การทบทวนวรรณกรรมเชิงบูรณาการเกี่ยวกับความรู้โรคเบาหวาน และการจัดการดูแลตนเอง สำหรับผู้ที่มีแผลเบาหวานที่เท้า

An Integrative Review of Diabetes Knowledge and Self-Care Management Among People with Diabetic Foot Ulcers

เสน่ห์ ขุนแก้ว (Saneh Khunkaew) [1]
Ritin Fernandez (Ritin Fernandez) [2]
Jenny Sim (Jenny Sim) [3]
อลิษา ขุนแก้ว (Alisa Khunkaew) [4]
นันทกานต์ ปักษี (Nuntakarn Paksee) [5]

Corresponding author E-mail: saneh@unc.ac.th
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บทคัดย่อ

แผลเบาหวานที่เท้านับเป็นปัญหาทางสาธารณสุขและมีอุบัติการณ์การเกิดเพิ่มขึ้นทุกปี วัตถุประสงค์ในการศึกษาครั้งนี้คือ เพื่อสังเคราะห์งานวิจัยขั้นปฐมภูมิและทุติยภูมิเพื่อนำเสนอความรู้เกี่ยวกับเบาหวานและการจัดการตนเองสำหรับผู้ที่เป็นแผลเบาหวานที่เท้า การทบทวนวรรณกรรมเชิงบรูณาการนี้ถูกนำมาใช้ตลอดการวิจัยในครั้งนี้ โดยการสังเคราะห์งานวิจัยทั้งเชิงปริมาณและเชิงคุณภาพที่ตีพิมพ์อยู่ในฐานข้อมูล MEDLINE, CINAHL, PsycINFO และ Scopus ถึง เดือนพฤศจิกายน 2562 งานวิจัยทั้งหมดนี้เป็นงานวิจัยปฐมภูมิและทุติยภูมิที่ถูกตีพิมพ์ในวารสารที่มีผู้ทรงคุณวุฒิและถูกประเมินคุณภาพงานวิจัยโดยใช้แบบประเมินของ CASP checklist โดยผู้วิจัยคนที่ 1 และตรวจสอบอีกครั้งโดยคนที่ 2 งานวิจัยทั้งหมด 12 เรื่อง ถูกคัดเลือกเข้ามาในการศึกษาครั้งนี้ นำมาวิเคราะห์แก่นสาระ ประกอบด้วย 3 แก่นเรื่อง ดังนี้ 1) ความรู้ในฐานะผู้ปฏิบัติงาน 2) การฝึกปฏิบัติการดูแลเท้าด้วยตนเอง 3) ผลกระทบของความหลากหลายในการเกิดแผลเบาหวานที่เท้า การทบทวนวรรณกรรมเชิงบรูณาการนี้ได้ชี้ให้เห็นถึงประโยชน์ของความรู้เกี่ยวโรคเบาหวาน เทคนิคการดูแลตนเอง และการฝึกการดูแลเท้าด้วยตนเอง นอกจากนี้การศึกษานี้ยังมีส่วนช่วยผู้ที่ปฏิบัติงานในกลุ่มผู้ที่เป็นแผลเบาหวานที่เท้านั้นได้พิจารณาถึงวิธีการให้สุขศึกษา และฝึกให้การดูแลตนเองแก่ผู้ที่เป็นแผลเบาหวานที่ได้อย่างมีประสิทธิภาพอีกด้วย

คำสำคัญ: ความรู้เบาหวาน, แผลเบาหวานที่เท้า, การทบทวนวรรณกรรมเชิงบรูณาการ, การจัดการดูแลตนเอง

1 วิทยาลัยพยาบาลบรมราชชนนี อุตรดิตถ์ อีเมล์: saneh@unc.ac.th
Boromarajonani College of Nursing Uttaradit E-mail: saneh@unc.ac.th
2 School of Nursing, University of Wollongong E-mail: ritin.fernandez@health.nsw.gov.au
3 School of Nursing, University of Wollongong E-mail: jennysim@uow.edu.au
4 วิทยาลัยพยาบาลบรมราชชนนี อุตรดิตถ์ อีเมล์: alisa@unc.ac.th
Boromarajonani College of Nursing Uttaradit E-mail: alisa@unc.ac.th
5 วิทยาลัยพยาบาลบรมราชชนนี อุตรดิตถ์ อีเมล์: nuntakarn@unc.ac.th
Boromarajonani College of Nursing Uttaradit E-mail: nuntakarn@unc.ac.th

ABSTRACT

Diabetic foot ulcers have become a major public health problem and their prevalence is rapidly increasing. The purpose of this study was to synthesise the primary and secondary research to provide knowledge relating to diabetes self-care management for adults living with diabetic foot ulcers. An integrative literature review was undertaken, using hand searched and publications indexed in MEDLINE, CINAHL, PsycINFO and Scopus published up to December 2020. Primary research published in peer reviewed journals were appraised against quality assessment criteria using CASP checklist by one author and checked by a second author. Twelve papers met the selection criteria for synthesis. Three themes were identified: 1) Knowledge as an enabler 2) Actual foot self-care practices and 3) Impact of diversity on diabetic foot ulcer development. This integrative review has identified the impact knowledge and foot-self-care management strategies can have on development of diabetic foot ulcers care. These findings can assist health care providers to make decisions on the types of education and self-care management practices to educate people with diabetes.

Keywords: Diabetes knowledge, Diabetic foot ulcers, Integrative review, Nursing, Self-care management

Introduction

Diabetes has become a major public health problem and its prevalence is rapidly increasing. In the United States, the prevalence of diabetes among older adults has risen from 5.8% in 1988-1994 to 12.4% in 2005-2010 (Selvin, Parrinello, Sacks, & Coresh, 2014). In Canada, the estimated prevalence of diabetes is 7.6% of the population (Greiver et al., 2014). One of the major complications of diabetes if not managed appropriately is diabetic foot ulcers (Barshes et al., 2013) normally caused from neuropathy. Diabetic foot ulcers (DFUs) are a major complication affecting up to 15% of people with diabetes mellitus (Meetoo, 2014). It has been reported that up to 4.5% of people newly diagnosed with diabetes mellitus have diabetic foot ulcers (Sinharay, Paul, Bhattacharyya, & Pal, 2012). Factors reported to cause foot ulcers among people with diabetes mellitus include changes in the bony structures of the foot, peripheral neuropathy and peripheral arterial disease (Aiello et al., 2014). Diabetic foot ulcers are the highest cause of hospitalization amongst people with diabetes mellitus (Thewjitcharoen et al., 2014). In addition, up to 25% of people with diabetic foot ulcer(s) require lower limb amputations (Boulton, Vileikyte, Ragnarson-Tennvall, & Apelqvist, 2005; Singh, Armstrong, & Lipsky, 2005). Living with diabetic foot ulcers has a significant impact on the quality of life of the person affected and their families (Kossioris & Karousi, 2015).

