

## SYSTEMATIC REVIEW

# Improving Foot Self-care Practices Through Health Education Intervention Programs Among Diabetic Patients: A Systematic Review

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## ABSTRACT

**Introduction:** Diabetic foot ulcers (DFUs) remain one of the greatest significant problems of diabetes mellitus. It is a cause of main suffering and expenses for patient, and financial problem on health facilities and public. One of the strategies to overcome DFU is through health education to prevent foot ulcer, which focused in promoting foot self-care. To reach this aim, researchers had applied different educational approaches. This systematic review is to evaluate various types of educational programs in terms of its method of delivery and effectiveness. **Methods:** The search involved various databases; EBSCOHOST, MEDLINE, CINAHL, Cochrane library, ScienceDirect, PubMed, SAGE SpringerLink, Web of Science and Wiley Online Library. It was limited to full text research articles that report intervention studies, and the write up in English Language, the publication was from 2005 to 2021. The key words were “diabetes”, “diabetes foot”, “foot self-care”, health education and “interventions”. **Results:** Twenty studies were involved in this review. Nine studies were randomized controlled trials (RCTs), while eleven reported non-randomized controlled trials (NRCTs). **Conclusion:** There are evidences that foot care education improves foot care and diabetic foot problems. Various health education approaches, for instance foot assessment, discussion, counseling, homebased visitation and telephone calls have been shown to be effective in improving educational programs. Studies in the future should focus on RCTs in different sites and apply follow-up of long duration to provide better recommendations to healthcare practitioners on effective educational interventions to prevent DFUs.

*Malaysian Journal of Medicine and Health Sciences* (2023) 19(4):315-325. doi:10.47836/mjmhs19.4.44

**Keywords:** Diabetes, Foot ulcer, Foot self-care, Health education, Systematic review

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## INTRODUCTION

Diabetes mellitus (DM) is a worldwide burden for public health and socio-economic development (1). About 537 million people age from 20 to 79 live with DM (2). Diabetic foot ulcers (DFUs) are among the significant complications of DM (3). An estimate of 25% DM patients develops foot ulcer once in lifetime (4,5). Globally in 2016 the prevalence of DFU was 6.3% and was higher in men (4.5%) compared to women (3.5%), it was higher among type 2 diabetic patients (6.4%), compared to type 1 diabetics (5.5%) (6). The prevalence of DFU greatly indicate the quality of diabetes care because this complication of DM is generally avoidable

with appropriate management of DM (7). The guidelines for management of DM recommended appropriate management of Type 2 DM, which include proper diet at all stages of management of diabetes including those on medication. Meal plans that meet individualized caloric goals with a macronutrient distribution that is consistent with healthy eating pattern is recommended for long-term achievement of glycaemia, lipids and weight goals. Moderate exercise is encouraged, at least 150 mins/week or at least 75 mins/ week of vigorous aerobic (Ministry of health, 2020). The recommended targets for glycemic control for adults with type 2 DM is that A1C should be less than 6.5%, most adults with type 1 or type 2 DM, A1C should be less than 7.0%. Intensive glucose control with lowering A1C values to  $\leq 7.0\%$  in both type 1 and type 2 diabetes provides strong benefits for microvascular complications (8). One of the consequences of DFU is that, it causes the loss of lower limb every 30 seconds in the world. Other adverse

effects comprise of physical disability, poor quality of life and economic burden (9).

Diabetic foot ulcers are defined as infection, ulceration or damage of foot tissues related to neuropathy or peripheral arterial disease among individuals with DM. It is a known cause of suffering and expenses for patient and it results to financial problem on healthcare (10). The signs and symptoms of DFU include purulent discharge accompanying foul smell, warm sensation around the wound, pain and firmness on touching the wound, forming of black tissue around the ulcer and numbness around the wound. DFU can be detected during routine DM care through careful physical examination, visual inspection of the skin of the legs and feet, particularly the dorsal, plantar, medial, lateral, and posterior surfaces, as well as a close examination of each toenail (11,12). It was reported that foot care decreases the danger of neuropathy, DFU and infections effectively (3). Diabetic neuropathy frequently results to foot complications and amputation. Peripheral neuropathy is commonly the cause of DFU and most often leads to sensory deficiency with loss of protective pain feeling (13). Peripheral neuropathy is diagnosed through extensive medical history, blood tests, spinal fluid tests, muscle strength tests, when healthcare provider suspects nerve damage, this is to determine the location and extent of nerve damage (14). Infection and re-ulceration complicate DFU and it led to hospitalization among diabetic patients (15,16). The risk of developing DFU is between 10% to 15%. About 60% to 80% DFU will heal, while 10% to 15% will be active, and 5% to 24% will result to lower extremity amputations (LEA) within six to eighteen months (17).

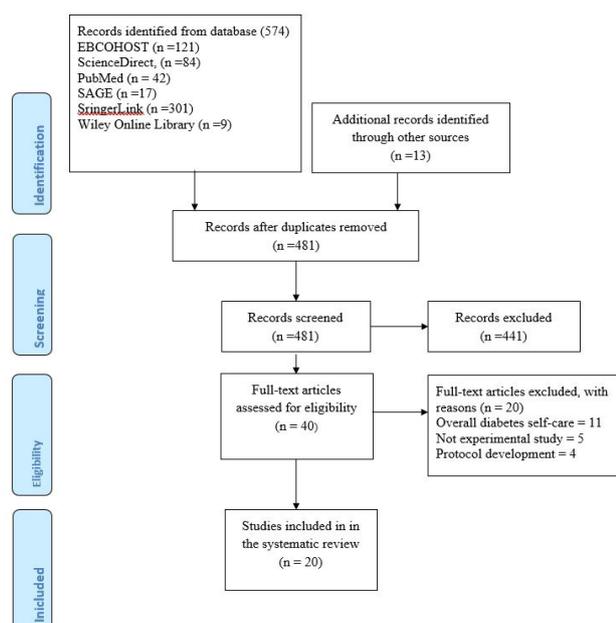
One of the strategies to prevent DFU is through preventive foot care education among the diabetic patients. The guidelines for foot care are part of standard practice for diabetes self-care. Based on the principles of patient empowerment, foot care preventive education is meant in promoting foot self-care practices such as inspection of the foot daily, daily washing of feet, nail and toe care, and avoid walking bare-footed to prevent DFU, or DFU re-occurrence, which eventually will help to promote foot health (18). Although interventions to prevent DFUs was implemented, patients still develop DFUs. Studies pointed out that there is no evidence to prove that preventive practice is adequate to promote foot self-care practices in order to prevent DFUs. Thus, this may be challenging in primary prevention of DFUs and re-occurrence of DFUs (19,20,21). Also busy clinical practice of diabetologists that spare little time regarding foot care education diabetic patients, moreover patients ignorant attitude and unwilling to abide to foot care practices for a long period of time were the risk factors for foot problems (22,23,24).

