes Diabetes clinic	Instrument: Diabetic Foot Care Behaviors Questionnaire	control group - (n = 35) observation Intervention group - (n = 35) foot care education and support self-management program and telephone follow-up	Nurse & Counseling clinic	10 months	- The intervention group received adequate exercise related to foot care compared to the control group (60%) who did not have adequate foot care practices with p-value (<0.001*).	- Effectively increase knowledge in foot care practice and behavior	- Increase knowledge of foot care behavior
13	Nguyen, Edwards (27) Vietnam	Effectiveness of a theory-based foot care education program (3STEP-FUN) in improving foot self-care behaviors and foot risk factors for ulceration in people with type 2 diabetes	Method: Quasi-experimental Sample (MF): 119 (33/86) Participants in Ho Chi Diabetes Treatment Clinic, Minh City, Vietnam	Instrument: - Foot Care Confidence Scale (FCCS) - Summary of Diabetes Self-Care Activities (SDSCA) -Scale Self-Care Knowledge Questionnaire	Follow-up 10 months control group - (n = 60) routine maintenance & brochures Intervention group: - (n = 59) theory-based education (3STEPFUN) , (1) intensive education in small groups, (2) equipment for foot care documents, (3) telephone follow-up.	Nurse	6 months	- The intervention group had significantly improved outcomes compared to the control group after more than 6 months. (p = 0.001).	- effective in improving foot care behavior and reducing risk factors for DM foot ulcers.	- Increase prevention regarding foot care behavior
14	Jeltoom, Khyali (26) Iran	The Effect of Educational Program Based on the Extended Theory of Reasoned Action on Self - Care Behaviors in Women with Type 2 Diabetes	Method : Quasi-experimental Sample (MF): 100 (0/100) Participants in Diabetes Clinic Shariati Hospital, Fasa	Instruments: questionnaire extended theory of reasoned action and self care behaviors	control group - (n = 50) routine maintenance Intervention group - (n = 50) educational intervention based on extended theory of reasoned action and self care behaviors	Nurse	3 months	- Has a significant effect on the patient's self-care behavior in the experimental group compared to the control group (p < 0.05).	- Effective for designing educational interventions to promote self-care behavior in diabetic patients..	- Improve self-care behavior
15	Toygat, Hanaerlioglu (28) Turkey	Effect of an Educational Intervention Based on Bandura's Theory on Foot Care Self-Efficacy in Diabetes: A Prospective Quasi-Experimental Study	Method: Quasi-experimental Sample (MF): 33 (17/16) Participants in the Iranian hospital Diabetic foot care council	Instruments: Diabetic Foot Care Self-Efficacy Scale (DFCSES)	n=33 respondents received foot care education intervention based on Bandura's Theory on Foot Care Self-Efficacy.	Nurse	1 month	- There was a significant difference after the intervention on the level of knowledge on diabetic foot (P < .001), health status (P < .001), and perceived quality of life improved (P < .001)	- Effective for improving foot care self-efficacy, increasing knowledge of foot diabetes, health status, and quality of life.	- Impact on improving foot care behavior, and quality of life of DM patients.

that this model could be a viable intervention for long-term behavior change among people living with chronic disease (21).

Direct intervention (n=12)

Education interactive group discussions (n = 3)
Interventions carried out in this study were carried out by nurses through an interactive group method with a follow-up of 4 weeks to 1 month which produced a significant change. The interactive group health education program, was given on how to take care of feet through lectures and interactive group discussions with the use of PowerPoint media. This approach was demonstrated to lead to significantly effective foot care performance ($p < 0.05$) (22). Direct interventions using narrative videos, PowerPoint presentation media, and guidebooks were also shown to be effective (mean variation was 2.4 ± 3.1 days; $p < 0.001$) (23), which was also true for the division of collective groups and individual groups ($p \leq 0/05$) (24). There are similarities in the effectiveness of the interventions and the interactive group discussion intervention was found to be effective for improving foot care performance and independence; increasing knowledge and attitude scores; and increasing foot care beliefs.