Evidence suggests that in addition to control of blood glucose levels, providing patient education about strategies to reduce the incidence of diabetic foot ulcers will reduce amputations (ADA, 2010; Dorresteijn, Kriegsman, Assendelft, & Valk, 2012; Haas et al., 2014; Nemcova & Hlinkova, 2013; Ren et al., 2014). Foot care is an important part of diabetic foot ulcer prevention and should involve daily monitoring (Mayfield, Reiber, Sanders, Janisse, & Pogach, 2003). Numerous studies have investigated patients' perceptions of foot self-care practice, self-care behavior and awareness, prevalence of risk factors in diabetic foot ulcers, and the prevention of diabetic foot ulcers (Abbas, Lutale, & Archibald, 2009; Chellan et al., 2012; Chin, Huang, & Hsu, 2013; Dixit et al., 2011; Kiani, Moghimbeigi, Azizkhani, & Kosarifard, 2013). The majority of these studies have focused on prevention of diabetic foot ulcers in residential aged care settings and in the general population. Quandt et al. (2014) examined the link between diabetes knowledge, age, income, and literacy levels and found that older participants, people with low incomes, and individuals with low literacy levels, all had lower scores related to their diabetes knowledge. People with low literacy levels also have an increased risk of having diabetes complications particularly diabetic foot ulcers (Al-Kaabi, Al Maskari, Cragg, Afandi, & Souid, 2015).

According to diabetes has become a major burden to global public health. Foot ulcers are a serious complication of diabetes mellitus and have a significant impact on quality of life. Especially, the domain of physical functioning, role physical, general health, and vitality were reported poor quality of life among adults living with diabetic foot ulcers (Khunkaew, Fernandez, & Sim, 2019). A lot of literature has been reported on the diabetes care and management. However, there are a small number of studies that examine particularly in patient's knowledge and self-care management relating to diabetic foot ulcers. This literature review undertakes the existing studies on the knowledge and self-care management skills of people with diabetic foot ulcers. An integrative literature review technique was chosen to enable different study designs to be explored as part of the review (Whittemore & Knafl, 2005).

Purpose

The purpose of this integrative review was to synthesize primary research findings relating to diabetic foot care knowledge and self-care management skills of adults who have diabetic foot ulcers to inform future research on the phenomenon.

Methods

This study was conducted using the Whittemore and Knafl (2005) integrative review framework so that information from various study designs could be synthesized. The steps involved in the review were: problem identification; literature search; appraisal of methodological quality; data analysis; and presentation. The PICOS framework (Participants, Interventions,

Comparisons, Outcomes, Study designs) was used to guide development of the research question and is presented in Table 1 (Polit & Beck, 2012)

Table 1 PICOS framework

	PICOS (Participants, Interventions, Comparisons, Outcomes, Study designs)
P	People with diabetic foot ulcers
I	Nil intervention
C	Nil comparatives
O	Self-care management and knowledge of DFUs and diabetes
S	Primary quantitative and qualitative research and secondary research

Data sources and Keyword searches

A comprehensive search strategy was implemented to identify the relevant literature. The data sources were: MEDLINE, CINAHL, PsycINFO, and Scopus. A search of the electronic databases was conducted using the following key terms, truncation, MeSH Terms and Boolean combinations: "diabetic foot ulcer*" OR "diabetic foot sore*" OR "diabetic foot" OR "diabetic foot wound" AND "self care" OR "self management" OR "self-care" OR "self-management" AND knowledge. References from the selected studies were screened to identify any further studies which were not retrieved in the initial search. This can be identified the relevant articles which is not indexed or unindexed; allow researcher scan the relevant studied and ensured the relevant that not overlooked (Craane, Dijkstra, Stappaerts, & De Laat, 2012; Richards, 2008).

Inclusion and exclusion criteria

Studies were included if they were published in English; used primary research methods (quantitative and/or qualitative); were peer reviewed; published up to December 2020; included data on assessment of patient knowledge and self-care management of people with DFUs; and included participants aged 18 years or older. Studies that included people who did not have a diagnosis of type 2 diabetes mellitus and people with foot ulcers related to foot deformities and general injuries were excluded.

Table 2 Study Eligibility Criteria

Inclusion	Exclusion
1. Adult aged ≥ 18-year-old	1. Participants who did not diagnosis with diabetes mellitus (DM)
2. Published in English	2. Participants who did not have a diabetic foot ulcer (DFU)
3. Peer reviewed	3. Participants with foot ulcers related to an accident, foot deformities and injuries
4. Primary and secondary research	4. Did not describe the knowledge or self-care management in people with DFUs
5. Type 2 diabetes mellitus with active foot ulcers	5. Editorials, discussion papers, conference papers, expert opinions
6. Assessment patient knowledge and self-care or self-care management	
7. Published up to November 2018	

Search outcomes

Results from all electronic database searches were downloaded into Endnote© Version X8 (Reuters, 2011). The search identified 232 publications that were potentially relevant to the review (see Figure 1). Following removal of duplicates, 140 publications remained. Evaluation of the title and abstract of each article against the inclusion and exclusion criteria was undertaken by one author and then checked by a second author; this excluded an additional 119 publications. Full text copies of 21 potentially eligible studies were obtained. Two researchers read each article independently to determine if it met the inclusion and exclusion criteria. Nine studies were excluded as they did not assess patient knowledge (n = 1); or did not report specifically on people with diabetic foot ulcers (n = 8). Following this review 12 studies were included in this review.