Most diabetic patients are negligent when it comes to injury, infection and other symptoms related to the feet,

thus this will lead to a delay in seeking medical treatment. Efforts to institute good foot care practices are expected to be highly successful. An important component of these practices is selection of appropriate footwear (19). It was reported that there was an increased occurrence of diabetic foot problems among diabetic patients who has little knowledge and practices on care of their foot (25). Study revealed that when diabetic patient has increase knowledge regarding their foot, this will decrease problems with the foot, amputations and healing of DFU will improve (26). However, it was reported that foot self-care is not often practiced among diabetic patients (27). Foot examination is necessary to identify patients at risk to enable the implementation of appropriate and timely interventions. Educating the diabetic patients on wound care, nail care and callus is important and should be delivered by a multi-disciplinary team which include the physicians, nurses, podiatrists, dietitians and clinical psychologists, although it may be difficult to be implemented into primary health care services (28). Education on foot care empowers people with diabetes with comprehensive knowledge regarding their disease, this will make them to fully partake in the treatment and it will facilitate them to understand the importance of achieving personal health goals (29). Thus, this paper reviews literature in order to understand the impact after health education intervention on foot care knowledge, foot self-care behavior among diabetic patients. The purpose of this review is to evaluate the various methods used for health education programs and the effectiveness of the programs in improving foot care amongst diabetic patients.

## METHODOLOGY

In this review Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines were used figure 1 (30). The study protocol is available from The Clinical Trials Registry- India (CTRI), Reference no CTRI/2021/06/034311. The search involved various databases; EBSCOHOST, MEDLINE, CINAHL, Cochrane library, ScienceDirect, PubMed, SAGE SpringerLink, Web of Science and Wiley Online Library. It was limited to full text research articles that reported intervention studies, written in English Language and published between 2005 to 2021. However, limiting review papers to English language articles may introduce a language bias and lead to erroneous conclusions. (31). The key words were foot, feet, foot ulcer, foot disability, foot problem, neuropathy, self-care, self-care behavior, self-management, self-care practice, diabetes mellitus, diabetic foot, foot self-care behavior, health education and interventions. Reference lists were checked and search for important studies, in order to detect additional related publications. Independently two authors reviewed the full-text articles to check if inclusion criteria were in accordance and compared results at each stage. Article retrieved during the search was assessed independently by two authors of the



**Figure 1: PRISMA flow Diagram of search process**

team. Each article titles and abstracts were screened subsequently and the full text screening was reviewed by two authors.

Self-care in diabetes is an evolutionary process of knowledge development or awareness by learning to survive with the complex nature of the diabetes (32;33). Majority of day-to-day care in diabetes is done by patients or family member, it is important for reliable and valid measures for diabetic self-management (34). However, there are essential self-care behaviours for diabetes patients which include healthy eating, being physically active, monitoring of blood sugar, compliant with medications, good problem-solving skills, healthy coping skills and risk-reduction behaviors (35,36).

### Inclusion criteria

Inclusion criteria were intervention studies (e.g. randomised control trials (RCTs) and non-randomised controlled study (NRS), assessing the effects of patient foot care education, interventions on self-care, self-care behaviour and self-management in individuals with both type 1 and 2 diabetes. Age limits of participants ranges from 18 years and above. The intervention includes educational programs involving teaching, discussion, practical and demonstration.

### Exclusion criteria

Non-experimental studies, review papers, pharmacological trials, studies that focus on other chronic diseases were excluded. Articles that are not published in English language and articles published before 2005. Initially, the search was limited to the past 10 years; however, due to the scarcity of good articles, the date range was expanded. Health education

interventions studies that did not focus on foot care, and studies that foot care education are not sole intervention were excluded.

### Search outcome

Studies on educational programs to improve self-care of the foot among diabetic patients were searched. A total of 574 studies were identified through electronic search using key words. Each article title and abstract were initially reviewed and assessed to know if they correspond with inclusion criteria to review the full text, published review paper, abstract, conference paper, dissertation and thesis were excluded from this review. Only 40 articles were included to review in full text. Only articles that reported Randomized Control Trails (RCTs) and Non-Randomized Studies (NRS) designs were included. Among the 40 articles, a total of 20 articles were excluded because of these reasons: articles are not intervention study and articles that are protocol development. The studies reviewed were based on the following: self-care of the foot, presented with or without foot problems diabetic patients, programs, follow-up and evaluation.

“The Consolidated Standards of Reporting Trials (CONSORT) statement for assessing non-pharmacologic treatments checklist was used as a reporting guideline to evaluate the articles” (37,38 p. 295) (Table I). The CONSORT components covered are title, abstract, introduction, methodology, results and discussion.

One author reviewed all abstracts for inclusion and screened all articles gotten from the search. The retrieved articles were assessed by second set of reviewers for uncertainty if the articles are eligible to ensure rigor. Articles that meet inclusion criteria were included to review full-text to confirm if inclusion criteria were met. For assessing risk of bias, the authors applied Cochrane Risk of Bias Tool, Table II shows summary of risk of bias (Cochrane Statistical Methods Group and the Cochrane Bias Methods Group). Based on the tool, assessing risk of bias in studies were as follows: “random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias) (patient-reported outcomes), incomplete outcome data (attrition bias) (short-term outcomes (2–6 weeks), incomplete outcome data (attrition bias) (long-term outcomes (>6 weeks) and selective reporting (reporting bias)” (39 p. 2).

### RESULTS

In this systematic review, 20 studies were reviewed (Table I). The revived studies reported the sample size and it is from 25 to 495 patients. All studies stated respondents age, the age ranged from 18 years and above.

