

REVIEW

# Foot Care among Diabetes Patients: A Concept Analysis



Parliani Parliani<sup>1,2</sup>, Somporn Rungreangkulkij<sup>2</sup>, Khanitta Nuntaboot<sup>2</sup>

<sup>1</sup>Faculty of Nursing, Institut Teknologi dan Kesehatan (ITEKES) Muhammadiyah Kalimantan Barat, Indonesia

<sup>2</sup>Faculty of Nursing, Khon Kaen University, Thailand

## Article Info

Article History:  
Received: 6 December 2022  
Revised: 28 August 2023  
Accepted: 29 August 2023  
Online: 31 August 2023

Keywords:  
Concept analysis; diabetes;  
foot care; ulcer

Corresponding Author:  
Parliani Parliani  
Faculty of Nursing, Institut  
Teknologi dan Kesehatan  
(ITEKES) Muhammadiyah  
Kalimantan Barat, Indonesia  
Email:  
[parliani@stikmuhptk.ac.id](mailto:parliani@stikmuhptk.ac.id)

## Abstract

**Background:** The concept analysis of “foot care” is essential for expanding the nursing knowledge base, synthesizing a broader theoretical concept, and guiding more effective care for diabetes patients with and without diabetic foot ulcers (DFU). Foot care in nursing has not yet been comprehensively defined for nurses and other healthcare professionals.

**Purpose:** This concept analysis aimed to elucidate the nursing practice concept of foot care. The study identified surrogate terms associated with the concepts, attributes, antecedents, and consequences by employing Rodger’s evolutionary method in a critical analysis of the relevant literature.

**Methods:** This research used Rodger’s evolutionary analysis. The databases were PubMed (n=188), ProQuest (n=4,790), ScienceDirect (n=292), and Google Scholar (n=7,810) with a total of 13,080 articles identified in this study. The screening process involved evaluating titles and abstracts, followed by a thorough analysis of inclusion criteria, which included full-text articles and the presence of keywords: foot care, diabetes, diabetic foot ulcer. Articles that did not provide a clear definition of foot care were excluded. A total of 45 articles were included. Rodger’s evolutionary analysis stressed inductive investigation and careful analysis of the concept.

**Results:** The results of the foot care concept analysis were: (1) among people with diabetes without DFU, the attributes were foot screening and foot examination, while the antecedents were high glycemic levels, inability of the pancreas to produce insulin, abnormal foot skin condition, and foot-related behaviors; (2) among patients with DFU, the attributes were foot intervention and education, while the antecedents included foot self-care knowledge, motivation, and family and social support. The consequences associated with the concept of foot care included improvement in self-efficacy, quality of life, and self-care behavior.

**Conclusion:** Nurses can use the findings of this foot care analysis in their clinical work by promoting and practicing foot care as a preventative measure that shields patients from ulcers. Additionally, nurses can intervene when patients already have ulcers and provide appropriate wound care. Foot examinations become more manageable when specific practice guidelines are available for diabetes patients.

**How to cite:** Parliani, P., Rungreangkulkij, S., & Nuntaboot, K. (2023). Foot care among diabetes patients: A concept analysis. *Nurse Media Journal of Nursing*, 13(2), 246-262. <https://doi.org/10.14710/nmjn.v13i2.50722>

## 1. Introduction

Diabetes is a metabolic disorder caused by high blood glucose levels due to impairments in insulin secretion, its action, or a combination of both (American Diabetes Association [ADA], 2021). The classifications of diabetes are type 1 diabetes, where a complete deficiency of insulin arises from autoimmune b-cell, and type 2 diabetes, when beta cell insulin production lowers, usually due to insulin resistance, genetic mutations creating monogenic diabetes illnesses, such as neonatal, young adult and gestational diabetes (ADA, 2022). Diabetes is badly affected by diabetic foot ulcer (DFU), which requires a comprehensive therapy (Turkment et al., 2021).

Foot care is one of the preventative measures for protecting diabetes patients from DFU (Adiewere et al., 2018). There is a 15% prevalence of diabetic foot ulcers worldwide (Das et al., 2022). The prevalence of DFU has increased globally, reducing life expectancy (Yimam et al., 2021). Over 2% to 3% of diabetics have active DFU, with a 25% lifetime risk (Lim et al., 2017). Twenty-seven percent of diabetics in Ethiopia have DFU (Yimam et al., 2021), and North-West England DFU epidemiology reports 2.2% prevalence (Lim et al., 2017). In Indonesia, 7.3% of diabetics have complications of DFU (Yunir et al., 2021). A previous study also found that 12% of

diabetics have DFU, and high-risk patients should be educated on proper foot care to reduce their risk of DFU (Yusuf et al., 2016).

DFU might cause economic burdens (Adeyemi et al., 2021), psychological impacts on patients and families, amputation risks, sepsis, and death (Yunir et al., 2021). This condition can lengthen hospital stays, resulting in poor quality of life (Adeyemi et al., 2021) and long-time care on DFU treatment (Das et al., 2022). DFU, the most dangerous diabetic complication in Indonesia, increases morbidity, death, and disability (Damhudi et al., 2021), and 51.7% of diabetics during 6.5 years get complications of DFU (Yunir et al., 2021). DFU is mostly caused by poor self-care (Megayanti & Suantika, 2021), 50% of no proper diet, and 88.7% of not doing foot care (Ramadhaniyati & Parliani, 2020). Diabetes foot care behaviors are influenced by illness perception, local belief, and treatment management (Indrayana et al., 2019). A previous study explained that inadequate foot care knowledge and practice can contribute to amputation in DFU patients (Sivan et al., 2021). Another study evaluated that health attitudes affect foot self-care (Tsai et al., 2021). In recent years, a study utilizing the instrument for DFU foot care evaluation revealed that diabetes patients have never scrutinized their feet, never dried their toenails after cleansing, and have insufficient foot care behaviors influenced by their health beliefs (Tsai et al., 2021).

The major purpose of self-, family- and community-centered treatment is to improve diabetes patients' quality of life. The government should assess public services and health care in personals, families, and communities, such as screening programs including foot exercise, foot care, and insurance for patients with DFU (Pourkazemi et al., 2016). The Ministry of Health of the Republic of Indonesia has campaigns about diabetes foot care to prevent diabetic foot complications. This program aims to decrease the number of DFU (Mahendradhata et al., 2017). Self-care behavior, including diabetes foot care, can be improved by self-instructional training among diabetes patients (Wahyuni et al., 2021).

The term foot care has multiple meanings depending on the science disciplines or the patients (Subrata & Phuphaibul, 2019). Foot care by nurses is unclear. A previous study pointed out a limitation in conducting foot assessments, specifically related to the term "foot care." This limitation stems from the need for consistent understanding of foot care terminology among foot-care educators, which can result in similar perceptions (Fujii et al., 2021). Currently, both nurses and patients perceive foot care as limited to wound care. The comprehensive definition of foot care in nursing has not yet been established for patients or practitioners.

Referring to the study by Subrata & Phuphaibul (2019), which utilized the Walker and Avant concept analysis method in DFU patients during wound care, it is essential to analyze the concept of "foot care." This analysis serves to expand nursing knowledge, synthesize a greater theoretical concept, and provide a guide for more effective care of diabetic patients with or without DFU. Another study suggested that nurses need to explore their understanding of the term "foot care" and its tests to see their understanding of foot care assessment and foot care practice for a significant improvement in the quality of foot care (Stolt et al., 2018). The latest guideline developed by researchers has not yet specifically defined "foot care" among diabetes patients with and without DFU (Parliani et al., 2021). Therefore, the definition of foot care needs to be explored to develop assessment tests and indicators of foot care. A comprehensive definition of foot care for diabetes patients without DFU, with DFU, and after DFU using a revolutionary method of concept analysis is deemed necessary. Therefore, this concept analysis was conducted to elucidate the nursing practice concept of foot care. This study identified surrogate terms related to concepts, attributes, antecedents, and consequences by applying Rodger's evolutionary method in a critical analysis of the relevant literature.

## **2. Methods**

### **2.1 Research design**

This study utilized Rodger's analysis of evolutionary concepts. This methodology emphasizes inductive research and rigorous analysis. The evolutionary stages of foot care include the following primary actions: (1) to identify the concept of interest and associated expressions (including surrogate terms); (2) to identify and select an appropriate realm (settings and samples for data collection); (3) to collect data pertinent to identify the attributes and the contextual basis of the concepts; (4) to analyze data pertinent to the aforementioned characteristics of the concept;

(5) to identify an illustration of the concept; and (6) to identify hypotheses and implications of the concepts (Rodgers & Knaf, 2000).

2.2 Data collection

The literature search included PubMed, ProQuest, ScienceDirect, and Google Scholar. Inclusion criteria were literature in the English language, nursing studies as primary literature, full text, research paper or review, and published from 2018 to 2022. The literature search used “OR” and “AND”. The keywords and MeSH used were “Forefoot, Human OR Metatarsus OR Toes OR Heel AND Care AND Diabetic Foot Ulcer”. The initial search for ‘foot care in diabetic ulcer’ and ‘foot care in diabetes’ in PubMed found 188 articles and only 21 articles were included. The second search, performed on ProQuest, found 4,790 articles, of which only three articles matched the search terms of ‘foot care in diabetes’ and ‘foot care in diabetic ulcer.’ ScienceDirect was used to conduct the third search, which found 292 articles and only four articles were reviewed. Google Scholar, the fourth database, found 7,810 publications, and only 17 publications met the study criteria (Figure 1). The samples for this investigation consisted of 45 articles.