Appraisal of methodological quality

Checklists from the Critical Appraisal Skills Programme (CASP) specific to the research design of each included study were used to appraise the methodological quality (CASPChecklists, 2014). We used the CASP Cohort and Qualitative Study Checklist for appraising which consists of three sections and 12 questions. Appraisal of methodological quality was undertaken by one author (XX) and then independently reviewed by another author (YY). The possible answer was recorded a “yes”, “no” or “can’t tell”. Section A, the first two answer “yes”, then proceeded to next remaining questions. Any disagreements were resolved via discussion. Two studies were identified as low quality (Mahakalkar, Kaple, Jain, Laddha, & Wagh, 2015; Neil, 2002) but were included as they contributed to understanding of the problem being explored.

Data analysis

The data from all included studies were abstracted into a summary table by one author (XX) and then reviewed by all authors. Thematic analysis was used to compare and contrast the findings in each of the studies using the guidelines published by Braun and Clarke (2006). One author (XX) presented a potential thematic structure which was discussed and agreed with all authors.

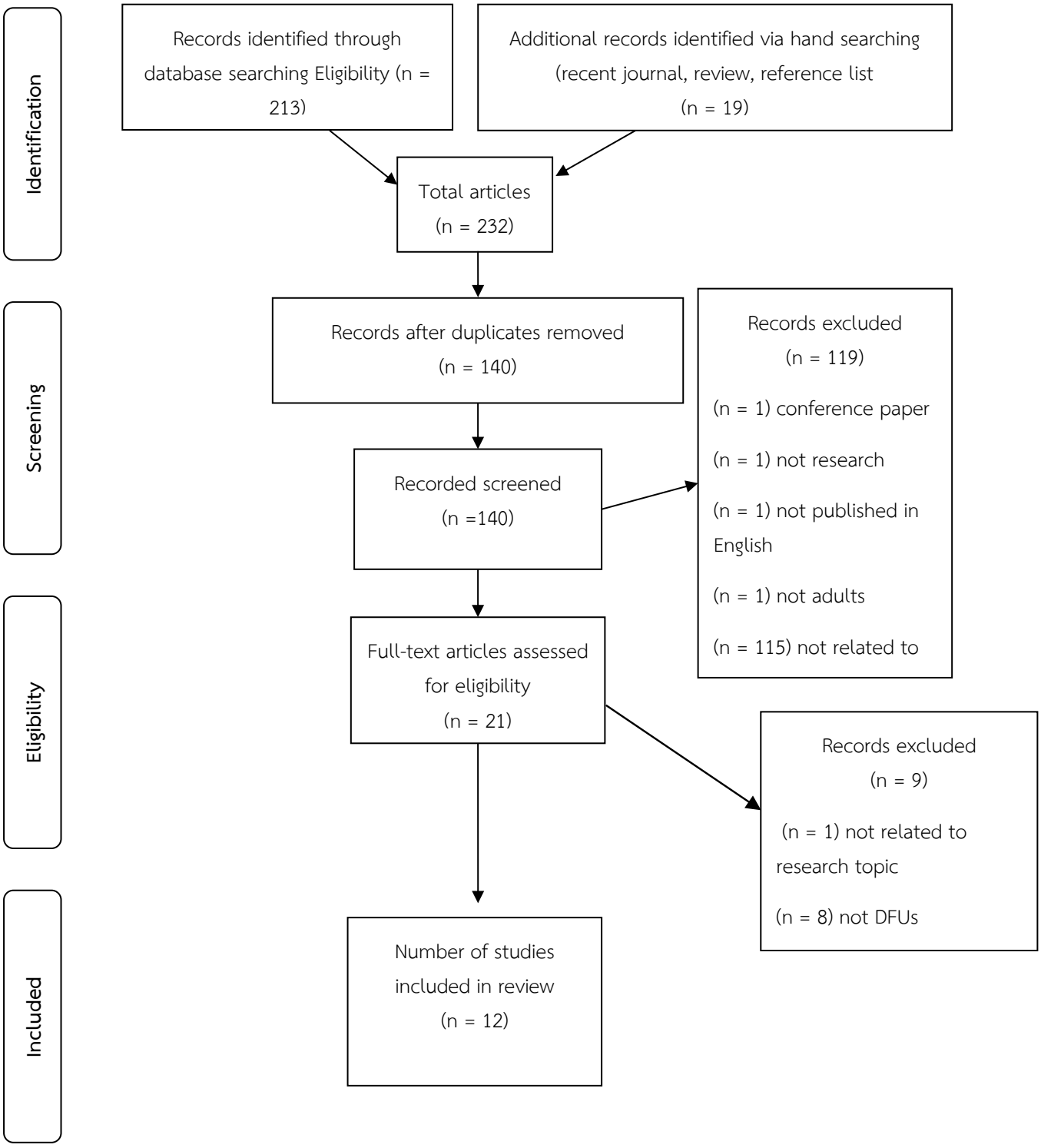

Figure 1: Process of paper selection – PRISMA Flow diagram (Moher, Liberati, Tetzlaff, & Altman, 2010)

Results

A narrative summary of the included studies is presented in Table 3.

Included papers and demographics

A total of 12 studies were included in the final review (see Figure 1). The studies were conducted in a range of different countries including: India, Tanzania, Sweden, Ethiopia, Thailand, the United States of America, Slovakia, and the United Kingdom. The sample size in the included studies ranged from six (Chithambo & Forbes, 2015) to 404 (Chiwanga & Njelekela, 2015). The majority of the studies used a cross-sectional design (n=8) (Chellan et al., 2012; Chiwanga & Njelekela, 2015; Mahakalkar et al., 2015; Mariam et al., 2017; Navicharern, 2012; Neil, 2002; Nemcová & Hlinková, 2014; Sriussadaporn, Ploybutr, Nitiyanant, Vannasaeng, & Vichayanrat, 1998) and four qualitative studies (Chithambo & Forbes, 2015; Hjelm & Apelqvist, 2016; Khunkaew, Tungpunkom, Sim, & Fernandez, 2018; Searle et al., 2008) were also included. No secondary research was identified that met the inclusion criteria.