**Table 1: Health education interventions to improve foot self-care behaviour and foot problems among diabetes patients**

Author	No of participants	Age of participants	Study type	Intervention type	Study country (city)	Outcome	Findings
Pai et al (2021)	108	20 years and above	Randomized Controlled Trial	one-on-one health education program in separate rooms.	China	Glycosylated hemoglobin (HbA1c) level and self-management ability	There was significant improvement in the experimental group, the mean score increases in the Perceived Diabetes Self-Management Scale (PDSMS) at 3 and 6 months after the intervention were significantly higher
Lincoln et al. (2008)	172	Not available	Randomized Controlled Trial	One-to-one education, home-visit Diabetes foot self-care education programs.  Delivered by diabetes research nurse specialist or a research occupational therapist	United Kingdom	Anxiety and depression, Quality of life, Foot care behaviours	Foot care behaviors at 12 months improved in the intervention group than in the control group (p=0.03). No significant differences observed between groups in ulcer and amputation incidence at 6 months & 12 months (p> 0.05)
Borges & Ostwald, (2008)	167	40 years and above	Randomized Controlled Trial	Group, health setting. Delivered by the researchers	Mexican American	Improve diabetes foot self-care behaviors	There was a significant improved foot self-care behaviours within the IG2 t(47) = -4.32, p < 0.01)
Sharoni et al., (2018)	76	60 years and above	Randomized Controlled Trial	A group seminar presentation on foot care, Power Point presentation (and a pamphlet	Malaysia	To evaluate the effectiveness of health education programs based on the self-efficacy theory on foot self-care behavior	Foot care outcome expectation and knowledge of foot care improved in the intervention group compared to the control group (p < 0.05).
Rahaman et al., (2018)	127	>18 years age	An open-label Randomized Controlled study	Health setting. Education module consisted of an audio-visual display and a pamphlet.	New Delhi, India	Improvement in diabetic foot knowledge and foot care behavior in the patients who received foot care education through audio-visual aid.	Foot care practice improved significantly (P < 0.001) in the intervention group in the second visit but not in the control group.
Deakin et al. (2006)	314	30–85	Randomized Controlled Trial	Group, health setting. Diabetes education, usual care and review with prearranged individual appointment.	United Kingdom	Self-care (including foot care) Quality of life Diabetes Empowerment and Medication intake	The differences with respect to foot care remained significant at 14 months (difference 0.6 day, 95% CI 0.2, 1.0, respectively)
Ose et al. (2019)	495	18-years or older	Randomized Controlled Trial	Home visit, telephone-monitoring calls. Face to face meetings.	Germany	Improvement of self-care behavior	No significant change for the sub-score group. foot care (p = 0.8472, 95%-CI = [-0.3482; 0.4239] significantly increased sum score of the SD-SCA-G in the intervention group over time (P =0.012) but not in the control group (p = 0.1973).
Yokota et al., (2019)	55	40 to 75 years old	Randomized Controlled Trial	Health education using a printed leaflet	Japan	Improved (reduced) the removal rate of skin debris, and the symptoms and conditions of the feet in the participants in the SFCEP group.	There were significant differences in removal rate of skin debris (p < 0.05), and the conditions of the feet, dryness (p < 0.001), horny tissue (p < 0.001) and peripheral coldness (p < 0.05
Lutes et al., (2018)	139	18 to 75 years old	Randomized Controlled Trial	Involve an integrated and collaborative care delivery system that extends the capacity of busy primary care providers to be able to screen and manage the psychological and behavior	United States of America	Outcomes included change from baseline to 12-months in HbA1c, diabetes related distress, depressive symptoms, and diabetes self-care activities.	There were significant improvement in mean diabetes empowerment scale scores were improved in the intervention group
Mohammad & Khresheh (2018)	60	18-years or older	Quasi-experimental, design	educational program	Saudi Arabia	Improvement in the patients level of knowledge , patients ability to perform self-foot care and level of patient awareness after orogram implementation.	Health educational program showed significant improvement in the patients level of knowledge, patients ability to perform self-foot care and level of patient awareness after program implementation.
Fujiwara et al., (2011)	88	68.0 (10.3) years,	Quasi experimental	one-to-one or group health setting. Delivered by certified diabetic foot care nurse	Japan	Foot-ulcer Callus	The programme reduced the severity score of tinea pedis (P= <0.001) and improved callus grade (P= <0.001)

**Table 1: Health education interventions to improve foot self-care behaviour and foot problems among diabetes patients (Continued....)**