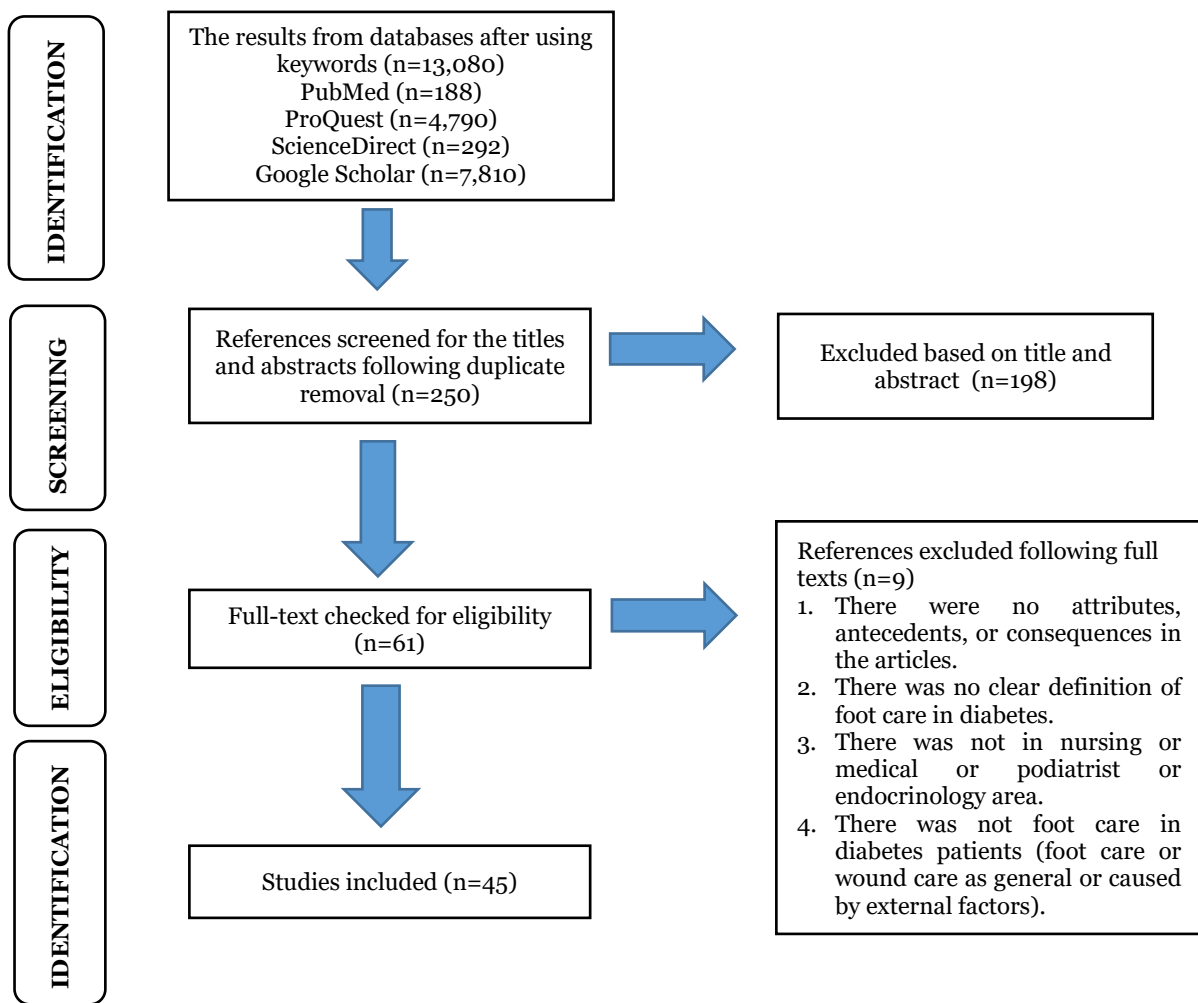


Figure 1. Article’s screening in literature review systematic process

2.3 Data analysis

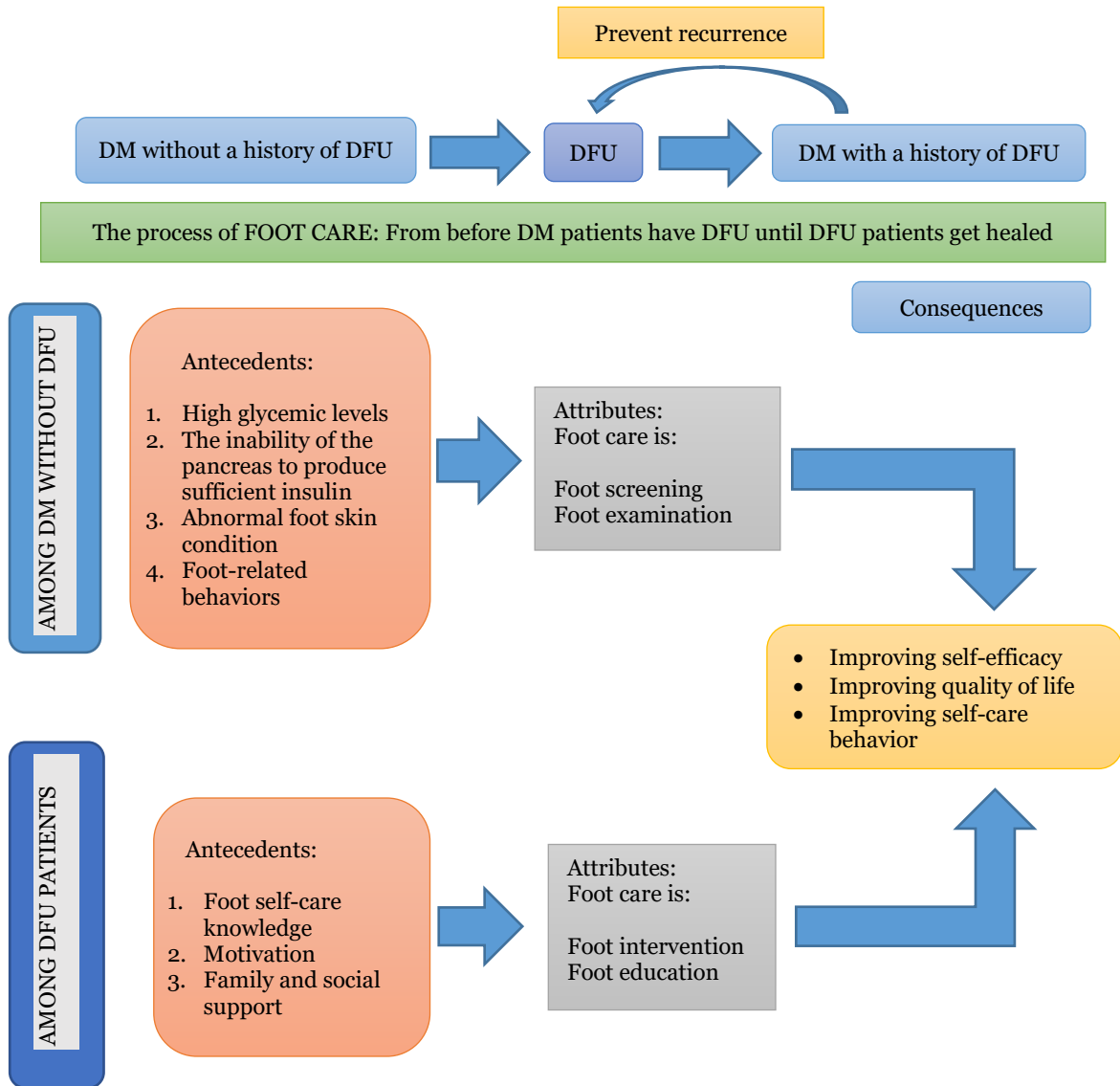
Roger’s evolutionary data analysis approach is inductive and discovery-oriented, aiming to identify the significant components of the concept (Rodgers & Knaf, 2000). The first researcher (PP) utilized PDF software to search each document for “foot care.” Subsequently, the researchers (PP, SR, KN) reviewed the definitions and documented them in Microsoft Word. They then categorized the features using the main words from the articles. Traits, sub-attributes, antecedents, and consequences were further categorized by the researchers (PP, SR, KN). Finally, they meticulously constructed the framework of concept summaries. The concept’s synonyms

were identified using surrogate terminologies, and related terms were words similar to the concept but did not share the same characteristics (Toftthagen, 2010).

### 3. Results

#### 3.1 The results of the concept analysis

The results of the concept analysis indicated that individuals with diabetes without DFU are prone to complications that could lead to DFU, while diabetes patients with DFU, after receiving proper foot care, may experience healing of the ulcer. Foot care for DFU patients will likely prevent the recurrence of DFU. The concept analysis of foot care is divided into diabetes patients without DFU and diabetes patients with DFU, which have their own antecedents and attributes yet similar consequences (Figure 2).