Only three of the 12 studies had a population with a larger number of female participants (Chiwanga & Njelekela, 2015; Neil, 2002; Sriussadaporn et al., 1998). Participants' age was not reported in all studies. Where reported, participants ranged in age from 18 to 86 years (Hjelm & Apelqvist, 2016; Khunkaew et al., 2018; Neil, 2002) with the mean age reported as varying between 49.8 to 61.08 years (Mariam et al., 2017; Nemcova & Hlinkova, 2013). Seven studies included the clinical characteristics of participants and where provided these are summarised in table 3. The clinical characteristics included: duration of diabetes, duration of DFU, medications, presence of risk factors (neuropathy, peripheral vascular disease, smoking history, BMI), and HbA1c. The presence and severity of DFU was reported in most studies with four studies explicitly using the Wagner classification system (Chellan et al., 2012; Khunkaew et al., 2018; Mahakalkar et al., 2015; Navicharern, 2012; Nemcova & Hlinkova, 2013). One study also used the University of Texas diabetic wound classification stages and grading tool (Mahakalkar et al., 2015). The remaining studies stated that a person had a DFU but data on the severity of the DFU was not provided.

The key themes from the literature were: 1) Knowledge as an enabler 2) Actual foot self-care practices and 3) Impact of diversity on DFU development.

Table 3: Summary Table

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
1. Chellan et al. (2012)	To examine risk factors for DFU's; and evaluate relationship between knowledge, attitude and practice (KAP) of diabetic foot care between patients with and without DFUs	India	203 people (103 with DFUs; 100 without DFU)	A cross-sectional study	KAP questionnaire on diabetic foot care	67.5% males 59.9 ±11.4 years 29.1% on insulin 37.1% on OHA 33.0% on insulin + OHA DFU group had a DFU on the Wagner classification system for wounds but no summary data provided	• In DFU group, occurrence of DFU increased with duration of diabetes. Incidence of DFU at < 10 years of diabetes = 37.8%; between 10-20 years = 58.8%; > 20 years = 70.3% (compared to 29.7% in non-DFU group who had diabetes > 20 years ($p < 0.001$)). • 30.1% of people with DFUs had poor foot care knowledge (compared to 14.0% in non-DFU group) • Poor foot care practice assessed in people with DFUs = 39.8% patients (compared to 9.0% of people without DFUs ($p < 0.001$)). • Risk factors of diabetic peripheral neuropathy; peripheral vascular disease; retinopathy; nephropathy; smoking; pan-chewing; alcohol consumption all significantly ($p < 0.001$) associated with DFU development
2. Chithambo and Forbes (2015)	To explore patient reasons for the delay in seeking help for foot problems related to diabetes.	England	6 people with DFUs	Interpretative Phenomenol-ogical Analysis	Qualitative interview guide	Age range (49 to 69 years) Duration of diabetes (8 months to 49 years) All with active DFU's (2 with history of amputations)	• Participants reported variations in information provided to them about foot risk. Those with more detailed information did not translate this into prompt action when they identified foot problems. • Those living alone or with vision impairments had difficulties completing foot care behaviours • Participants were able to detect foot problems but still delayed seeking help and necessary treatment. • Most common DFU presentation was a blister which participants tended not to regard as significant. • Two participants experienced delayed secondary referral by GP. The consequences of non-referral in primary care were one person being hospitalised for 3 months and the other 7 months.

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
3. Chiwanga and Njelekela (2015)	To determine current prevalence of DFU and assess knowledge and practices of foot care among patients attending public diabetes clinic.	Tanzania	404 people (62 with DFU; 342 without DFU)	A cross-sectional study	Knowledge assessed using open ended questions (Authors own tool – max. score =23) Summary of Diabetes Self-care Activities (SDSCA) measure Clinical measures: Modified Neuropathy Disability Score (NDS); Ankle brachial pressure index (ABPI); presence of DFU	55.4% female 53.6±12.7 years 15.3 % people had DFU (no Wagner scoring provided) 44% people had peripheral neuropathy 15.0% people had peripheral vascular disease	• The mean scores of knowledge on diabetes foot care was 11.2 ± 6.4 SD (Maximum score = 23). Scores were similar among people with and without DFU. • Higher means scores were associated with higher level of education, longer duration of diabetes, and having received information on foot care. • A total of 48.0% of people had previously received information about foot care. Participants received education from nurses (83.5 %); doctors (16.6%) and media (6.2%). • Foot self-inspection were completed regularly (6-7days per week) by 37.9 % of patients. When a person had a DFU, this fell to 37.1% of patients. • A total of 27.5 % of people reported having their feet examined by a doctor at least once since their initial diagnosis.

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
4. Hjelm and Apelqvist (2016)	To describe beliefs about health and illness among foreign-born people with DFUs regarding self-care and health-care seeking and, also to study whether there are dissimilarities related to origin.	Sweden	26 people with DFUs	A qualitative descriptive study	Semi-structured individual qualitative interviews	76.92% males Aged 38-86 years old(median: 59.5 years) 13 born in European counties 12 born in Middle East 1 born in South America Duration of diabetes (median: 22 years; range: 8-36) Duration of DFUs (median: 7 years; range 0-14 years) DFU group reported complications but no DFU status provided	• Patients received limited advice or no advice at all concerning daily foot care. The health care providers said “take a foot bath and rub the feet”. No more details were provided. • Some of participants sought help from professional podiatrists or physicians at the diabetes clinic or health-care centre. Others sought help in their home countries. • The wives of male patients were the key persons to perform self-care management procedures. • Self-care management was influenced by religious practices, particularly among Muslims. There was a positive influence on hygiene care related to praying in combination with rituals such as washing their feet and other parts of the body. • Limited knowledge about managing hyperglycaemia or hypoglycaemia was given when medication and treatment was changed.
5. Khunkaew et al. (2018)	To explore the experiences of Thai adults in Northern Thailand living with DFUs	Thailand	13 people with DFUs	A qualitative descriptive study	Semi structure interview	Seven female and six male Average Age (years) was 63.46 years old (range 52-76 years). Wagner’s Classification Grade 1 = 6 Grade 2 = 7	• Using a cotton bag or wearing a sock to protect the wound on their feet from dust was a common self-care management strategy. • Using the Phlong (to be clam) and Thum Jai (think positive) techniques can reduce stress from unhealed DFUs. • Sandals are a suitable footwear choice among Thai people because of the weather (which is hot and humid). • Moderating carbohydrate consumption was a strategy used by many participants. This involved avoiding having tropical fruits, dessert and sticky (glutinous) rice.