Author	No of participants	Age of participants	Study type	Intervention type	Study country (city)	Outcome	Findings
Baba, Duff, Foley, Davis, & Davis, (2015)	154	Mean $\pm$ SD Age $68 \pm 10$ years	Quasi-experimental	Interactive  Foot-smart education program (foot facts, diabetes complication, how diabetes affects your feet, how to care for your feet,	Australia	Foot care behaviour Foot care related worries in diabetes	Foot care behavior showed no significant difference between groups ( $p=0.13$ )  There was a greater change in Foot Score from baseline to 3 months in G1 vs G2 ( $p < 0.001$ )
Williams et al., (2014)	25	18 years or older,	Quasi experimental  Experimental	Community-based culturally tailored education intervention Delivered by a certified diabetes educator and nurse	United States of America	Knowledge Diabetes empowerment Diabetes problem-solving skills, Quality of life	Improvement of foot care was seen in participants' from baseline to 3 months post intervention ( $P = .013$ ) and at 12-month follow-up.
Aikens, Rosland, & Piette, (2015)	301	60 to 70 years old	Quasi Experimental	One to one, health setting and by Telecommunication. Delivered by the research team	United States of America	Quality of life Medication adherence Self-management (including foot care)	There were significant improvements in foot self-management; patients' ( $p < 0.001$ ).
Saleh, Shebl, Hatata, & Refiei, (2012)	160	50 to 70 years	Quasi Experimental	Group, health setting. Educational, 5 practical / training sessions) program was implemented. Delivered by the researcher	Egypt	Knowledge Foot self-care practice	foot self-care practice IG before (mean= $12.47 \pm 5.68$ ) and after (mean= $43.17 \pm 3.89$ ) program was Improved.
Tang et al., (2012)	89	Ages of 40 and 84 years	Quasi Experimental	Group, health setting. group-based problem-solving, and ask questions about diabetes and its care. Delivered by nurse certified diabetes educator and a clinical psychologist	United States of America	To improve Quality of life, Self-care behaviour (including foot care) Diabetes empowerment	There was significant improvements following performing foot exams (4.8 days/wk versus 5.6 days/wk; $p < 0.01$ ).
Ko et al., (2011)	96	Mean age $67.23 \pm 12$ years	Quasi Experimental	Individually tailored education educational session was conducted for 60–90 min, followed by a question-and-answer period. Delivered by public health nurse	Korea	To improve diabetes knowledge and self-management in all categories of lifestyle	Foot self-management improved significantly ( $p < 0.001$ )
Dettori et al., (2005)	213	Mean $\pm$ SD $68 \pm 11$ years	Quasi Experimental	One-to-one and group, health facility and home setting	United States of America	Knowledge, Satisfaction with care, Diabetes self-management (including foot care)	The diabetes education improve care (including foot care) and reduce barriers for rural patients with diabetes. Foot care education (baseline= $69\%$ , $N=201$ to follow up = $89\%$ , $N=235$ $p < 0.001$ )
Chen et al., (2011)	323	Mean age $68.9 \pm 9.5$ years	Quasi Experimental	Group, one-to-one, health setting and home	Taiwan	Peripheral neurological assessment. Peripheral vascular assessment Foot self-care capability	Foot self-care behaviour improved significantly after the program ( $p < 0.01$ ). The neuropathy Screening Index and right side ankle brachial pressure index improved significantly ( $p < 0.01$ ).
Nguyen et al. (2019)	119	Mean age 62.22 years (SD 9.33)	Quasi Experimental	Group intensive education and hands-on skills session; a foot care kit and documents; and three regular booster follow-up phone calls over 6 months.	Vietnam	To improve foot self-care behaviour	The intervention group had significantly improved outcomes compared to the control group over 6 months in the following aspects: improved preventive foot care behaviour ( $p = 0.001$ ); and decreased prevalence of foot risk factors for ulceration (i.e. dry skin, corns/ callus) (OR: 0.04, 95% CI 0.01 – 0.13, $p < 0.001$ )

**Table II: Risk of bias summary (Cochrane Statistical Methods Group and the Cochrane Bias Methods Group)**

Author	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of Participants and personnel (performance bias)	Blinding of outcome assessment (detection bias) (patient-reported outcomes)	Blinding of outcome assessment (detection bias) (Mortality)	Incomplete outcome data addressed (attrition bias) (Short-term outcomes (2–6 weeks))	Incomplete outcome data addressed (attrition bias) (Longer-term outcomes (>6 weeks))	Selective reporting (reporting bias)
Pai et al (2021)	+	+	-	-	-	-	-	+
Lincoln et al. (2008)	+	+	+	+	?	+	+	+
Borges & Ostwald, (2008)	?	?	+	?	?	?	?	+
Sharoni et al., (2018)	+	+	+	+	+	+	+	+
Rahaman et al., (2018)	+	+	-	-	-	-	-	+
Deakin et al. (2006)	+	+	-	+	?	+	+	+
Ose et al. (2019)	+	+	-	-	-	-	-	+
Lutes et al., (2018)	+	+	-	-	-	-	-	-
Yokota et al., (2019)	+	+	-	-	-	-	-	+
Mohammad & Khresheh (2018)	+	-	-	-	-	-	-	+
Fujiwara et al., (2011)	-	-	-	-	?	?	?	+
Baba, Duff, Foley, Davis, & Davis, (2014)	-	?	?	?	?	?	?	+
Williams et al., (2014)	-	-	-	-	?	?	?	+
Aikens, Rosland, & Piette, (2015)	-	-	-	-	?	?	?	+
Saleh, Shebl, Hatata, & Refiei, (2012)	-	-	-	?	?	?	?	+
Tang et al., (2012)	-	-	-	-	?	?	?	+
Ko et al., (2011)	-	-	-	-	?	?	?	+
Dettori et al., (2005)	-	-	-	-	?	?	?	+
Chen et al., (2011)	-	-	-	-	?	?	?	+
Nguyen et al. (2019)	-	-	+	?	?	+	?	+

High Risk (-), Low Risk (+), Unclear risk (?)

**Risk of bias**

Table II summarized the risk of bias for the reviewed studies. Among the reviewed studies, the risk of bias was not clear, however two studies reported methodologically low risk of bias (40,41). For both studies, the education interventions improved self-care behaviors among the participants.

**Types of intervention studies**

Nine studies reported randomized controlled trial (RCTs) (42,43,44,45,46,47,48,49,50). Five studies reported non-randomized controlled trial (NRCT) (51,52,53,54,55). Six studies reported non-randomized case series design (56,57,58, 59,60,61).

Most studies focus on education programs on diabetic foot self-care while some studies focused on overall diabetes education programs on self-care, some studies

focus on foot care aspect. Educational programs in all the studies was taught by trained personnel that has knowledge of research and they are either medical or health science graduates (example educator in the field of diabetes, physician, foot doctors and nurses).

**Sample and Setting**

Among the reviewed articles, studies were carried out either in health facility or at participant’s house. Some studies reported that there was no control group in their studies.

Regarding the study location, seventeen studies were carried out in health facilities (41,42,43,44,45,46,47, 48,49,50,51,52,53,54,55,56,57,58). However, two studies were first carried out in the health facility where education intervention were given to the participants and follow up visit in their homes (57,59). A study

delivered the education session to participants in their homes (40).

The educational approach included one-to-one or group approaches, novel health technologies education programs, focus groups discussion, teaching delivery method, demonstration, booklet, leaflet, handbook, home visit, videotaped and phone call.

Nine studies were carried out in groups (44,45,47,49,50,51,53,55,56). Seven studies applied one-to-one approach (40,42,43,46,48,54,58). However, two studies applied both one-to-one and group method (58,60). One study did not state if it was a one-to-one or a group method (52).