**Figure 2.** The results of the foot care concept analysis

#### 3.2 Surrogate terms and related terms

Today, nursing is related to caring and holistic care. Researchers from many areas have studied nursing care and holistic care, where foot care is one of the holistic care for diabetes with or without DFU that lacks a meaningful term (Jasemi et al., 2017). The commitment, connection, and focus in experiences with individuals, organizations, and others can be part of nursing care that can improve personality traits, communication skills, management of health problems, and promotion (Babaei, 2019). Foot care is potentially interchangeable. Foot care is also related to routine care of the feet (Nang et al., 2019).

### *3.2.1 Dictionary definitions*

This concept analysis combines “foot” with “care.” Foot care is defined as “pertaining to the care of one’s feet by a foot-care specialist” (Oxford Learner’s Dictionary, 2008). Furthermore, Collins Dictionaries (2018) defines care as “the process of caring for someone or something and providing what they need for their health or protection.” The Cambridge Dictionary (2009) defines care as “the process of protecting someone or something and meeting their needs.” Oxford Learner’s Dictionary (2008) describes care as “providing for someone’s health, welfare, upkeep, and protection”. Meanwhile, foot is defined as the noun in the first phrase. The foot “is the lowest part of the leg, below the ankle, on which a person or animal stands” (Oxford Learner’s Dictionary, 2008).

### *3.2.2 Foot care definitions from the perspective of nursing*

#### *3.2.2.1 Nursing field*

In the nursing field, “care” is the foundational term for nurturing and a central concept of the discipline (Brilowski & Wendler, 2005). The literature on diabetes and/or DFU mentioned the term “management” in the context of diabetic foot care (Abate et al., 2020; Aydin & Ertuğrul, 2021; Boulton, 2021). It may clarify the phrase from Oxford Learner’s Dictionary (2008), which describes management as “the activity of running and controlling” or “the act or skill of dealing with a situation.” Nursing interventions for foot care comprise controls, actions, and skills (process). Patients with diabetes who have already developed an ulcer are treated with offloading, debridement, and topical agents, and their foot care is also managed using clinical guidelines (Ousey et al., 2018). Foot screening, foot care skills, and therapeutic footwear can avoid diabetic foot ulcers, and patients who do not engage in active prevention have an elevated risk of developing ulcers (Coffey et al., 2019). Physical and psychological factors, including interactions between biological risk factors, such as peripheral neuropathy, and foot-related behaviors, such as donning ill-fitting shoes, foot self-care knowledge, engagement, barriers, motivators, family support, and community health services, support the complications (Coffey et al., 2019).

DFU patients’ foot care is part of the nursing intervention and assessment (Karadag & Sengul, 2021; Niculescu & Grumezescu, 2022). Foot intervention in DFU involves hyperbaric oxygen therapy (Oley et al., 2020). Self-care should promote DFU patient management throughout care (Mohseni et al., 2021). The foot care management of DFU patients includes examination, dressing, offloading, blood glucose control, and wound prevention in diabetes (Sulistyo, 2018). The interventions of foot care among diabetes patients are prevention for improving knowledge and treatment, such as daily foot wash with soft soap and keeping them moist, avoiding walking barefoot, checking the feet daily, contacting a doctor or podiatrist expert if there are any red or swollen or small ulcers, wearing appropriate shoes to give sufficient space to move the toes, wearing special shoes if necessary, and consulting to the doctor if there is callus on the foot (Saltar & Sahar, 2020). The treatments such as offloading, dressing selection, infection control, and biofilm may be included in foot care interventions, followed by palpation of pulses, testing for loss of protective sensation, and assessment of wounds as the components of a physical examination (Levy & Gillibrand, 2019; Niculescu & Grumezescu, 2022).

Foot care can be defined as the process of foot examination through screening and education, as well as the management of diabetes with or without DFU and infection control among DFU patients (Abate et al., 2020). The purpose of foot examination is to enhance self-care behavior (Niculescu & Grumezescu, 2022).

#### *3.2.2.2 Health science field*

Nurses play a role in educating DFU patients about proper foot care and promoting self-care practices to prevent the development of DFU in individuals with diabetes (Adiewere et al., 2018; Olowo et al., 2022). Patients with diabetes who do not receive comprehensive management may be at risk of developing DFU, lower limb amputation, ulceration, melancholy, and finally, resulting in a reduced quality of life (Adiewere et al., 2018). If patients have knowledge and self-efficacy, foot screening and intervention can be improved (Goodall et al., 2020).

Foot care among DFU patients includes assessments and interventions of wound care. The assessment can use instruments such as computer software, portable and mobile devices, optical imaging, spectroscopy, and artificial intelligence (Chan & Lo, 2020). Diabetes foot care refers to DFU education, which requires improved patient foot care knowledge (Heng et al., 2020). Foot

care consists of offloading interventions, such as devices, footwear, surgical procedures, and other techniques, such as felted foams (Lazzarini et al., 2020), and wound care interventions among DFU patients, such as dressing choice, wound assessment (depths, exudates, infections), and regular wound cleaning (De Waal & Vermeulen, 2022). Interventions for foot ulcers include foot infection prevention and ulcer healing process treatment. Ulcers can lead to amputations, infections, disability, and hospitalization (Lazzarini et al., 2020).

### 3.3 The attributes or characteristics

The characteristics or attributes in the foot care concept can be seen in Table 1. The attributes of foot care can be divided into the attributes for DM without DFU and the attributes for DM with DFU.

**Table 1.** Attributes of foot care

No	Literature	Attributes	DM with/ without DFU
1.	Firdaus & Jittanoon (2021), Norman et al. (2020), Saltar & Sahar (2020)	Foot screening	DM without DFU
2.	Aydin & Ertuğrul (2021), Firdaus & Jittanoon (2021), Musuuza et al. (2020), Ousey et al. (2018), Perez-Favila et al. (2019), Tulloch et al. (2020)	Foot intervention	DM and DFU
3.	Abate et al. (2020), Alven et al. (2022), Cassidy et al. (2021)	Foot education	DM and DFU
4.	Boulton (2021), Lee et al. (2022), Olowo et al. (2022)	Foot examination	DM without DFU

#### 3.3.1 The attributes of DM without DFU

##### 3.3.1.1 Foot care is foot screening

The first attribute of foot care is foot screening (Firdaus & Jittanoon 2021; Norman et al. 2020; Saltar & Sahar 2020). Foot screening can be done using a monofilament test, Ankle Brachial Index (ABI), history of amputation or history of previous ulcers, and inspection of foot deformity (Parliani & Wahyuni, 2020). Screening for diabetic foot complications is an essential component of diabetes care because it prevents significant morbidity, loss of function, and mortality; however, foot surveillance is frequently disregarded (Allen et al., 2021).

##### 3.3.1.2 Foot care is foot examination

The second attribute is foot examination, which describes the self-care practice of foot care (Lee et al., 2022; Olowo et al., 2022). Diabetic patients typically require an annual comprehensive diabetic foot examination in order to decrease the risk of developing severe infections. However, individuals who have experienced foot complications due to diabetes may require more frequent comprehensive foot examinations that can be conducted by a primary care provider specializing in foot care (Ousey et al., 2018). A study suggests that examination of the feet is needed during foot care (Boulton, 2021).

#### 3.3.2 The attributes of DM with DFU

##### 3.3.2.1 Foot care is foot intervention

Foot care can be interpreted as interventions of the foot. Foot care refers to adequate care for DFU, such as management of adequate perfusion, pressure mitigation, infection control, relieving pressure, optimizing blood flow (Perez-Favila et al. 2019), guideline standard for preventing DFU, wound care (Aydin & Ertuğrul 2021; Chan & Lo, 2020; Musuuza et al. 2020; Ousey et al. 2018, Tulloch et al., 2020), diabetic foot care team interventions (Firdaus & Jittanoon, 2021), treatment for ulcer infections (Boulton 2021), management of ischemia, medical management of comorbidities, and surgical management of DFU (Lung et al. 2020).

##### 3.3.2.2 Foot care is foot education

Foot care can be generalized as foot education. Poor knowledge regarding diabetic foot care has been linked to a higher incidence of DFU among diabetes patients; alternatively,

uncomplicated health education measures can enhance both knowledge and practice regarding diabetes and DFU (Cassidy et al., 2021). Diabetes can be hazardous to the feet. A minor cut on the feet can result in severe complications. Diabetes may cause nerve injury, resulting in loss of sensation in the feet. Diabetes may also decrease blood flow to the feet, making it more difficult to repair wounds or to fight off infections where, due to the aforementioned issues, diabetes patients are mostly not aware of when they are wearing shoes (Adiewere et al., 2018). Consequently, they may develop a lesion or sore (Crawford et al., 2020). This could result in an infection or a wound that does not resolve, putting at risk for amputation (Abate et al., 2020; Alven et al., 2022). Foot education by nurses can play an important role in this concept.

### 3.4 The antecedents

The antecedents of foot care are illustrated in Table 2. They include the antecedents of DM without DFU and the antecedents of DM with DFU.