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
6. Mahakalkar et al. (2015)	To evaluate the pattern of distribution of foot ulcers in diabetic foot patients.	India	30 people with diabetic foot ulcers	A cross-sectional study	Wagner's classification and University of Texas diabetic wound classification	70% males Aged range (32-78 years) Duration of diabetes (8.20 ± 10.06 years) Wagner's classification Grade 1 n=5 Grade 2 n=6 Grade 3 n= 9 Grade 4 n= 6 Grade 5 n= 4 University of Texas diabetic wound classification Stages & grading IA n= 3 IB n=4 IC n= 0 ID n=0 IIA n=1 IIB n=12 IIC n=0 IID n= 6 IIIA n= 0 IIIB n=0 IIIC n=0 IIID n= 4	• Foot ulcers were spread evenly across feet: left foot (50%); right foot (46.7%); both feet (3.3%) • A high percentage of foot ulcers were at fifth metatarsal (53.3%), followed by heel (26.7%) and great toe (10%) • The majority of the people had DFUs of Wagner grade 3 (Deep ulcer with abscess or osteomyelitis) and University of Texas diabetic wound classification of II B. • 20.0% of participants had a prior amputation • 36.7% of participants had foot deformity • 56.7% of participants had insensitivity to 5.07 S-W monofilaments • 43.3% of participants had impaired vibration • 40.0% of participants had abnormal Achilles tendon reflex • 30.0% of participants had impaired posterior tibial artery • 33.3% of participants were found to have ankle-brachial index lower than 0.8 • 46.7% of participants were found to regularly walk barefoot. • 13.3% of participants had customised footwear

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
7. Mariam et al. (2017)	To determine diabetic foot ulcers and associated factors among adult with diabetes mellitus	Ethiopia	279 people (38 DFUs; 241 without DFUs)	Cross –sectional study	A structured and pretested questionnaire (Author's own)	55.2% males Mean age was 49.8 with SD ± 15.6 years 6.5% smokers BMI between 18 and 24.5 kg/m^2 38.6% had diabetes more than 6 years 13.6% people had DFU (no Wagner scoring provided)	• The following factors were found to be significantly associated with DFUs: Residence (AOR= 2.57; 95% CI: 1.42, 5.93), type of diabetes mellitus (AOR= 2.58; 95% CI: 1.22, 6.45), overweight (AOR= 2.12; 95% CI: 1.15, 3.10), obesity (AOR= 2.65; 95% CI: 1.25, 5.83), foot self-care practice (AOR= 2.52; 95% CI: 1.21, 6.53), and neuropathy (AOR= 21.76; 95% CI: 8.43, 57.47). • People with diabetes living in rural areas were 2.75 times more likely to develop DFUs than those who live in an urban area (AOR= 2.57; 95% CI: 1.42, 5.93). • People who had type 2 diabetes were 2.58 times more likely to develop DFUs than those who had type I diabetes (AOR= 2.58; 95% CI: 1.22, 6.45). • Overweight diabetic patients were 2.12 times more likely to develop DFUs as compared to diabetic patients with normal weight (AOR= 2.12; 95% CI: 1.15, 3.10). • Obese diabetic patients were 2.65 times more likely to develop diabetic foot ulcers as compared to diabetic patients with normal body mass index (AOR= 2.65; 95% CI: 1.25, 5.83). • Diabetic patients who had not practiced foot self-care were 2.52 times more likely to develop diabetic foot ulcers than those diabetic patients who had practiced foot self-care (AOR= 2.52; 95% CI: 1.21, 6.53). • Diabetic patients who had neuropathy were 21.7 times more likely to develop diabetic foot ulcers as compared to those diabetic patients without neuropathy (AOR= 21.76; 95% CI: 8.43, 57.47)

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
8. Navicharern (2012)	To examine the correlation between diabetes self-management, fasting blood glucose and quality of life among patients with diabetic foot ulcers.	Thailand	80 people with diabetic foot ulcers	A cross-sectional study	WHOQOL-BREF-THAI and Summary of Diabetes Self-care Activities (SDSCA)	51.3% males 37.5% of DFUs had no income 35% of DFUs were primary school education level 61.3 % had diabetes more than 10 years Severity of foot ulcers (Wagner grade) Level 1: 61.5% Level 2: 25% Level 3: 6.3% Level 4: 2.1% Level 5: 5.2%	• SDSCA measures self-reported behaviours on last 7 days (High mean = high levels of adherence to the measured concept) • Highest mean score on SDSCA were for medication adherence (mean = 5.58); Diet control (mean = 4.16); hygiene and foot care (mean = 4.14) • Lowest mean score on SDSCA were for exercise (mean = 1.03) • "Moderate" scores of QOL were reported by 78.8% of participants • There was a negative relationship between high fasting blood glucose levels and quality of life (r=-0.35, p <0.05). • High score in diabetes self-management were associated with higher quality of life (r=0.35, p< 0.05).
9. Neil (2002)	To illustrate the findings on self-care practices related to foot care of people with diabetes mellitus.	America	61 people live in rural area (24 with DFU; 37 without DFU)	A cross-sectional study	Modified Siriraj Foot –Care Score Questionnaire	49.18% males Age range (18-81 years) Duration of diabetes (mean 8.5 years) Duration of having DFU (mean 2.5 years) 83 % people had DFU (no Wagner scoring provided)	• 78.3% of people with foot ulcers checked their feet at least five times a week. • 79.2% of people with foot ulcers cleaned their feet once a day. • 79.2% of people with foot ulcers used soap and water to clean their feet. • 6.3% of people with foot ulcers used knives or razor blades to cut their nails. • 17.4% of people with foot ulcers did not wear shoes outside • 54.2% of people with foot ulcers went barefoot inside the house.