Three studies stated that usual care alone was given to respondents in control group, (41,45,47). One study reported that participant in control group received routine shared care (42). One study mentioned that usual care and foot care brochure was given to respondents in control group and participants in control group were also given foot care written materials (a booklet) at the end of the study (49). Similarly, two studies reported that the respondents in control groups were given usual care, leaflet and education on care of the foot (40,48). Another study reported that written education was given to participants in group A, while interactive education session was given to participants in group B (53). Meanwhile three studies did not mention what was given to the control group (42,46,51). Another study reported that participants in control group received printed leaflet (44). One study reported that participants from group two received standard hospital care (50). Some studies do not have control group, however among the studies, patients were grouped into groups, some was one-group pretest-posttest study (52,54,55,56,57,58,59).

### **Follow-up, evaluation and duration**

Follow-up time differs in various studies, some was assessed at baseline. There was an observed time interval difference from baseline to end of the research in the reviewed studies. One study reported the shortest time of evaluation of one month (47). One study reported the longest evaluation time of over 1-year follow-up (40).

Teaching duration varies from one study to another, the duration of teaching was from 15 minutes to 2 hours in a session. One study used 15 minutes to deliver the health education in each session, which is the shortest duration of teaching among the reviewed articles (47). Some studies delivered the health education in each session for more than 1 hour and they used the longest duration for teaching (48,53,55,56).

### **Outcome measures**

In the reviewed studies, outcomes measured included foot self-care (example checking of the feet, cleanliness, proper shoes and socks, care of the nails), self- support,

social support, emotional efficacy, empowerment, knowledge, acculturation, problem-solving, adherence to medication, nervousness and unhappy, quality of life, health facility utilization and care satisfaction. As for secondary outcomes, it includes foot problems and symptoms (example assessment of peripheral neurology, pain and incapacity, morbidity, ulcers, and amputation). Additionally, there are further important outcomes related to diabetes example, self-monitoring of blood sugar was measured.

### **Summary of finding**

In the studies reviewed, some studies show improvement in only the foot self-care scores. A study shows that the incidence of foot problems improved based on lower foot score (53). Another study shows that foot self-care behavior, foot care self-efficacy, foot-care outcome expectation improved in the intervention group, foot care knowledge become better (41). A study shows improvement in foot-care knowledge and foot-care among the participants in the intervention group (45). Another study revealed that patient's level of knowledge, patient's efficacy in performing foot self-care and patient's awareness level after the health education program implementation improved (50).

A study revealed that diabetes empowerment scale scores improved in intervention group (46). In another study, it shows improvement in preventive foot care behavior (49). A study shows improvement in the rate of skin debris removal, symptoms and situations of the feet among the patients in the foot self-care educational program group (44). Study reported that there was a significant increased sum score of Diabetes Self-care Activities Measure (SDSCA-G) in intervention group over time (43).

In another study, the experimental group mean score increases in the Perceived Diabetes Self-Management Scale (PDSMS) at 3 and 6 months (42). Some studies only foot self-care scores showed an improvement (40,47,48,51,54,55,58,59). A study shows significant improvements for self-care behaviors, healthy diet, monitoring blood sugar and performing foot exams (56). Moreover, a study improved in both foot self-care scores and foot problem occurrence, example ulcers and neuropathy (57). There was decrease in the severity of tinea pedis and callus in a study (52).

## **DISCUSSION**

This review reported 20 studies on education of diabetes foot from different kinds of intervention RCTs and NRSs. Based on the reviewed articles, the NRSs has high risk of bias even with or without a control group, although the studies are relevant and have information on health education program.

Diabetes foot care education which comprises of diabetic foot care, written or spoken instructions on

care of foot, group discussions on care of the foot and also counselling that focused on promoting foot self-care practices or behaviors, aiming at preventing the occurrence of DFU. The result of the reviewed studies shows that all education programs applied by the previous researchers' shows improved foot self-care, foot problems, foot care self-efficacy, outcome expectation of foot care and foot care knowledge amongst participants in the intervention group. Trained personnel in research field delivered the educational programs and this will prevent observer bias. Previous education interventions revealed that education programs improve knowledge, foot self-care practices, DFUs and re-ulceration health outcomes. Study revealed that there were brief duration effects on knowledge achieved and practices of self-care (20).

Based on the reviewed articles, some studies were carried out in health facility and some at participants house. With regards to the methods of educational programs, different intervention studies used different methods and approaches. The education programs were carried out in group session or one on one method, which include discussions, counseling, demonstrations, handbooks and leaflets. Based on the review articles, discussion method during the health education is more effective compared to other methods because it helps to express, clarify participants knowledge, experiences, opinions and feelings. Discussion method will help the participants to apply and interchange ideas within the context of the group and enable them to think about what they are learning. However, the challenges in discussion method is time consuming, because after discussion there will be allocated time for the participants to ask questions. It also involves more talk and less action. Discussion method is not expensive unlike other methods example is demonstration method which requires materials to teach the respondents. This method is suitable for both inpatients and outpatients and also suitable for diabetic patients in the community.

There was lack of information about control group by six studies (52,54,55,57,58,59). However, without a control group in a study, the study is deceptive and renders the result of the program ineffective. The lack of a comparative group has affected the quality of the results and makes it difficult to assess the effectiveness of the program. One study did not mention if the study was conducted in a group or one to one (52). Two studies did not mention the time period of teaching (57,59). Among the reviewed studies, some studies gave same leaflet to control groups and intervention group and some received usual care.

In the reviewed studies follow-up duration differs; there were differences in time period between follow-up time and the assessment time, it appeared that the interval time is longer when the foot problems development outcome was assessed. In a study, it took two years

to evaluate tinea pedis and callus grade severity (52). The researchers of the reviewed studies used different instruments to measure outcomes. Most researchers used questionnaire; some studies used already developed tool while some studies developed their tool.

Among the twenty articles in this review only two studies were low risk of bias (40,41). Both studies reported that the education interventions improved self-care behaviors among the participants. Both studies revealed that the detected improvements in self-care behaviors were together with significant clinical outcomes improvements compared to usual care, as well as quality of life, occurrence of DFU and amputation. Based on previous systematic review which reported that there is absence of acceptable indication to conclude that only education of patient is actual method in decreasing DFU incidence and amputation (60).

The National Institute for Health and Care Excellence (NICE) guidelines for the management of diabetic foot problems and The International working Group on the Diabetic Foot (IWGDF) guidelines for the prevention of foot ulcers in diabetes patients at risk, both guidelines mentioned foot care health education interventions when managing people at risk of developing DFU (7). The IWGDF guidance for the prevention of DFU in at risk patient recommended education that improves foot care knowledge and behavior, and also inspiring patient to stick to foot care guidelines. The Society for Vascular Surgery recommends that health education regarding preventative foot care ought to be given to patients and their families regardless of the little level of evidence and uncertain improved outcomes (61).