**Table 2.** Antecedents of foot care

No	Literature	Antecedents	Patients
1	Alven et al. (2022), Dávila et al. (2018), Hasan et al. (2019), Olowo et al. (2019)	High glycemic levels, the inability of the pancreas to produce sufficient insulin	DM without DFU
2	Niculescu & Grumezescu (2022), Pietrzak et al. (2022)	Abnormal foot skin condition	DM without DFU
3	Sen et al. (2019), Woo & Cui (2023)	Foot-related behaviors, for example, wearing ill-fitting shoes	DM without DFU
4	Sen et al. (2019), Woo & Cui (2023), Tuglo et al. (2022)	Foot self-care knowledge	DM with DFU
5	Norman et al. (2020), Tuglo et al. (2022), Woo & Cui (2023)	Motivation	DM with DFU
6	Kadiri (2023), Sen et al. (2019), Coffey et al. (2019), Zhu et al. (2023)	Family and social support	DM with DFU

#### 3.4.1 The antecedents of DM without DFU

##### 3.4.1.1 High glycemic levels

The fiber hypothesis implies that fiber lowers nutrition inflow from the colon, and the glycemic index is especially important to chronic disorders linked with central obesity and insulin resistance (Alven et al., 2022). There is substantial evidence of the importance of the glycemic index in certain diseases, including diabetes, cardiovascular disease, cancer, and even weight management (Dávila et al., 2018).

##### 3.4.1.2 The inability of the pancreas to produce sufficient insulin

Reducing insulin demand or increasing insulin sensitivity may be able to reduce the risk of developing diabetes and after years of exposure to hyperglycemia, pancreatic cells lose function, resulting in glucose intolerance and eventually an irreversible state of diabetes (Hasan et al., 2019). Obesity increases insulin resistance; thus, pancreatic b-cells secrete more insulins where after b-cell compensation, inadequate b-cell mass growth or inability to react to glucose may cause b-cell failure and diabetes then these may result from pancreatic b-cell insulin and IGF-1 signaling deficiencies (Olowo et al., 2022).

##### 3.4.1.3 Abnormal foot skin condition

Foot skin lesions and abnormalities impair daily living (Pietrzak et al., 2022). Diabetes can be caused by dermatological complications due to abnormal carbohydrate metabolism, AGEs in soft tissues and joint ligaments, limb atherosclerosis (macroangiopathy), dermal microangiopathy, limb and dermal neuron degeneration, and impaired immune mechanisms (Niculescu & Grumezescu, 2022).

#### 3.4.1.4 Foot-related behaviors

Poor foot care habits are one of the leading causes of diabetes-related foot disorders (Sen et al., 2019). Diabetic foot care behaviors include foot examination and sanitation (cleansing and drying), care of toenails, rudimentary wound management, and selection of appropriate footwear (Woo & Cui, 2023).

#### 3.4.2 The antecedents of DM with DFU

##### 3.4.2.1 Foot self-care knowledge

Diabetics need foot care instruction due to the rising prevalence of diabetes (Sen et al., 2019). Diabetes patients' awareness and understanding of foot-related hazards and effects would improve diabetic foot care (Woo & Cui, 2023). Foot care instruction is neglected, and after a foot ulcer or amputation, many people discover they need it, and the rise in diabetic foot ulcers requires epidemiological research, evidence-based therapy, and patient-specific preventative interventions (Tuglo et al., 2022).

##### 3.4.2.2 Motivation

Diabetes patients lack the awareness to prevent DFU (Woo & Cui, 2023). Lack of motivation to do foot care can lead to DFU, which may cause psychological harm (Norman et al., 2020). Knowledge, practice, and motivation undermine DFU (Tuglo et al., 2022).

##### 3.4.2.3 Family and social support

Family and social support can help diabetes patients adhere to foot care, which influences patients' motivations and confidence (Kadiri, 2023). The support from family and social can lead to foot care behavior (Sen et al., 2019). Family and social function in foot care to support diabetes patients with DFU to do wound care as scheduled and decrease the stigmatization among DFU patients to improve their confidence to do diabetic foot care (Coffey et al., 2019; Zhu et al., 2023).

#### 3.5 The consequences

The results of foot care consequences are improving self-efficacy, quality of life, and self-care behaviors (Table 3).

**Table 3.** Consequences of foot care

No	Literature	Consequences
1.	Goodall et al. (2020), Nonpanya et al. (2021)	To improve self-efficacy
2.	Adiewere et al. (2018), Perez-Favila et al. (2019), Saltar & Sahar (2020)	To improve quality of life
3.	Goodall et al. (2020)	To improve self-care behavior

##### 3.5.1 Improving self-efficacy

A quasi-experimental study shows that foot care behavior can significantly improve self-efficacy among diabetes patients (Nonpanya et al., 2021). A systematic review study (Goodall et al., 2020) explained that four of five studies reported that the primary outcomes indicated a substantial improvement in self-efficacy scores among participants in the education groups. Foot care knowledge was also significantly better in intervention groups versus control groups in three of seven studies (Goodall et al., 2020). Self-efficacy is a crucial notion within the framework of social cognitive theory, originally formulated by Albert Bandura. Self-efficacy refers to an individual's confidence in their capacity to effectively execute particular tasks and anticipate favorable outcomes (Ahmad et al., 2018).

##### 3.5.2 Improving quality of life

Some studies showed that foot care significantly improves the quality of life among people with diabetes and DFU (Adiewere et al., 2018; Perez-Favila et al., 2019; Saltar & Sahar, 2020). Foot pathologies have a negative impact on the quality of life related to foot health, but foot care can help patients improve their quality of life and prevent them from amputation and infections (López-López et al., 2021).



### 3.5.3 Improving self-care behavior

A previous study found that foot care can help diabetic patients improve their self-care behavior (Goodall et al., 2020). The implementation of daily foot care habits is contingent upon various individual and familial factors (Khatichop et al., 2022). This condition helps diabetes persons with or without DFU improve their self-care behavior, especially foot self-care behavior.

## 3.6 Example cases of the concept

### 3.6.1 Model case

The model case provides all of the attributes for DM with DFU, such as foot intervention and education, as explained in the conversation below.

*Mr. J, who is 35 years old and overweight, has developed an ulcer as a result of his diabetes. He is currently in a chronic disease ward, where the nurse is assisting him and monitoring his health progress.*

*Nurse: How are you feeling now, Mr. J? As I promised yesterday, today I am going to assess your left foot to check the risk of ulceration. I'll be conducting an ankle-brachial index test, a monofilament test to assess neuropathy, examining your foot's skin, and checking your blood glucose levels.*

*Mr. J: Yes, of course. How about the treatment for my wound on the right side?*

*Nurse: Nurse B, who specializes in wound care, will come here at 3 p.m. She will do the interventions for your wound using biofilms and other dressings. She will also perform offloading, remove any dead tissues, and assess the risk of infections.*

*Mr. J: Oh, I see. Yesterday, she let me know how to do a screening of an ulcer in my left foot. She told me to practice self-care, such as foot examination and controlling my food.*

*Nurse: Wonderful. After your ulcer heals, you have to undergo a rehabilitation process, which includes managing DFU, doing routine exercises, and controlling peripheral neuropathy and vasculopathy.*

*Mr. J: Oh, ok. I will always control my foot once it is healed. When I was first diagnosed with diabetes, the hospital provided me with an application. They did education on self-management among diabetes patients using this application.*

*Nurse: Yes, you can use it to perform foot examinations to reduce the high risk of DFU, such as how to do foot exercises, how to control your diet, and the signs and symptoms that lead to ulcerations that I had told you before.*

### 3.6.2 Borderline Case

The borderline case explains partial attributes such as only having foot intervention or foot education in DFU patients. It is illustrated in the case below.

*Mr. James is 35 years old, obese, and just got a cut that got worse because of his diabetes. He is in the hospital now. The nurse gives him medication and talks with him about how his care is being evaluated.*

*Nurse: Mr. James, how are you feeling now? Do you remember the advice that you have to follow to keep your feet safe?*

*Mr. James: Yes, I remember the nurse telling me yesterday about preventing ulcers on my left foot. Yesterday, I did meditation and small exercises for my body using this diabetes exercise video. I also wore appropriate footwear recommended by the doctor and told nurses when I had callus to ask them to perform callus debridement.*

*Nurse: Good. I will check the ulcer on your right foot, and then do wound care interventions using the appropriate dressing.*

*Mr. James: Yes, please. This ulcer was so painful last night, disturbing my sleep. (after the intervention) How about the wound on my right foot?*

*Nurse: After performing wound care treatment, your infection is getting better. I have changed the dressing to one that can absorb the exudates.*

*Mr James: Thank you for your caring.*

### 3.6.3 Contrary case

The contrary case explains the contrast attributes, such as amputation for the contrasting attribute of foot intervention and recovery after surgery for the contrasting attribute of foot examination and screening. It can be seen from the case below.