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
10. Nemcova and Hlinkova (2013)	To evaluate the efficacy of diabetic foot care education.	Slovakia	100 people (52 with DFU; 48 without DFU)	A cross-sectional study	Using structured assessment based on the practical reasoning scheme	53 % males BMI overweight ≥ 25 n=32 HbA1c 5.3% - 13.8% n=73 Smoker n= 27 57.9% of people had DFUs; Wagner's grade 3-5)	• People with diabetic foot ulcers had a higher level of knowledge ($p = 0.028$) regarding foot care ($x = 80.37\%$) than people with IDLE ($x = 72.71\%$). • People with IDLE were more willing and motivated to be educated than patients with diabetic foot ulcers (IDLE $x = 78.55$; DFS $x = 70.43$). • Regardless of education approach (group or individual) there was statistically significant ($p = 0.037$) difference in willingness and motivation to be educated following the education program. • The organisation and format of education (individual vs. group) impacted on willingness and motivation to participate ($p = 0.001$). • Education program was effective as all clinical parameters showed significant positive changes six months after education ($p < 0.05$).
11. Searle et al. (2008)	To explore the psychological impact on behavioural factors that influence both the incidence of chronic wounds and their progression.	The United Kingdom	44 people (26 with DFU; 18 without DFU)	Qualitative study	Interview	65.38% male Mean age for people with DFUs was 67 years 69.23% had DFUs related to T2DM 59.09% of people had DFUs (no Wagner scoring provided)	• Participants with DFUs were often not able to recall key recommendations for foot care immediately following consultations. • Some participants did not understand the cause of DFUs and were unaware of how to prevent DFUs occurring. • Poor circulation was perceived to be the primary reason for amputations. Injuries or foot ulcers were only thought to lead to amputations in rare cases. • People with foot ulcers had difficulty engaging in the foot care management outside of the consultations with podiatrists. • Some podiatrists felt frustrated and unsupported to empower and build partnerships with people with foot ulcers.

Reference	Aim	Country	Sample	Methods	Instruments	Demographics & DFU status of participants	Findings
12. Sriussadaporn et al. (1998)	To examine behaviour in self-care of the foot and foot ulcers in Thai non-insulin dependent diabetic patients.	Thailand	165 people (55 with DFU; 110 without DFU)	A cross-sectional study	Questionnaire foot-care management (Author's own)	76.4% females DFU locations: 25.4% at first toe and first metatarsal head, 18.4% at lateral malleolus, 16.4% at sole, 12.8% at pretibial area, and 12.7% fifth toe. Duration of DFUs range 9-360 days (mean 36.4 ± 50.2 days) Of patients with DFU (n=55) 92.7 % had one DFUs, 7.3% had two DFUs, 89.1% had concomitant infections, and 24.5% had gangrene 54.5 % occurred on right leg	• Foot self-care management questionnaire had total score of 20. High mean scores indicate good self-care management practices. • The mean score in foot inspection, foot cleaning, nail care and use of footwear were lower in DFU group. • The Foot cleaning score was significantly lower in people with foot ulcers compared to people without foot ulcers (7.35 ± 0.21 vs 7.88 ± 0.11; $p < 0.05$). • The risk of developing foot ulcers was significantly increased by 2.5 fold with a total self-care score less than 15 (OR = 2.6, 95%CI 1.3 – 5.6). • 38% of participants were able to recognise the antecedent events of foot ulceration • 45.5% of people with foot ulcers neglected their foot ulcers • 54.5 % of people with foot ulcers inappropriately care for their wounds

Abbreviations:

ABPI = Ankle brachial pressure index; BMI = Body Mass Index; DFU = Diabetic Foot Ulcer; GP = General Practitioner; HbA1c = Glycosylated Haemoglobin; IDLE = Ischaemic Disease of Lower Extremities; KAP = Knowledge, Attitude and Practice; NDS = Neuropathy Disability Score; OHA = Oral Hypoglycaemic Agents; SDSCA = Summary of Diabetes Self-care Activities; T2DM = Type 2 Diabetes Mellitus; WHOQOL-BRIEF-THAI = World Health Organization Quality of Life Brief Thai version

Theme 1: Knowledge as an enabler

Diabetic foot care knowledge has been identified as an enabling factor for prevention of a DFU. Two studies examined the knowledge levels of people living with diabetes and found deficiencies in knowledge of foot self-care among people with and without DFU's. One study undertaken in India with 103 participants identified that diabetic foot care knowledge was poor in 30.1% of participants with DFUs in comparison to 14.0% among those without DFUs (Chellan et al., 2012). Another study reported that having a DFU did not influence knowledge about foot care when compared to people without DFUs; this finding may have been influenced by the fact that only 48% of people with a DFU in this study had received foot care education (Chiwanga & Njelekela, 2015). The impact of knowledge on foot self-care practices was examined by Sriussadaporn and colleagues (1998) who found that 61.7% of all participants with a DFU were unable to recognise the antecedents to developing their own foot ulcer. The source of educational information is also important. One study undertaken in a public diabetes clinic in Dar es Salaam in Tanzania reported that of the 194 participants (48%) who had received foot care, education came from nurses (83.5%); doctors (16.6%); and other sources such as the media (6.2%) (Chiwanga & Njelekela, 2015).

In terms of willingness and motivation to be educated, one study used an educational intervention to measure knowledge and the impact it had on foot self-care practices (Nemcova & Hlinkova, 2013). Participants were allocated to either individual or group foot care education programs which included information on: diet and diabetes, self-assessment of their feet, footwear selection, solutions to problems with the feet, diabetic ischaemic disease of the lower extremities, and foot exercises (Nemcova & Hlinkova, 2013). Significantly higher levels of knowledge, willingness and motivation regarding foot care ($p = 0.028$) were identified after the intervention regardless of whether individual or group education was used (Nemcova & Hlinkova, 2013). The education program was deemed effective, as all reported clinical parameters showed significant positive improvements six months after the educational intervention (Nemcova & Hlinkova, 2013). No follow up was examined beyond this time point.