Education based on the theory of behavior (n = 5)

There were 5 intervention programs based on behavioral theory, including Albert Bandura's self-efficacy theory (40%) which presented an increase in the prevention of foot care behavior ($p = 0.001$); (3STEPFUN) theory (20%) ($p = 0.001$); theory of reasoned action and theory of planned behavior (20%) ($p < 0.05$); and extended theory of reasoned action & self-care behaviors (20%) ($p < 0.05$). Overall, 83.3% nurses provided these theory-based interventions and had proved that these were effective in improving foot care in diabetic patients ($p < 0.05$). (13, 25-28).

Interactive education (n=3)

The three studies that used the interactive education approach were carried out in a multidisciplinary collaboration, including nurses providing education to DM patients; podiatrists in charge of examining health problems around the feet, and endocrinologists diagnosing DM patients. The combination of illustrated written materials (e.g., booklets) and interactive education provided the best approach to foot care education in diabetic patients, evidenced by a higher foot score increase from baseline to 3 months in Group A (8.3 ± 3.6 , 1.8(95% CI:2.4 to 1.2) than Group B (6.8 ± 2.6 , -0.1(-0.7 to 0.4); ($P < 0.001$) (29). Audio-visual methods and pamphlets in outpatient settings were shown to be effective ways to improve knowledge and practice of care feet in patients with diabetes ($p < 0.001$) (30). Health education could improve individual health-related habits and behaviors with a significant improvement seen in the experimental group compared to the control group ($F(3, 264) = 55.53$, $p = 0.0001$) (31).

Self-management support (n=1)

A self-management support program is an important factor in encouraging diabetic patients to improve their diabetic foot care behavior. In studies using this approach, nurses and DM clinical counseling officers assisted patients in this activity. Self-management support programs was shown to increase knowledge, reflecting improvements in diabetic foot care practices and behaviors after the intervention. More than half of the patients (60.0%) in the control group who had no intervention had inadequate preparation related to the foot care with a P-value ($< 0.001^*$) (32).

Follow-up

All studies reviewed includes data on follow-up with 40% included data on 1-month follow-ups (19, 22-25, 28), 33% on 3-month follow ups (13, 23, 26, 29-30), 7% on 4-month follow ups (21), 13% on 6-month follow ups (27, 31), and 1% on 10-month follow-ups (32). Nurses performed follow-ups to assess patients' ability to achieve predetermined goals.

Intervener

The interventions given in the studies under review involved various health professional professions, including nurses (13, 19-22, 24-29, 31-32); podiatrists (29); clinical counselors (32); endocrinologists (30); and diabetologists (23). The majority of foot care behavior improvement interventions (72.2%) involved nurses.

DISCUSSION

Characteristics of Articles and Respondents

Most participants in the studies under review were women (63.5%) with an age range of between 30 to 79 years old (adult to elderly). This supports the study by Ariyanto (2014) which stated that the prevalence of type 2 DM is higher in women (n=77, 81.92%) which may due to the fact that women have a greater chance of increasing body mass index, such as during the premenstrual period, post-menopausal period, and pregnancy. In addition, women also have different activities and daily lifestyles that may affect the incidence of a disease, such as eating fatty foods and drinking excessive sugar (33). According to Smeltzer and Bare (34), age is closely related to increased blood sugar as the older the person is, the higher the risk for experiencing type 2 diabetes.

Intervention

Suboptimum foot care can jeopardize the physical function and quality of life of people with diabetes. Intervention regarding foot care is very important and effective as a possible starting point for changes in attitude and lifestyle of patients with diabetes mellitus. There are a lot of interventions that can be applied by nurses to improve foot care behavior, including online-based interventions.

Online-based interventions can improve services without requiring a higher cost through the use of technology.