*Mr. James is 35 years old, obese, and just got a cut that got worse because of his diabetes. He is in the hospital now, where the nurse gives him his prescriptions and talks with the doctor about how well his wounds are healing.*

*Nurse: How are you feeling now, Mr. James?*

*Mr. James: I feel good, nurse*

*Nurse: How is the healing process of your wound? I thought it had already healed.*

*Mr. James: Yeah.. Unfortunately, I had an accident. So, my foot got wounded for the second time. Tomorrow, I have to undergo amputation because there is no proper blood supply in my right foot.*

*Nurse: I am sorry to hear that. However, I will help you to recover after surgery.*

*Mr. James: That will help a lot. Thank you.*

### 3.7 Hypotheses and implications

Foot care is a complex part of nursing practice that can improve the quality of life of diabetes with DFU and without DFU. Foot care also reduces the burden of psychological and social impacts such as stigmatization, anxiety, and negative self-esteem (Coffey et al., 2019). Many kinds of treatment that are explained in attributes can help in preventing DFU among diabetes patients and improving the process of wound healing among DFU patients (Everett & Mathioudakis, 2018). With the high prevalence of DFU among diabetes patients, nurses are required to be aware that these patients will have different complex problems in physical, social, and psychological aspects.

## 4. Discussion

This study aimed to clarify the concept of foot care in nursing. Surrogate terms related to concepts, attributes, antecedents, and consequences are identified. The results showed that diabetic patients without DFU have two attributes, including foot screening and foot examination, while diabetic patients with DFU have two attributes, namely foot intervention and foot education. The antecedents of patients without DFU include high glycemic levels, inability of the pancreas to produce sufficient insulin, abnormal foot skin condition, and foot-related behaviors. On the other hand, the antecedents of patients with DFU are foot self-care knowledge, motivation, family and social support. This study found the attributes of foot care among DM are foot screening, foot intervention, foot education, and foot examination. The foot care attributes in DM with DFU are foot intervention and foot education.

The patients' perspective of foot care is that "foot care is not important" because they believe the important aspect of diabetes is medications (Soprovich et al., 2019). Foot care can be defined as the process of foot prevention from DFU by doing screening and education. Training programs for nurses can be managed by organizations to improve nurses' skills for caring for diabetes patients with or without DFU and help them control ulcer infection (Abate et al., 2020). The importance of foot care is to encourage diabetes patients who still have less knowledge to prevent them from ulcers. The belief that a wound or lesion can recover normally (Zaharieva & Addala, 2022) influences diabetes patients' practice. This misperception may affect health outcomes such as screening, intervention, and examination. The belief derived from the statement, "A friend with diabetes advised me to soak my foot twice daily in cold salt water. Consequently, I did it for 20–25 days. The wound's surface then became worse. The doctor referred me to a surgeon who would perform surgery on it" (Aydin & Ertuğrul, 2021). This case is an example of diabetes patients who lack knowledge about foot care.

Foot care, as foot screening, is a part of foot prevention that can be used among diabetes patients with a history of DFU or without a history of DFU. The prevention of DFU recurrence among diabetes patients with a history of DFU is more complex than those without a history of DFU. The nurses have to routinely prevent the foot from ulcers, such as asking the patients for daily self-examination of the feet, checking the bath and shower temperature, wearing therapeutic

shoes, and undergoing callus debridement by professionals should the calluses exist (Ousey et al., 2018). In addition to providing health care for individuals, families, and communities, one of the duties of nurses is to provide preventative care for patients, which includes screening and management, as well as diabetes care programs (Flaubert et al., 2021). This screening can help diabetes patients protect themselves from DFU.

Foot education involves providing knowledge to diabetes patients with or without DFU as direct education or using some applications about foot care (Cassidy et al., 2021). The key recommendations are education to improve patients' awareness that leads to their foot care practice (Tamata & Mohammadnezhad, 2023). Nurses have primary roles in providing the appropriate health care among diabetes patients (Karaca & Durna, 2019). By promoting the prevention of DFU and any complications of ulcers, foot education helps patients improve their quality of life.

The foot interventions consist of assessment and treatment (Sulistyo, 2018). The intervention is the overall foot care process since before diabetes patients had ulcers until the patients healed and prevented them from DFU recurrence (Paton et al., 2021). The foot interventions include assessing the signs of neuropathic and vascular problems and assessing signs of inflammation or infection in DFU patients (Pitocco et al., 2019). The interventions for diabetes with or without DFU are based on the results of diabetes assessment; then, they follow the guidelines based on needs, such as dressing when nurses provide wound care among DFU patients. Patients with a high risk of DFU require a detailed assessment for ulcer prevention, such as weekly examinations and advice on self-care, foot care, and the use of appropriate stockings and shoes (Dhandapani et al., 2022). The role of nurses in the examination is essential for decreasing the incidence of DFU patients (Alven et al., 2022). Foot examination can help diabetes patients to have optimum blood circulation to their feet. The lack of foot examination can lead to diabetes vascularization disorder on the feet, which is one of the factors associated with ulcers.

The antecedents of diabetic patients with and without DFU are different. These differences occur because the conditions of patients with DFU and without DFU are different. Foot care in diabetic patients without DFU is rarely performed. There is a significant factor that influences foot care among patients in this group, such as diabetes patients' foot care behavior is influenced by foot care knowledge, foot care self-efficacy, and social support (Sen et al., 2019). The diabetes condition can lead to DFU as one of the complications. Foot care for diabetes with a high glycemic index needs to be advised on a regular basis (Al-Owais & Shido, 2020). Abnormal foot skin condition is one of the reasons why diabetes patients go to check their feet because this condition can lead to wounds. Patients with abnormal foot skin conditions are advised to perform foot care in screening, infection control, treatment of bacterial infection, and knowledge to prevent DFU (Lertsirimunkong et al., 2019). The antecedents of foot care among diabetes with DFU can be the effects of the ulcer itself. DFU patients should do foot care in terms of foot management. Patients with DFU will go to the wound clinical settings when they have foot self-care knowledge and follow the foot care schedule. An integrative study shows that foot care knowledge is a predictor that relates to foot care behaviors among DFU patients (Woo & Cui, 2023). Motivation is something that comes from within the patients. Patients who have the motivation to do foot care will come to the clinics to do their wound care. The lack of motivation, family, and social support will influence the perspective of foot care, leading to foot care behaviors among DFU patients (Woo & Cui, 2023).

The consequences of foot care among diabetes with and without DFU are, first, improving self-efficacy among diabetic patients with or without DFU. When the patients have abilities to do foot care, such as daily inspection, cutting nails carefully, keeping feet dry, and others, these abilities can develop their self-efficacy as the basic or fundamental concept in social cognitive theory developed by Bandura (Seyyedrasooli et al., 2015). Second, patients living with diabetes with or without DFU performing foot care can improve their quality of life. DFU patients who have already been cured of DFU will have more confidence and further decrease their economic burdens for wound care. In diabetic patients without DFU, foot care helps prevent DFU, which will also improve their quality of life. Foot care management is the key to decreasing the mortality and morbidity of DFU patients (Khunkaew et al., 2019). Foot care guided by health care professionals leads patients to have good self-care behaviors through professionals' promotion. Diabetic patients without DFU who have poor knowledge are likely to have poor foot care

behaviors, which are influenced by family support, level of education, and knowledge of programs to reduce diabetes distress (Sari et al., 2020).

## 5. Implication and limitation

The implications of this study suggest that the findings can be used to develop assessment tools for foot care among diabetic patients with or without DFU. This study can also help nurses arrange foot education and examination models to comprehensively support foot care management. However, it is important to acknowledge this study's limitations. The researchers had not yet looked into the qualitative assumptions in the nursing field, such as nurses' and health care providers' perspectives and their beliefs regarding foot care. This study had not explored the details yet of each attribute in this concept.

## 6. Conclusion

This findings of this study demonstrate that the foot care process is complex, and individuals with diabetes who do not have a history of DFU should take preventive measures to avoid developing DFU. On the other hand, patients who do not have DFU after getting an ulcer should be prevented from having DFU recurrences. The concept of foot care explains that patient with or without DFU have to get foot screening, foot intervention, foot education, and foot examination to decrease the number of complications and improve their self-efficacy, self-care behavior, and quality of life. This study recommends future studies to explain more about the concept of each attribute. This study can also be extended by incorporating additional studies from databases and expanding it into scoping reviews or other research methodologies. For the clinical setting, the foot care concept can be proposed as a guideline for assessing foot care from foot screening to intervention. This foot care concept can help nurses and health care providers develop tools to promote foot care among diabetic patients with or without DFU.

## Acknowledgment

The researchers would like to thank the Ph.D. program of the Faculty of Nursing, Khon Kaen University, Thailand, for providing this concept analysis subject to contribute to the expansion of knowledge.

## Author contribution

PP, SR, and KN conceived the presented idea. All authors developed and performed the concept analysis. SR and KN encouraged PP to investigate the cases, develop attributes, and supervise the findings of this work. All authors discussed the results and contributed to the final manuscript.

## Conflict of interest

There is no conflict of interest in this study.