People with DFUs are reported to have low levels of knowledge about foot care which impacts on their awareness of their foot problem and perceptions about wound care. Four qualitative studies aimed to explore patient problems related to diabetic foot care (Chithambo & Forbes, 2015; Hjelm & Apelqvist, 2016; Khunkaew et al., 2018; Searle et al., 2008). People with DFUs were shown to be lacking awareness, were hardly able to recall what the healthcare providers had told them and had difficulty engaging in foot care management outside of consultations with podiatrists (Searle et al., 2008). Another study also reported that people with DFUs tended not to regard their problems as

significant (Chithambo & Forbes, 2015). Participants in Chithambo and Forbes (2015) study did not convert the knowledge they had about DFUs into prompt action for treatment when they identified foot problems. In Hjelm and Apelqvist's (2016) study patients reported receiving only limited or no advice at all concerning foot care. This translated into low levels of health-seeking practices within this population of overseas born Swedish residents. In contrast, Khunkaew et al. (2018) found that people with DFUs used their knowledge to initiate self-care strategies. In the qualitative study of 13 individuals with DFUs, many participants reported using a cotton bag or a sock to protect the wound from dust when shoes were not available or not suitable (Khunkaew et al., 2018). This action indicates that knowledge influenced the self-care management practices. In addition most respondents reported that they moderated their diet in an attempt to reduce their blood glucose levels by avoiding and/or moderating the quantity of tropical fruits, dessert and sticky rice that they consumed (Khunkaew et al., 2018).

Theme 2: Actual foot self-care practices

Foot self-care management practices are crucial to prevention and management of DFUs. Seven studies examined foot self-care practices. The Summary of Diabetes Self-Care Activities measure (SDSCA) was used by two studies (Chiwanga & Njelekela, 2015; Navicharern, 2012). One study (Neil, 2002) used the Modified Sriraj Foot-Care Score questionnaire and all other studies (Chellan et al., 2012; Mahakalkar et al., 2015; Mariam et al., 2017; Sriussadaporn et al., 1998) used questionnaires developed by the research teams.

In the study by Chiwanga and Njelekela (2015), foot self-inspection was completed regularly (defined as 6-7 days per week) by 37.9% of all patients. In the group with an existing DFU this fell to 37.1% (Chiwanga & Njelekela, 2015). People with DFUs reported some high-risk behaviours, such as: not inspecting the inside of shoes (69.4%); walking barefoot outside (62.9%); and using sharp instruments to cut nails (91.9%) (Chiwanga & Njelekela, 2015). In addition, shoe selection is important for people with DFUs. Shoes need to fit correctly and be breathable. A qualitative study undertaken in Thailand reported that sandals with heel straps were the most commonly selected shoe (Khunkaew et al., 2018). Participants reported that even though the government supplied shoes for people with diabetes in Thailand, participants did not wear them because of the climate in Thailand and their preference for shoes that were breathable (Khunkaew et al., 2018).

Neil (2002) also reported high-risk behaviours among people who had DFUs: 17.4% went barefoot outside the house; 54.2% went barefoot inside the house; and 6.3% used knives or razor blades to cut their nails. Navicharern (2012) used mean scores to assess SDSCA responses where a maximum score was 7. The mean scores for

self-management related to medication adherence was 5.58, diet control was 4.16 and hygiene and foot care was 4.14; the lowest mean score was for exercise (mean = 1.03) (Navicharern, 2012).

Similarly, findings from other self-report studies identified poor foot self-care management practices. Chellan and colleagues (2012) identified that 39.8% of patients with a DFU had poor foot-care practices in comparison to 9.0% of people without a DFU ($p < 0.001$). In an Indian population of people with DFU's, 46.7% of participants reported walking around barefoot on a regular basis and only 13.3% of participants used customised footwear (Mahakalkar et al., 2015). In an Ethiopian study of 279 participants (38 of whom had a DFU), diabetic patients who did not practice foot self-care practices were 2.52 times more likely to develop a DFU than those patients who did (OR = 2.52, 95% CI 1.21-6.53) (Mariam et al., 2017). Sriussadaporn et al. (1998) reported that there was a significant difference in self-care practices between people with DFUs compared to people without DFUs (7.35 ± 0.21 vs 7.88 ± 0.11; $p < 0.05$). It was reported that 45.5% of people neglected their foot ulcers and 54.5% of people with foot ulcers used inappropriate methods or materials to care for their wounds (Sriussadaporn et al., 1998).

The cross-sectional studies that explore self-care management of DFUs do not examine why people with DFUs demonstrate poor self-care management practice. The qualitative studies included in this review provide some insight into this phenomenon. The study by Chithambo and Forbes (2015) found that participants were able to detect foot problems when they occurred but still delayed seeking help because antecedents such as a blisters were not regarded as significant. Hjelm and Apelqvist (2016) reported that patients received limited advice or no advice at all concerning daily foot care. The health care providers were reported by participants to give general advice and this type of advice was seen as unhelpful by participants (Hjelm & Apelqvist, 2016). Some health care providers, such as podiatrists, felt frustrated and unable to empower patients to engage in adequate foot care outside the consultation (Searle et al., 2008). Similarly, participants were often unable to recall what the healthcare providers had told them and had great difficulty engaging in foot care management outside of the consultations (Searle et al., 2008). For some participants this meant that they sought alternative sources of assistance with family members taking on a key role for diabetic foot care (Chithambo & Forbes, 2015; Hjelm & Apelqvist, 2016). This reliance on others was successful in some cases but became problematic when the support person was not available to help or had another disability such as blindness or partial loss of vision (Chithambo & Forbes, 2015; Hjelm & Apelqvist, 2016). In the study undertaken in Thailand (Khunkaew et al., 2018), the wealth of family members played a role in the quality of wound care products chosen

and in the use of specialist footwear. Participants who did not have access to additional funds to support care reported alarming practices such as the use of alcohol, herbal medicines and toothpaste on wounds as cleansing products (Khunkaew et al., 2018).

Theme 3: Impact of diversity on DFU development

Many studies explored the demographic, location and cultural differences among people with and without DFUs. Higher mean scores of knowledge about foot self-care management were related to participants' level of educational attainment, length of time they had diabetes and whether they had received education on foot self-care management by a health care provider (Chiwanga & Njelekela, 2015). Location was also found to be significant factor with 54.2% of people living in rural areas going barefoot outside the house (Neil, 2002). The practice of not wearing shoes outside and their rurality meant that rural participants were 2.75 times more likely to develop a DFU than those who lived in an urban area (OR= 2.57; 95% CI: 1.42-5.93) (Neil, 2002). In addition, type of diabetes had an impact, with people who had been diagnosed with type 2 DM being 2.58 times more likely to develop DFUs than those who had type I DM (OR= 2.58; 95% CI: 1.22-6.45) (Mariam et al., 2017).