Through this method, the total cost of health care can be reduced and access to health care can increase without having to allocate a high amount of budget to cover the cost (35). The results of a study by Fadhila and Ariani (36) demonstrated that Indonesia, as an archipelagic country, will very much benefit from the application of online-based interventions, such as telenursing. Online interventions may become the answer to the issue of the uneven health service distribution in Indonesia, especially in rural or remote areas.

Online-based foot care improvement interventions bring great benefits for DM patients, although direct interventions can also have a very effective impact on changing diabetes health behavior. Interactive group discussion interventions can effectively change foot care performance and able to increase the average score of foot care knowledge after 1 month of intervention (22). To support a more optimal intervention, it is necessary to involve various parties, starting from the health care facilities to the community. Thus, it is recommended that the integrated health care services should be improved (37). Another factor that can increase the effectiveness of the intervention on improving foot care behavior is the duration of diabetes and the patient's level of knowledge. According to Albikawi and Abuadas (38), people who have lived with diabetes in a longer period have already better adapted to their DM treatment when compared to people who have just experienced this disease for a shorter duration.

From the perspective of the results of the studies under review, both online and in-person interventions are beneficial and effective for increasing knowledge, understanding, practice and awareness of foot care behavior among patients and may prevent diabetic foot complications. Other benefits of these interventions are increased self-confidence, independence in self-care, self-management, and perceived impact of quality of life improvement of diabetes mellitus patients.

Comparison of Intervention

Foot self-care is an activity performed by diabetes mellitus patients for foot care management in reducing the risk of foot ulcers (39). Nursing intervention methods for foot care include both online and direct in-person interventions that have been demonstrated to give significant benefits to the patients in improving foot care behavior. Direct interventions seem to require longer time, which is between one month to ten months. In contrast, the online-based approach can be implemented in a shorter period and only requires a follow-up period of one month to three months. Therefore, online-based interventions can result in a better and more efficient nursing service quality, in addition to giving a positive effect on the patient. This type of intervention also affects the dynamic behavior change process based on patient's awareness of a healthy and quality life (40, 41, 43).

Online -based interventions create a great opportunity to be implemented in Indonesia, in view of the current information technology development in the country. The effectiveness of the interventions carried out cannot be determined with certainty yet because not many comparative studies are available. Therefore, there is a need for further research by conducting meta-analytical studies to properly describe the relationship between studies to be able to compare the intervention results.

Follow-up

In most studies under review, the majority of the follow-up interventions (40%) are performed in one month (19, 22-25, 28). Follow-up interventions as a form of evaluation and mentoring, both programmed and incidental, are necessary to maintain the quality of the intervention activity results and increase collaboration between nurses and clients (42).

Intervener

Approximately 72.2% of these studies involve nursing profession despite the fact that interventions in studies under review also involve various health professionals. Nurses play an important role in the management of diabetic patients, with collaboration with other health care providers such as podiatry, clinical counselors, endocrinologists, diabetologists. One of the roles of medical-surgical nurses in health facilities, especially in hospitals or clinics, is providing educational interventions. Patients with diabetes need this type of intervention because diabetes is a chronic disease that requires certain independent self-care behavior throughout life.

Implication

The results of this study imply that innovative approaches for developing a new intervention strategies that are more effective and efficient for patients with diabetes are very much needed to improve the quality of nursing care and provide the quality of life and service satisfaction among patients with diabetes.

Limitations of Literature Studies

Limitations of systematic review studies include the potential for bias inherent to the studies under review due to the determination of the allocation of control and intervention groups, especially in terms of participant characteristics.

CONCLUSION

There are two choices of intervention that have significant benefits with different levels of effectiveness and can be applied to improve diabetic foot care behavior: online-based interventions and direct interventions. However, further research is needed to compare the efficacy of existing interventions. Online -based interventions may become the answer to the problem of uneven distribution of health services in Indonesia and bring

a great opportunity to be applied based on the current development of information technology in Indonesia.

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