## References

- Abate, T. W., Enyew, A., Gebrie, F., & Bayuh, H. (2020). Nurses' knowledge and attitude towards diabetes foot care in Bahir Dar, North West Ethiopia. *Heliyon*, 6(11), e05552. <https://doi.org/10.1016/j.heliyon.2020.e05552>
- ADA. (2021). Standards of medical care in diabetes - 2021 abridged for primary care providers. *Clinical Diabetes*, 39(1), 14–43. <https://doi.org/10.2337/cd21-as01>
- ADA. (2022). Classification and diagnosis of diabetes: Standards of medical care in diabetes — 2022. *Diabetes Care*, 45(Suppl), S17–S38. <https://doi.org/10.2337/dc22-S002>
- Adeyemi, T. M., Olatunji, T. L., Adetunji, A. E., & Rehal, S. (2021). Knowledge, practice and attitude towards foot ulcers and foot care among adults living with diabetes in tobago: A qualitative study. *International Journal of Environmental Research and Public Health*, 18(15), 8021. <https://doi.org/10.3390/ijerph18158021>
- Adiewere, P., Gillis, R. B., Jiwani, S. I., Meal, A., Shaw, I., & Adams, G. G. (2018). A systematic review and meta-analysis of patient education in preventing and reducing the incidence or recurrence of adult diabetes foot ulcers (DFU). *Heliyon*, 4, 614. <https://doi.org/10.1016/j.heliyon.2018>

- Ahmad, A., Abujbara, M., Jaddou, H., Younes, N. A., & Ajlouni, K. (2018). Anxiety and depression among adult patients with diabetic foot: Prevalence and associated factors. *Journal of Clinical Medicine Research*, 10(5), 411–418. <https://doi.org/10.14740/jocmr3352w>
- Allen, M. L., van der Does, A. M. B., & Gunst, C. (2021). Improving diabetic foot screening at a primary care clinic: A quality improvement project. *African Journal of Primary Health Care and Family Medicine*, 8(1), 1–9. <https://doi.org/10.4102/phcfm.v8i1.955>
- Al-Owais, M. M., & Shido, O. A. (2020). Knowledge and practice of foot care in patients with diabetes mellitus attending primary care center at Security Forces Hospital, Riyadh, Saudi Arabia: A cross-sectional study. *Journal of Family Medicine and Primary Care*, 9(12), 5954–5960. [https://doi.org/10.4103/jfmpe.jfmpe\\_943\\_20](https://doi.org/10.4103/jfmpe.jfmpe_943_20)
- Alven, S., Peter, S., Mbese, Z., & Aderibigbe, B. A. (2022). Polymer-based wound dressing materials loaded with bioactive agents: Potential materials for the treatment of diabetic wounds. *Polymers*, 14(4), 724. <https://doi.org/10.3390/polym14040724>
- Atri, A., Kocherlakota, C. M., & Dasgupta, R. (2020). Managing diabetic foot in times of COVID-19: Time to put the best “foot” forward. *International Journal of Diabetes in Developing Countries*, 40, 321–328. <https://doi.org/10.1007/s13410-020-00866-9>
- Aydin, E., & Ertuğrul, M. B. (2021). The role of rehabilitation in the management of diabetic foot wounds. *Turkish Journal of Physical Medicine and Rehabilitation*, 67(4), 389–398. <https://doi.org/10.5606/TFTRD.2021.8616>
- Babaei, S., & Taleghani, F. (2019). Compassionate care challenges and barriers in clinical nurses: A qualitative study. *Iranian Journal of Nursing and Midwifery Research*, 24(3), 213–219. [https://doi.org/10.4103/ijnmr.IJNMR\\_100\\_18](https://doi.org/10.4103/ijnmr.IJNMR_100_18)
- Boulton A. J. M. (2021). Diabetic foot disease during the COVID-19 pandemic. *Medicina (Kaunas, Lithuania)*, 57(2), 97. <https://doi.org/10.3390/medicina57020097>
- Brilowski, G. A., & Wendler, M. C. (2005). Nursing theory and concept development or analysis: An evolutionary concept analysis of caring. *Journal of Advanced Nursing*, 50(6), 641–650. <https://doi.org/10.1111/j.1365-2648.2005.03449.x>
- Cassidy, B., Reeves, N. D., Pappachan, J. M., Gillespie, D., O’Shea, C., Rajbhandari, S., Maiya, A. G., Frank, E., Boulton, A. J., Armstrong, D. G., Najafi, B., Wu, J., Kochhar, R. S., & Yap, M. H. (2021). The DFUC 2020 dataset: Analysis towards diabetic foot ulcer detection. *European Endocrinology*, 1(1), 5. <https://doi.org/10.17925/EE.2021.17.1.5>
- Chan, K. S., & Lo, Z. J. (2020). Wound assessment, imaging and monitoring systems in diabetic foot ulcers: A systematic review. *International Wound Journal*, 17(6), 1909–1923. <https://doi.org/10.1111/iwj.13481>
- Coffey, L., Mahon, C., & Gallagher, P. (2019). Perceptions and experiences of diabetic foot ulceration and foot care in people with diabetes: A qualitative meta-synthesis. *International Wound Journal*, 16(1), 183–210. <https://doi.org/10.1111/iwj.13010>
- Collins Dictionaries. (2018). *Collins English Dictionary*. Collins.
- Crawford, F., Chappell, F. M., Lewsey, J., Riley, R., Hawkins, N., Nicolson, D., Heggie, R., Smith, M., Horne, M., Amanna, A., Martin, A., Gupta, S., Gray, K., Weller, D., Brittenden, J., & Leese, G. (2020). Risk assessments and structured care interventions for prevention of foot ulceration in diabetes: Development and validation of a prognostic model. *Health Technology Assessment*, 24(62), 1–232. <https://doi.org/10.3310/hta24620>
- Damhudi, D., Kertia, N., & Effendy, C. (2021). The effect of modified diabetes self-management education and support on self-care and quality of life among patients with diabetic foot ulcers in rural area of Indonesia. *Journal of Medical Sciences*, 9, 81–87. <https://doi.org/10.3889/oamjms.2021.6614>
- Das, S. K., Roy, P., & Mishra, A. K. (2022). DFU\_SPNet: A stacked parallel convolution layers based CNN to improve diabetic foot ulcer classification. *ICT Express*, 8(2), 271–275. <https://doi.org/10.1016/j.icte.2021.08.022>
- Dávila, L. A., Contreras, M. C. E., Agüero, S. D., & Nava, V. C., Guerrero-Wyss, M., de Assis Costa, J., Pirela, V. B. (2018). Glycemic index trends and clinical implications: Where are we going? *Revista Latinoamericana de Hipertension*, 13(6), 621-632.
- De Waal, G. H., & Vermeulen, H. (2022). Overview of wound care interventions for hospital and community care nurses: A systematic scoping review. *International Journal of Nursing and Health Care Research*, 5(1), 1-17. <https://doi.org/10.29011/2688-9501.101268>