Comorbid conditions and foot deformity also impact on development of DFUs. Mahakalkar et al. (2015) found that people with foot deformity (36.7%), neuropathy (56.7%), impaired vibration (43.3%) impaired posterior tibial artery (30.0%) and ankle-brachial index lower than 0.8 (33.3%) were more likely to have foot ulcers. Mariam et al. (2017) indicated that obese diabetic patients were 2.65 times more likely to develop diabetic foot ulcers (OR= 2.65; 95% CI: 1.25-5.83); and people with neuropathy were 21.7 times more likely to develop DFUs (OR= 21.76; 95% CI: 8.43-57.47) as compared to those diabetic patients without these complications.

The rationale for why people with demographic and cultural differences have different outcomes related to DFU development is not always clear. Chithambo and Forbes (2015) identified that people who live alone or have vison impairments frequently find it difficult to participate in foot self-care management behaviours. Self-care management was found to be influenced by religious practices in the qualitative study undertaken by Hjelm and Apelqvist (2016). This was particularly the case among Muslim participants where a positive influence on hygiene was related to rituals around praying and washing of the feet at places of worship (Hjelm & Apelqvist, 2016). Similarly, Khunkaew et al. (2018) found that Phlong (to be calm) and Thum Jai (think positive) were techniques that helped participants in Thailand to reduce stress from unhealed DFUs. Identification of culturally appropriate techniques such as this may assist people to manage and/or prevent DFU development.

Discussion

This integrative review was undertaken to synthesise the existing research to provide knowledge relating to diabetes self-care management for adults living with diabetic foot ulcers. Despite the extensive literature on management of diabetic foot ulcer there was limited literature on self-care knowledge and foot self-care management practices of adults living with diabetic foot ulcers. The findings of this integrative review suggest that the link between knowledge about self-care management practices and the use of self-care management strategies on a daily basis for people with DFUs is not clear. This is consistent with findings from a systematic review undertaken in 2012 which found that education programmes alone are insufficient and additional strategies for the prevention of DFUs are necessary (Dorresteijn et al., 2012). This creates a challenge for health care professionals to identify how they can link knowledge about why a person needs to use self-care management practices and the actual use of those practices on a regular basis so that DFUs can be prevented. One study in this review (Nemcova & Hlinkova, 2013) demonstrated that an educational intervention can play a significant role in improving knowledge if it is structured and delivered as part of a package of care. The program resulted in significant improvements in clinical characteristics at 6-month follow-up. Longer term follows up is required to evaluate the efficacy of this type of holistic education program.

The evidence from this review demonstrates that improved knowledge regarding foot care occurs when a person participates in formal education programs (Nemcova & Hlinkova, 2013). However, low literacy levels and socioeconomic status were factors that affect self-care management among people with DFUs (Chiwanga & Njelekela, 2015). For example, people who developed a blister did not take any further action to manage it as they did not recognise that it was significant in terms of foot self-care management (Chithambo & Forbes, 2015). This is similar to findings from Desalu et al. (2011) among people with diabetes mellitus which found that 68.8% of respondents were unaware of what they should do when they found redness/bleeding between their toes. As a result of this information, education programs need to be targeted at the needs of the individual, incorporated into routine care and evaluated so that the efficacy of education programs on an individual's knowledge of self-care management practices can be assessed as part of clinical care.

This integrative review should provide the impetus for health care professionals to review existing education programs and ensure that education programs are integrated into clinical care so that self-care knowledge in people with diabetic foot ulcers is enhanced. Education that is provided must be individualised and knowledge of participants must then be assessed as part of the program. The use of knowledge to then impact upon foot self-

care management practices is pivotal to ensuring people with diabetes who are at risk of developing DFUs and people with an existing DFU practice effective foot self-care management practices. One challenge for health care professionals is to decide whether to educate people with diabetes who are at risk of developing DFU's in a group setting or on an individual basis. Further evidence is required to identify the efficacy of different approaches.

This review has shown that there are improvements that can be made to the coordination and integration of education on self-care management into clinical care for people with diabetes to prevent and manage DFUs. Specialist advice should be available to support people with their self-care knowledge requirements. Evidence suggests that when self-care education is provided and understood by participants that it impacts self-care practices (Nemcova & Hlinkova, 2013). Multi-disciplinary teams need to work together to design appropriate interventions to minimise complications that can occur from diabetes. All people with diabetes should receive education on self-care management to prevent diabetic foot ulcers.

Limitation of the study

There are a few limitations to this review. The majority of studies used cross-sectional design, and as a result could not assess the cause and effect of knowledge regarding self-care management in an adult living with diabetic foot ulcers. Only five studies used validated tools to assess knowledge and foot self-care management practices. In addition, there was no benchmarking between studies and limited data about the contents of education interventions which made it difficult to evaluate and compare the effectiveness of different diabetic foot care education programs. Another limitation of this review was the inability to identify any reliable evidence to demonstrate the impact of knowledge on self-care management of people with diabetic foot ulcers. Robust evidence is required to explore both the potential of quantitative and qualitative designs to inform the best methods of preventing foot ulcers amongst people living with diabetes mellitus.

Conclusion and recommendation

This integrative review has identified a number of factors that impact upon the effectiveness of diabetic foot care education programs among people with diabetic foot ulcers. Health care professionals need to design education and self-care management programs that combine clinical management and education into an integrated program that meets individual participant's needs. All health care professionals working in diabetes management settings should be educated about what causes DFUs and should integrate education into routine clinical care. This approach then needs to be rigorously evaluated. A specific focus on prevention of DFUs and the self-care management skills required by people with diabetes mellitus to prevent DFUs is

required as part of routine care. Specific attention on developing programs which can reduce DFUs in individuals with low literacy levels and in developing countries is also warranted.

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