RCT is better than other designs in assessing the effectiveness of a program because it is a straightforward investigation of cause affect relationships with minimal bias. It is easy to blind/mask when compared to observational studies. Results can be analyzed using well-known statistical package, also, populations of contributing persons are identified clearly. The authors of this present paper recommend that for future studies, RCTs should be consider for long term follow-up period, when outcome assessed is based on foot problems expansion; the time interval seemed to be lengthier. Furthermore, upcoming RCTs ought to concentrate on patient-centered interventions, powered samples, randomization approaches, and concealment and appropriate reporting of sample. Also, future research should evaluate education program that will be effective to improve self-care of the foot and foot problems. Designing high quality RCTs is vital to make available stronger recommendations to healthcare practitioners and clinicians on the perfect education interventions in preventing DFUs, reoccurrence of DFU and lower extremity amputations. Healthcare personnel's ought to communicate and come to an agreement with patients on management plan through education on care of the

foot in order to improve their knowledge, reduce injury and inspire self-care (62).

### Strength and limitations of the study

This article reports the finding from a systematic review that focus on effectiveness of health education intervention programs to improve foot self-care practices among DM patients. The review has scientific merit and is of value.

The limitation of this review was that the selected articles were original research only, written in English language from year 2005 to 2021. During data extraction, there may be selection bias due to only full text articles were searched. This review adherence with proper systematic review methodology. As a result of limited time, resources and methodological issues in some of the reviewed studies, the authors could not proceed to meta-analysis.

### CONCLUSION

This review elaborated on the evidence that education on foot care improves foot care scores and foot problems. Due to diverse methods, populations, study locations, follow-up, outcomes measured, and evaluation, the findings needs to be discussed with caution due to the different context. Various health education approaches, for instance foot assessment, discussion, counseling, home visits and phone calls, improved the effect of education programs.

### REFERENCES

- Wang L, Gao P, Zhang M, Huang Z, Zhang D, Deng Q, Li Y, Zhao Z, Qin X, Jin D, Zhou M, Tang X, Hu Y, & Wang L. Prevalence and Ethnic Pattern of Diabetes and Prediabetes in China in 2013. *JAMA*. 2017; 317(24), 2515–2523. doi:10.1001/jama.2017.7596.
- International Diabetes Federation (IDF). *Diabetes Atlas 10th Edition*. Diabetes Facts and Figure. 2021. <https://idf.org/aboutdiabetes/what-is-diabetes/facts-figures.html>
- International Diabetes Federation (IDF). *Diabetes Atlas*. 6th Edition, IDF, Belgium. [www.idf.org/diabetesatlas](http://www.idf.org/diabetesatlas). 2013.
- Rice JB, Desai U, Cummings AK, Birnbaum HG, Skornicki M, Parsons NB. Burden of diabetic foot ulcers for Medicare and private insurer. *Diabetes Care*. 2014; 37(3): 651-658. doi: 10.2337/dc13-2176.
- Margolis DJ, Malay DS, Hoffstad OJ, Leonard CE, MaCurdy T, Tan Y, Molina T, de-Nava KL Siegel KL. Economic burden of diabetic foot ulcers and amputations. Agency for Healthcare Research and Quality, USA. 2011. <https://pubmed.ncbi.nlm.nih.gov/22049568/>
- Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis. *Annals of Medicine*. 2017; 49(2) 106–116. doi:org/10.1080/07853890.2016.1231932.
- Bus SA, Van-Netten JJA. Shift in priority in diabetic foot care and research: 75% of Foot Ulcers are Preventable. *Diabetes Metab Res Rev*. 2016. 32 195-200. doi:10.1002/dmrr.2738
- Imran, SA, Agarwal G, Bajaj HS, Ross S. Targets for Glycemic Control: Diabetes Canada Clinical Practice Guidelines Expert Committee. *Canadian Journal of Diabetes* 2018. [https://www.diabetes.ca/health-care-providers/clinical-practice-guidelines/chapter-8#panel-tab\\_FullText](https://www.diabetes.ca/health-care-providers/clinical-practice-guidelines/chapter-8#panel-tab_FullText)
- Seid AW, Tsige YO. Knowledge, practice, and barriers of foot care among diabetic patients attending felege hiwot referral Hospital, Bahir Dar, Northwest Ethiopia, *Advances in Nursing*. 2015; 1-9. doi:10.1155/2015/934623
- Schaper NC, Van-Netten JJ, Apelqvist J, Lipsky BA, Bakker K. On Behalf of the International Working Group on the Diabetic Foot (IWGDF). Prevention and management of foot problems in diabetes: a summary guidance for daily practice 2015, based on the IWGDF guidance documents. *Diabetes/ Metabolism Research and Review*. 2016;6; 32(Suppl. 1): 7–15. doi: 10.1002/dmrr.2695
- ADA guidelines. Executive summary: standards of medical care in diabetes-2012. *Diabetes Care*. 2012;35(1):S4–S10. doi: 10.2337/dc12-s004.
- Hoffman AF. Evaluation of arterial blood flow in the lower extremity. *Clin Podiatr Med Surg*. 1992. 9(1):19-56.
- Boulton AJM, Cavanagh PR, Rayman G. *The Foot in Diabetes*. 4th Edition, John Wiley & Sons, UK. 2006. <https://books.google.com.my/books>.
- Boulton AJM, Armstrong DG, Kirsner RS, et al. *Diagnosis and Management of Diabetic Foot Complications*. Arlington (VA): American Diabetes Association; 2018. doi: 10.2337/db20182-
- Crawford F, Inkster M, Kleijnen J, Fahey T. Predicting foot ulcers in patients with diabetes: a systematic review and meta-analysis. *QJM*. 2007. 100: 65-86. doi:10.1093/qjmed/hcl140
- Ismail K, Winkley K, Stahl D, Chalder T, Edmonds M. A cohort study of people with diabetes and their first foot ulcer: the role of depression on mortality. *Diabetes Care*. 2007;30(6): 1473-1479. doi: 10.2337/dc06-2313.
- Alexiadou, K. & Doupis, J. (2012). Management of diabetic foot ulcers. *DiabetesTherapy*; 3(1):4. Doi: 10.1007/s13300-012-0004-9
- American Diabetes Association Standards of medical care in diabetes. *Diabetes Care*, 2017;40: s88-s96. <https://professional.diabetes.org>.
- Navarro-Flores E, Gijyn-Nogueryn G, Cervera-Marín JA, Labajos-Manzanares MT. Assessment of foot self-care in patients with diabetes: retrospective assessment (2008-2014). *Foot Ankle Spec*. 2015;8:

- 406-412. doi:10.1177/1938640015585963
20. Hoogeveen RC, Dorresteijn JA, Kriegsman DM, Valk GD. Complex interventions for preventing diabetic foot ulceration. *Cochrane Database Syst Rev.* 2015; 24(8) doi: 10.1002/14651858.CD007610.pub3.
  21. Dorresteijn JA, Kriegsman DM, Assendelf WJ, Valk GD. Patient education for preventing diabetic foot ulceration. *Cochrane Database Syst Rev.* 2012; 10: CD001488. doi: 10.1002/14651858.CD001488.pub4
  22. Chandalia HB, Das AK. Detection of diabetic foot at risk. In: Larkins RG, Zimmet PZ, Chisholm DJ, editors. *Diabetes.* Amsterdam: Excerpta Medica; 1988. pp. 1057–62
  23. Pendse S. Epidemiological aspects of diabetic foot. *Int J Diab Dev Countries.* 1994;14:37–8.
  24. Viswanathan V, Shobana R, Snehalatha C, Seena R, Ramachandran A. Need for foot education in diabetic patients, India. *J Assoc Phys India.* 1999;47:1083–5. Available from: <https://pubmed.ncbi.nlm.nih.gov/10862318/>
  25. Chandalia HB, Singh D, Kapoor V, Chandalia SH, Lamba PS. Footwear and foot care knowledge as risk factors for foot problems in Indian diabetics. *International Journal of Diabetes Developing Countries.* 2008;28(4): 109–13. doi: 10.4103/0973-3930.45269.
  26. Goie TT, Naidoo M. Awareness of diabetic foot disease amongst patients with type 2 diabetes mellitus attending the chronic outpatient's department at a regional hospital in Durban, South Africa. *Africa Journal Primary Health Care Family Medicine.* 2016; 8(1): 1170. doi:10.4102/phcfm.v8i1.1170.
  27. Chin Y, Huang T. Development and validation of a diabetes foot self-care behavior scale. *The Journal of Nursing Research.* 2013;21,19–25. doi: 10.1097/jnr.0b013e3182828e59.
  28. Allen, L., Park, N., Diehl, K. & Driver, V. (2014). Limb loss and the effect of a multidisciplinary treatment approach on global populations: A team approach can reduce diabetic morbidity globally. Available at: [www.podiatrym.com](http://www.podiatrym.com).
  29. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev* 1977;84:191e215. doi: 10.1037//0033-295x.84.2.191.
  30. Moher D, Liberati A, Tetzlaff J, Altman DG. PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-analyses: the PRISMA statement. *PLoS Med.* 2009 6(7):e1000097. doi:10.1371/journal.pmed.1000097
  31. Centre for Reviews and Dissemination. *Systematic reviews: CRD's guidance for undertaking reviews in health care.* York, UK: Centre for Reviews and Dissemination, University of York; 2009
  32. Cooper H, Booth K, Gill G. Patients' perspectives on diabetes health care education. *Health Educ Res.* 2003;18(2):191–206. doi: 10.1093/her/18.2.191.
  33. Paterson B, Thorne S. Developmental evolution of expertise in diabetes self management. *Clin Nurs Res.* 2000;9(4):402–419.
  34. Johnson SB. Health behavior and health status: concepts, methods and applications. *J Pediatr Psychol.* 1994;19(2):129–141. doi: 10.1093/jpepsy/19.2.129.
  35. American Association of Diabetes Educators AADE7 Self-Care Behaviors. *Diabetes Educ.* 2008;34:445–449.
  36. Funnell M, Brown T, Childs B, Haas L, Hoseney G, Jensen B, Weiss M. National standards for diabetes self-management education. *Diabetes Care.* 2010;33:589–596. doi: 10.2337/dc11-S089.
  37. Boutron I, Moher D, Altman D, Schulz K, Ravaud P. Extending the CONSORT statement to randomized trials of non-pharmacologic treatment: explanation and elaboration. *Annals of Internal Medicine.* 2008a;148,295–309. doi:10.7326/0003-4819-148-4-200802190-00008
  38. Boutron I, Moher D, Altman D, Schulz K, Ravaud P. Methods and processes of the CONSORT group: example of an extension for trials assessing non-pharmacologic treatments. *Annals of Internal Medicine.* 2008b; 148, W60–W66. Doi: 10.7326/0003-4819-148-4-200802190-00008-w1.
  39. Higgins JPT, Altman, DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD, Savović J, Schulz KF, Weeks L, Sterne JAC, Cochrane Bias Methods Group, Cochrane Statistical Methods Group. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ* 2011; 343 Doi: <https://doi.org/10.1136/bmj.d5928>.
  40. Lincoln NB, Radford K, Game FL, Jeffcoate WJ. Education for secondary prevention of foot ulcers in people with: a Randomized Controlled Trial. *Diabetologia,* 2008;51(11), 1954–61. doi:10.1007/s00125-008-1110-0.
  41. Sharoni SKA, Rahman HA, Minhat HS, Shariff-Ghazali S, Ong MHA. The effects of self-efficacy enhancing program on foot self-care behavior of older adults with diabetes: A randomised controlled trial in elderly care facility, Peninsular Malaysia. *PLoS ONE.* 2018;13(3): e0192417. doi:10.1371/journal.pone.0192417.
  42. Pai LW, Chiu SC, Liu HL, Chen LL, Peng T. Effects of a health education technology program on long-term glycemic control and self-management ability of adults with type 2 diabetes: A randomized controlled trial. *Diabetes Res Clin Pract.* 2021;175:108785. doi: 10.1016/j.diabres.2021.108785.
  43. Ose D, Kamradt M, Kiel M, Freund T, Besier W, Mayer M, Krisam J, Wensing M, Salize H, Szecsenyi J. Care management intervention to strengthen self-care of multimorbid patients with type 2 diabetes in a German primary care network: A randomized controlled trial; *PLoS ONE.* 2019;14(6): e0214056.