- Dhandapani, S., Kamar, S., & Hiremath, M. B. (2022). Practice and associated factors regarding foot care among diabetes mellitus patients attending a rural primary health center in South India. *Advanced Biomedical Research*, 11, 45. [https://doi.org/10.4103/abr.abr\\_279\\_20](https://doi.org/10.4103/abr.abr_279_20)
- Everett, E., & Mathioudakis, N. (2018). Update on management of diabetic foot ulcers. *Annals of the New York Academy of Sciences*, 1411(1), 153–165. <https://doi.org/10.1111/nyas.13569>
- Firdaus, M. K. Z. H., & Jittanoon, P. (2021). A literature review on intervention programs for diabetic foot care. *Enfermeria Clinica*, 31, S243–S246. <https://doi.org/10.1016/j.enfcli.2020.09.009>
- Flaubert, J. L., Le Menestrel, S., Williams, D. R., & Wakefield, M. K. (Eds.). (2021). *The future of nursing 2020-2030: Charting a path to achieve health equity*. National Academies Press (US).
- Fujii, K., Stolt, M., Komoda, T., & Nishikawa, M. (2021). Effects of nurse and care worker-led foot-care program on older people's foot conditions: Before and after intervention study. *SAGE Open Nursing*, 7, 1-15. <https://doi.org/10.1177/23779608211058492>
- Goodall, R. J., Ellauzi, J., Tan, M. K. H., Onida, S., Davies, A. H., & Shalhoub, J. (2020). A systematic review of the impact of foot care education on self efficacy and self care in patients with diabetes. *European Journal of Vascular and Endovascular Surgery*, 60(2), 282–292. <https://doi.org/10.1016/j.ejvs.2020.03.053>
- Hasan, T., Sultana, M., Shill, L. C., & Science, N. (2019). Effect of glycemic index and glycemic load on type 2 diabetes mellitus. *International Journal of Health Sciences and Research*, 9(2), 259–266.
- Heng, M. L., Kwan, Y. H., Ilya, N., Ishak, I. A., Jin, P. H., Hogan, D., & Carmody, D. (2020). A collaborative approach in patient education for diabetes foot and wound care: A pragmatic randomised controlled trial. *International Wound Journal*, 17(6), 1678–1686. <https://doi.org/10.1111/iwj.13450>
- Indrayana, S., Guo, S. E., Lin, C. L., & Fang, S. Y. (2019). Illness perception as a predictor of foot care behavior among people with type 2 diabetes mellitus in Indonesia. *Journal of Transcultural Nursing*, 30(1), 17–25. <https://doi.org/10.1177/1043659618772347>
- Jasemi, M., Valizadeh, L., Zamanzadeh, V., & Keogh, B. (2017). A concept analysis of holistic care by hybrid model. *Indian Journal of Palliative Care*, 23(1), 71–80. <https://doi.org/10.4103/0973-1075.197960>
- Kadiri, M. (2023). Family social support and children's mental health resilience during COVID-19—case of Morocco. *Youth*, 3(2), 541–552. <https://doi.org/10.3390/youth3020037>
- Karaca, A., & Durna, Z. (2019). Patient satisfaction with the quality of nursing care. *Nursing Open*, 6(2), 535–545. <https://doi.org/10.1002/nop2.237>
- Karadag, A., & Sengul, T. (2021). Challenges faced by doctors and nurses in wound care management during the COVID-19 pandemic in Turkey and their views on telehealth. *Journal of Tissue Viability*, 30(4), 484–488. <https://doi.org/10.1016/j.jtv.2021.09.001>
- Khatichop, N., Juntasopeepun, P., & Boonchiang, W. (2022). Factors influencing daily foot care behaviors among diabetic persons with peripheral neuropathy in a community. *Nursing Journal CMU*, 49(4), 357–368.
- Khunkaew, S., Fernandez, R., & Sim, J. (2019). Health-related quality of life and self-care management among people with diabetic foot ulcers in Northern Thailand. *SAGE Open Nursing*, 5, 1–10. <https://doi.org/10.1177/2377960819825751>
- Lazzarini, P. A., Jarl, G., Gooday, C., Viswanathan, V., Caravaggi, C. F., Armstrong, D. G., & Bus, S. A. (2020). Effectiveness of offloading interventions to heal foot ulcers in persons with diabetes: A systematic review. *Diabetes Metabolism Research and Reviews*, 36(Suppl 1), e3275. <https://doi.org/10.1002/dmrr.3275>
- Lee, D. M., Grose, E., & Cross, K. (2022). Internet-based patient education materials regarding diabetic foot ulcers: Readability and quality assessment. *JMIR Diabetes*, 7(1), e27221. <https://doi.org/10.2196/27221>
- Lertsirimunkong, J., Thavornwattanayong, W., Yongrat, K., Huengraksa, N., Chakranon, P., & Nimnuan, P. (2019). The protocol for diabetic foot care services by community pharmacists in Thailand. *Pharmaceutical Sciences Asia*, 46 (3), 140–46. <https://doi.org/10.29090/psa.2019.03.018.0036>

- Levy, N., & Gillibrand, W. (2019). Management of diabetic foot ulcers in the community: An update. *British Journal of Community Nursing*, 24(Sup3), S14–S19. <https://doi.org/10.12968/bjcn.2019.24.Sup3.S14>
- Lim, J. Z. M., Ng, N. S. L., & Thomas, C. (2017). Prevention and treatment of diabetic foot ulcers. *Journal of the Royal Society of Medicine*, 110(3), 104–109. <https://doi.org/10.1177/0141076816688346>
- López-López, D., Pérez-Ríos, M., Ruano-Ravina, A., Losa-Iglesias, M. E., Becerro-de-Bengoa-Vallejo, R., Romero-Morales, C., Calvo-Lobo, C., & Navarro-Flores, E. (2021). Impact of quality of life related to foot problems: A case–control study. *Scientific Reports*, 11(1), 1–6. <https://doi.org/10.1038/s41598-021-93902-5>
- Lung, C. W., Wu, F. L., Liao, F., Pu, F., Fan, Y., & Jan, Y. K. (2020). Emerging technologies for the prevention and management of diabetic foot ulcers. *Journal of Tissue Viability*, 29(2), 61–68. <https://doi.org/10.1016/j.jtv.2020.03.003>
- Mahendradhata, Y., Trisnantoro, L., Listyadewi, S., Soewondo, P., Marthias, T., Harimurti, P., & Prawira, J. (2017). *The Republic of Indonesia health system review: Health system in transition vol 7 no 1*. World Health Organization. <https://apps.who.int/iris/bitstream/handle/10665/254716/9789290225164-eng.pdf>
- Megayanti, S. D., & Suantika, I. R. (2021). Self-care pada pasien diabetes melitus dengan penyulit ulkus kaki diabetik [Self-care on diabetes mellitus patients with diabetic foot ulcers]. *Jurnal Riset Kesehatan Nasional*, 5, 13–16.
- Mohseni, M., Ahmadi, S., Azami-Aghdash, S., Mousavi-Isfahani, H., Moosavi, A., Fardid, M., Etemadi, M., & Ghazanfari, F. (2021). Challenges of routine diabetes care during COVID-19 era: A systematic search and narrative review. *Primary Care Diabetes*, 15(6), 918–922. <https://doi.org/10.1016/j.pcd.2021.07.017>
- Musuuza, J., Sutherland, B. L., Kurter, S., Balasubramanian, P., Bartels, C. M., & Brennan, M. B. (2020). A systematic review of multidisciplinary teams to reduce major amputations for patients with diabetic foot ulcers. *Journal of Vascular Surgery*, 71(4), 1433–1446.e3. <https://doi.org/10.1016/j.jvs.2019.08.244>
- Niculescu, A. G., & Grumezescu, A. M. (2022). An up-to-date review of biomaterials application in wound management. *Polymers*, 14(3), 421. <https://doi.org/10.3390/polym14030421>
- Nonpanya, U., Terathongkum, S., & Lininger, J. (2021). Effects of self-efficacy enhancement of foot care program on foot care behavior and insensate foot among persons with type 2 diabetes. *Thai Journal of Nursing and Midwifery Practice*, 7(2), 76–91.
- Norman, G., Westby, M. J., Vedhara, K., Game, F., & Cullum, N. A. (2020). Effectiveness of psychosocial interventions for the prevention and treatment of foot ulcers in people with diabetes: A systematic review. *Diabetic Medicine*, 37(8), 1256–1265. <https://doi.org/10.1111/dme.14326>
- Oley, M. H., Oley, M. C., Tjandra, D. E., Sedu, S. W., Sumarauw, E. R. N., Aling, D. M. R., Kalangi, J. A., Islam, A. A., Hatta, M., & Faruk, M. (2020). Hyperbaric oxygen therapy in the healing process of foot ulcers in diabetic type 2 patients marked by interleukin 6, vascular endothelial growth factor, and PEDIS score: A randomized controlled trial study. *International Journal of Surgery Open*, 27, 154–161. <https://doi.org/10.1016/j.ijso.2020.11.012>
- Olowo, S., Iramiot, J. S., & Ssenyonga, L. V. (2022). Knowledge of diabetic foot complication, self-care beliefs and practices among patients attending a tertiary hospital in Eastern Uganda. *International Journal of Africa Nursing Sciences*, 16, 100402. <https://doi.org/10.1016/j.ijans.2022.100402>
- Ousey, K., Chadwick, P., Jawień, A., Tariq, G., Nair, H. K. R., Lázaro-Martínez, J. L., Sandy-Hodgetts, K., Alves, P., Wu, S., & Moore, Z. (2018). Identifying and treating foot ulcers in patients with diabetes: saving feet, legs and lives. *Journal of Wound Care*, 27, S1–S52. <https://doi.org/10.12968/jowc.2018.27.Sup5.S1>
- Oxford Learner's Dictionary. (2008). *Oxford Learner's Dictionary*. Oxford University Press.
- Parliani, P., Phutthikhamin, N., & Sangchart, B. (2021). Validities and reliabilities of screening for diabetic foot ulcer (DFU) among diabetes mellitus patients with and without DFU. *Jurnal Keperawatan*, 13(3), 581–588. <https://doi.org/10.32583/keperawatan.v13i3.1415>
- Parliani, P., & Wahyuni, T. (2020). Development of foot care instrument and internal consistency test in the rural area. *Proceedings Series on Health & Medical Sciences*, 1, 163–167. <https://doi.org/10.30595/pshms.v1i1.57>

- Paton, J., Abey, S., Hendy, P., Williams, J., Collings, R., & Callaghan, L. (2021). Behaviour change approaches for individuals with diabetes to improve foot self-management: A scoping review. *Journal of Foot and Ankle Research*, 14, 1. <https://doi.org/10.1186/s13047-020-00440-w>
- Perez-Favila, A., Martinez-Fierro, M. L., Rodriguez-Lazalde, J. G., Cid-Baez, M. A., Zamudio-Osuna, M. J., Martinez-Blanco, M. D. R., Mollinedo-Montaño, F. E., Rodriguez-Sanchez, I. P., Castañeda-Miranda, R., & Garza-Veloz, I. (2019). Current therapeutic strategies in diabetic foot ulcers. *Medicina (Kaunas, Lithuania)*, 55(11), 714. <https://doi.org/10.3390/medicina55110714>
- Pietrzak, A., Wawrzycki, B., Schmuth, M., & Tysarowska, K. W. (2022). Structural and functional foot disorders in patients with genodermatoses: A single-centre, retrospective chart review. *Orphanet Journal of Rare Diseases*, 17(53), 1–11. <https://doi.org/10.1186/s13023-022-02207-x>
- Pitocco, D., Spanu, T., Di Leo, M., Vitiello, R., Rizzi, A., Tartaglione, L., Fiori, B., Caputo, S., Tinelli, G., Zaccardi, F., Flex, A., Galli, M., Pontecorvi, A., & Sanguinetti, M. (2019). Diabetic foot infections: A comprehensive overview. *European Review for Medical and Pharmacological Sciences*, 23(2 Suppl), 26–37. [https://doi.org/10.26355/eurrev\\_201904\\_17471](https://doi.org/10.26355/eurrev_201904_17471)
- Pourkazemi, A., Ghanbari, A., Khojamli, M., Balo, H., Hemmati, H., Jafaryparvar, Z., & Motamed, B. (2020). Diabetic foot care: Knowledge and practice. *BMC Endocrine Disorders*, 20(1), 40. <https://doi.org/10.1186/s12902-020-0512-y>
- Ramadhaniyati, R., & Parliani, P. (2020). Self-care management description in mellitus diabetes patients in urban area. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, 9(1), 11–18. <https://doi.org/10.9790/1959-0901061118>
- Rodgers, B. L., & Knafl, K. A. (2000). *Concept development in nursing: Foundation, techniques and applications* (2nd ed.) Saunders.
- Saltar, L., & Sahar, J. (2020). The intervention of foot care education in the prevention of diabetic foot ulcers: A literature review. *Proceedings Book of International Summit on Science, Technology, and Humanity* (79-88). Universitas Muhammadiyah Surakarta. <https://proceedings.ums.ac.id/index.php/iseth/article/view/1276>
- Sari, Y., Upoyo, A. S., Isworo, A., Taufik, A., Sumeru, A., Anandari, D., & Sutrisna, E. (2020). Foot self-care behavior and its predictors in diabetic patients in Indonesia. *BMC Research Notes*, 13(1), 4–9. <https://doi.org/10.1186/s13104-020-4903-y>
- Sen, H. T. N., Visudtibhan, P. J., & Siripitayakunkit, A. (2019). Factors related to foot care behaviors among patients with type 2 diabetes mellitus in Da Nang, Vietnam. *Ramathibodi Medical Journal*, 42(3), 57–68. <https://doi.org/10.33165/rmj.2019.42.3.162035>
- Seyyedrasooli, A., Parvan, K., Valizadeh, L., Rahmani, A., Zare, M., & Izadi, T. (2015). Self-efficacy in foot-care and effect of training: A single-blinded randomized controlled clinical trial. *International Journal of Community Based Nursing and Midwifery*, 3(2), 141–149.
- Sivan, S., Prasad, S., Nandan, P., Harikumar, H. K., Jacob, L. M., & D., T. (2021). Knowledge, attitude and practice of foot care in diabetes patients with foot at risk attending diabetology department of a tertiary care hospital. *International Journal of Basic & Clinical Pharmacology*, 10(2), 160. <https://doi.org/10.18203/2319-2003.ijbcp20210184>
- Soprovich, A. L., Sharma, V., Tjosvold, L., Eurich, D. T., & Johnson, J. A. (2019). Systematic review of community pharmacy-based and pharmacist-led foot care interventions for adults with type 2 diabetes. *Canadian Pharmacists Journal*, 152(2), 109–116. <https://doi.org/10.1177/1715163519826166>
- Stolt, M., Miikkola, M., Suhonen, R., & Leino-Kilpi, H. (2018). Nurses' perceptions of their foot health: Implications for occupational health care. *Workplace Health and Safety*, 66(3), 136–143. <https://doi.org/10.1177/2165079917727011>
- Subrata, S. A., & Phuphaibul, R. (2019). Diabetic foot ulcer care: A concept analysis of the term integrated into nursing practice. *Scandinavian Journal of Caring Sciences*, 33(2), 298–310. <https://doi.org/10.1111/scs.12645>
- Sulistyo, A. A. H. (2018). Management of diabetic foot ulcer: A literature review. *Jurnal Keperawatan Indonesia*, 21(2), 84–93. <https://doi.org/10.7454/jki.v21i2.634>
- Tamata, A. T., & Mohammadnezhad, M. (2023). A systematic review study on the factors affecting shortage of nursing workforce in the hospitals. *Nursing Open*, 10(3), 1247–1257. <https://doi.org/10.1002/nop2.1434>



- Tchero, H., Kangambega, P., Fluieraru, S., Bekara, F., & Teot, L. (2019). Management of infected diabetic wound: A scoping review of guidelines. *F1000Research*, 8, 737. <https://doi.org/10.12688/f1000research.18978.1>
- The Cambridge Dictionary. (2009). *The Cambridge dictionary*. Cambridge University Press.
- Toftagen, R. (2010). Rodgers' evolutionary concept analysis – A valid method for developing knowledge in nursing science. *Scandinavian Journal of Caring Sciences*, 24(Suppl. 1), 21-31. <https://doi.org/10.1111/j.1471-6712.2010.00845.x>
- Tsai, M. C., Chuang, H. L., Huang, C. Y., Lee, S. H., Liao, W. C., Lee, M. C., & Kuo, C. P. (2021). Exploring the relationship of health beliefs and self-care behaviors related to diabetic foot ulcers of type II diabetes mellitus patients: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 18(13), 1–9. <https://doi.org/10.3390/ijerph18137207>
- Tuglo, L. S., Nyande, F. K., Agordoh, P. D., Nartey, E. B., Pan, Z., Logosu, L., Dei-Hlorlewu, A. E., Haligah, D. K., Osafo, L., Taful, S., & Chu, M. (2022). Knowledge and practice of diabetic foot care and the prevalence of diabetic foot ulcers among diabetic patients of selected hospitals in the Volta Region, Ghana. *International Wound Journal*, 19(3), 601–614. <https://doi.org/10.1111/iwj.13656>
- Tulloch, J., Zamani, R., & Akrami, M. (2020). Machine learning in the prevention, diagnosis and management of diabetic foot ulcers: A systematic review. *IEEE Access*, 8, 198977–199000. <https://doi.org/10.1109/ACCESS.2020.3035327>
- Turkment, A., AK, E. S., & Ozbas, A. (2021). Research of knowledge and attitudes of patients with diabetic foot ulcer regarding foot care. *International Journal of Diabetes and Clinical Research*, 8(2), 1–7. <https://doi.org/10.23937/2377-3634/1410144>
- Vukas, H., Piljic, D., Kadic-Vukas, S., & Piljic, D. (2021). Challenges in diabetic foot treatment during pandemic of COVID-19. *Saudi Medical Journal*, 42(2), 166–169. <https://doi.org/10.15537/SMJ.2021.2.25687>
- Wahyuni, S., Prasetyowati, C. D., Pratiwi, W. N., & Alfiadi, K. (2021). Self-instructional training application on diabetic patients' self-care behaviors. *Nurse Media Journal of Nursing*, 11(2), 268–277. <https://doi.org/10.14710/nmjn.v11i2.29360>
- Woo, M. W. J., & Cui, J. (2023). Factors influencing foot care behaviour among patients with diabetes: An integrative literature review. *Nursing Open*, 10(7), 4216–4243. <https://doi.org/10.1002/nop2.1710>
- Yimam, A., Hailu, A., Murugan, R., & Gebretensaye, T. (2021). Prevalence of diabetic foot ulcer and associated factors among diabetic patient in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. *International Journal of Africa Nursing Sciences*, 14, 100285. <https://doi.org/10.1016/j.ijans.2021.100285>
- Yunir, E., Tahapary, D. L., Tarigan, T. J. E., Harbuwono, D. S., Oktavianda, Y. D., Kristanti, M., Iswati, E., Sarumpaet, A., & Soewondo, P. (2021). Non-vascular contributing factors of diabetic foot ulcer severity in national referral hospital of Indonesia. *Journal of Diabetes and Metabolic Disorders*, 20(1), 805–813. <https://doi.org/10.1007/s40200-021-00827-x>
- Yusuf, S., Okuwa, M., Irwan, M., Rassa, S., Laitung, B., Thalib, A., Kasim, S., Sanada, H., Nakatani, T., & Sugama, J. (2016). Prevalence and risk factor of diabetic foot ulcers in a regional hospital, Eastern Indonesia. *Open Journal of Nursing*, 06(01), 1–10. <https://doi.org/10.4236/ojn.2016.61001>
- Zaharieva, D. P., & Addala, A. (2022). Current and novel strategies to reduce fear of hypoglycemia as a barrier to physical activity in adults and youth with type 1 diabetes. *Canadian Journal of Diabetes*, 46(1), 1–2. <https://doi.org/10.1016/j.cjcd.2021.12.004>
- Zhu, X., Lee, E. S., Lim, P. X. H., Chen, Y. C., Chan, F. H. F., & Griva, K. (2023). Exploring barriers and enablers of self-management behaviours in patients with diabetic foot ulcers: A qualitative study from the perceptions of patients, caregivers, and healthcare professionals in primary care. *International Wound Journal*, 20(7), 2764–2779. <https://doi.org/10.1111/iwj.14153>