- doi:10.1371/journal.pone.0214056.
44. Yokota K, Hayashi Y, Kurata J, Fujita A. Effectiveness of a Self-Foot-Care Educational Program for Prevention of Diabetic Foot Disease. *Health*. 2019;11,9-19. doi:10.4236/health.2019.111002.
  45. Rahaman HS, Jyotsna VP, Sreenivas V, Krishnan A, Tandon N. Effectiveness of a patient education module on diabetic foot care in outpatient setting: An open-label randomized controlled study. *Indian Journal of Endocrinology and Metabolism*. 2018;22:74-8. doi: 10.4103/ijem.IJEM\_148\_17.
  46. Lutes LD, Cummings DM, Littlewood K, Solar C, Carraway M, Kirian K, Patil S, Adams A, Ciszewski S, Hambidge B. COMRADE: A randomized trial of an individually tailored integrated care intervention for uncontrolled type 2 diabetes with depression and/or distress in the rural southeastern US. *Contemp Clin Trials*. 2018;70:8-14. doi: 10.1016/j.cct.2018.04.007.
  47. Borges WJ, Ostwald SK. Behaviors with Pies Sanos. *Western Journal of Nursing Research*. 2008;30(3),325–341. doi: 10.1177/0193945907303104
  48. Deakin T, Cade JE, Williams R, Greenwood DC. Structured patient education: The Diabetes X-PERT Programme makes a difference. *Diabetic Medicine*. 2006;23,944–954. doi:10.1111/j.1464-5491.2006.01906.x.
  49. Nguyen TPL, Edwards H, Do TND, Finlayson K. Effectiveness of a theory-based foot care education program (3STEPFUN) in improving foot self-care behaviours and foot risk factors for ulceration in people with type 2 diabetes; *Diabetes research and clinical practice*. 2019;152,29-38. doi: 10.1016/j.diabres.2019.05.003
  50. Mohammad NA, Khresheh RM. Evaluate the effect of education interventions in the prevention of diabetic foot ulcers through knowledge of the disease and self-care practices in Saudi Arabia. *Maced J Med Sci*. 2018;6(11); 2206–2213. doi:10.3889/oamjms.2018.439.
  51. Saleh NM, Shebl AM, Hatata ESZ, Refiei MR. Impact of educational program about foot care on knowledge and self-care practice for diabetic older adult patients. *J Am Sci* 2012;8(12):1444-1452]. (ISSN: 1545-1003). Available from <http://www.jofamericanscience.org>.
  52. Fujiwara Y, Kishida K, Terao M, Takahara M, Matsuhisa M, Funahashi T, Shimizu, Y. Beneficial effects of foot care nursing for people with diabetes mellitus: An uncontrolled before and after intervention study. *Journal of Advanced Nursing*. 2011;67,1952–1962. doi:10.1111/j.1365-2648.2011.05640.x.
  53. Baba M, Duff J, Foley L, Davis W, Davis TA. Comparison of two methods of foot health education: The Fremantle diabetes study phase II. *Primary Care Diabetes*. 2015;9(2);1–8. doi:10.1016/j.pcd.2014.05.004.
  54. Aikens JE, Rosland AM, Piette JD. Improvements in illness self-management and psychological distress associated with telemonitoring support for adults with diabetes. *Primary Care Diabetes*. 2015;9(2),127–134. doi:10.1016/j.pcd.2014.06.003.
  55. Williams IC, Utz SW, Hinton I, Yan G, Jones R, Reid K. Enhancing diabetes self-care among rural African Americans with diabetes: results of a two year culturally tailor intervention. *The Diabetes Educator*, 2014;40(2), 231–239. doi:10.1177/0145721713520570.
  56. Tang TS, Funnell MM, Noorulla S, Oh M, Brown MB. Sustaining Short-term Improvements over the long-term: Results from a 2-year Diabetes Self-managementSupport(DSMS)Intervention. *Diabetes Research and Clinical Practice*. 2012;95(1), 85–92. doi:10.1016/j.diabres.2011.04.003.
  57. Chen MY, Huang WC, Peng YS, Guo JS, Chen CP, Jong MC, Lin HC. Effectiveness of a health promotion programme for farmers and fishermen with type-2 diabetes in Taiwan. *Journal of Advanced Nursing*. 2011;67, 2060–2067. doi:10.1111/j.1365-2648.2011.05678.x.
  58. Ko IS, Lee TH, Kim GS, Kang SW, Kim MJ. Effects of visiting Nurses' individually tailored education for low-income diabetic patients in Korea. *Public Health Nursing*. 2011;28(5), 429–437. doi:10.1111/j.1525-1446.2011.00941.x.
  59. Dettori N, Flook BN, Pessl E, Quesenberry K, Loh J, Harris C, Harwell TS. Improvements in care and reduced self-management barriers among rural patients with diabetes. *Journal of Rural Health*. 2005;21(2), 172–177. doi:10.1111/j.1748-0361.2005.tb00078.x.
  60. Dorresteijn JA, Kriegsman DM, Assendelft WJ, Valk GD. Patient education for preventing diabetic foot ulceration. *Cochrane Database Syst Rev*. 2014;12:CD001488. doi:10.1002/14651858.CD001488.pub5
  61. Hingorani A, LaMuraglia GM, Henke P, Meissner MH, Loretz L, Zinszer KM, et al. The management of diabetic foot: a clinical practice guideline by the society for vascular Surgery in collaboration with the American podiatric medical association and the society for vascular medicine. *J Vasc Surg*. 2016;63(2 Suppl):3Se 21S. doi: 10.1016/j.jvs.2015.10.003
  62. De-Berardis G, Pellegrini F, Franciosi M, Belfiglio M, Di Nardo B, Greenfield S, Kaplan S, Rossi MCE, Sacco, M, Tognoni G, Valentini, M, Nicolucci A. QUED Study Group. Physician attitudes toward foot care education and foot examination and their correlation with patient practice. *Diabetes Care*. 2004;27(1):286–287. doi: 10.2337/diacare.27.1.286.