



Nursing interventions to prevent type 2 diabetes foot complications

A Literature review

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Abstract

Diabetes is a chronic disease that places tremendous burden on both patients and healthcare facilities. Diabetic people can develop various complications if their glucose levels is poorly controlled; these complications are classified into two main categories: neuropathic foot ulcers, and neuroischemic, in addition to other complications such as, micro, and macrovascular diseases, eye, kidney problems, and foot ulcer.

Foot ulceration occurrence could be avoided by aggressive glucose levels control, and some other practices in the care plan to avoid sores that are hard to treat, and amputations which can significantly decrease diabetic people's quality of life.

The aim of the study was to conduct a literature review that explores the most updated information about diabetic foot ulcers prevention to update healthcare nurses. The databases used were CINAHL, PubMed, and Medline for the research. A total of 8 articles adhered to in conducting the research, furthermore, content analysis was conducted, codes, and categories were formed.

The results were cross checked with the research question. Limitations, and ethical considerations were also set to guide the study. Finally, conclusions were drawn, and recommendations were proposed for effective nursing care practices that help diabetic people keep moderate glucose values to avoid complications.

Keywords/tags (subjects)

Diabetes, Diabetic foot, Diabetic foot Ulcers or sores, Nurse's role, Prevention..

Miscellaneous (Confidential information)

For example, the confidentiality marking of the thesis appendix, see Project Reporting Instructions, section 4.1.2

Contents

1	Introduction	3
2	Background	4
2.1	Diabetes.....	4
2.2	Diabetes risk factors and complications	6
2.3	Nursing interventions to prevent diabetic foot ulcers.....	12
2.3.1	Diabetes foot assessment.....	12
2.3.2	Patient education and practices to promote selfcare	15
3	Aim and purpose	16
4	Methods.....	16
4.1	Litrature review	16
4.2	Article selection process	17
4.3	Method of Analysis.....	19
5	Results.....	20
5.1	Risk assesement.....	21
5.1.1	Annual foot assessment.....	22
5.1.2	Physical activity.....	23
5.1.3	Appropriate footwear	23
5.2	Patient education	24
5.2.1	Glycemic control	25
5.2.2	Blood pressure control	25
5.2.3	Lipid control	25
5.2.4	Smoking cessation	26
5.3	Discussion.....	26
5.3.1	Nursing Implications	26
5.3.2	Ethical considerations.....	30
5.4	Conclusion and recommendations	31
6	References.....	33
	Appendices	41
	Appendix 1. The reviewed articles in alphabetical order	41
	Appendix 2. Example of Content analysis.....	44
	Abbreviations	48

Figures

Figure 1. Monofilament and testing sites.....14

Figure 2. Data analysis illustration.....21

Tables

Table 1. Meggitt and Wagner classification system 11

Table 2. University of Texas classification system **Error! Bookmark not defined.**

Table 3. Key words used in the search process 17

Table 4. Inclusion and exclusion criteria..... 18

Table 5. Data selection method.....18

1 Introduction

“An ounce of prevention is worth a pound of cure” Benjamin Franklin.

Diabetes is growing worldwide, and it is estimated 382 million people are living with diabetes. Diabetes is set to rise even further. It is predicated that by 2035, the number of people living with diabetes will rise to 592 million. In Finland, about 500,000 people are living with diabetes and about 15% of Finnish healthcare expenditure goes to diabetes treatment (Käypähoito, 2021.)

Diabetes is a lifelong metabolic disorder that leads to chronic diseases and lower limb amputations, this metabolic disease is affecting the developing countries more. It is estimated that about 80% of diabetes deaths take place in countries with low and middle income (Hingorani et al, 2016.)

In 2030 diabetes will be the seventh leading cause for deaths in the world. In addition, diabetes is a leading cause for lower limb amputations every year. It is estimated that about 1 million diabetic people undergo amputations due to poor glycemic balance, an amputation occurs each 20 seconds in the world due to this enervative condition (Hingorani et al, 2016.)

Foot complication is common in diabetic people. It could be avoided with aggressive precautionary measures, otherwise it will be inevitable as people are aging and get obese (Hingorani et al, 2016.) It is estimated that 80% of limb amputations are related to foot ulceration. When ulcers occur, it is likely to be followed by infection, and PAD (Peripheral arterial disease) which contribute to future amputations. Diabetes places huge burden on health care facilities e.g., in the U.S diabetic foot complications cost about 6 billion dollars a year. The burden on patients, their families, and society is also huge particularly when they develop ulcers and or amputations. A Markov modeling approach proposes that combining aggressive sugar control and optimal foot care can significantly reduce care costs. Consequently, setting up diabetic foot care guidelines is very important for healthcare cost efficacy (Hingorani et al, 2016.)

The aim of this thesis is to conduct a literature review on nursing interventions required to prevent diabetic foot ulceration. This thesis explores all nursing interventions used to prevent diabetic

people from developing foot ulcers during their lifetime. It also aims to find the best nursing interventions to help nurses, patients, and their families to avoid diabetic foot complications.

2 Background

2.1 Diabetes

Diabetes is a dangerous life-long disorder that occur when the pancreas is impaired to produce sufficient insulin-a hormone responsible for glucose regulation in the blood, or when the body fails to use the insulin produced as it should. High blood sugar levels are typical to poorly controlled diabetes. In the long run high glucose levels may have dangerous consequences such as damage to the heart, blood vessels, eyes, kidneys, and nerves (WHO 2016.)

The incidence of diabetes prevalence was assessed in 2019 to be 9.3% (463 million people), (age 20-79 years) individuals with diabetes in the world. These numbers were anticipated to rise by 10.2% (578 million) in 2030, and 10.9% (700 million) by 2045. This prevalence phenomena are higher in urban and rich areas than in poorer rural areas (International Diabetes Federation 2019.)

It was projected that people living with impaired glucose tolerance is 7.2% (374 million) in 2019 are expected to rise to in 2030 by 8.0% (454 million), and to 8.6% (548 million) in 2045. In the world about 1/2 billion people are living with diabetes and the number is on a rise by 25% in 2030 and expected to hit 51% in 2045 (International Diabetes Federation 2019.)

Diabetes has many types, but in this thesis will discuss the three main types, type 1 (DT1), type 2 (DT2), and Gestational diabetes (GDM). Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) are the in-between state in the changeover between ordinary blood sugar levels and diabetes (particularly DM2), however the changeover is not foreseeable. Stroke and heart attacks are highly expected in people with IGT or IFG (WHO 2016.)

Type 1, (used to be named as insulin-dependent, juvenile, or childhood-onset diabetes) it is known by deficiency in insulin supply in the body. Type 1 diabetes people need insulin administration every day to manage the glucose level circulating in their blood. Insulin is crucial for type 1 diabetes otherwise they will be at risk of hyperglycemia which is life threatening (WHO 2016.)

The reason behind type 1 diabetes is still unidentified and up to now we cannot prevent it. Symptoms of type 1 diabetes are thirst, excessive urination, continuous hunger, weight loss, vision problems and exhaustion. Risk factors in type 1 diabetes, the precise reason behind this phenomenon is still mysterious. It is commonly established that type 1 diabetes resulted from multifaceted collaboration between genes and environmental factors, the risk of environmental factors is not yet clearly specified to cause this impairment, this condition is mostly occurred in adolescents and children (WHO 2016.)

Type 2, according to WHO, (2016), type 2 diabetes is used to be identified as "non-insulin dependent or adults' onset". It is the result of inefficient use of insulin by the body. Most of the diabetic people in the world have type 2 diabetes. Signs of type 2 diabetes could be comparable to those of type 1 diabetes but are often mild or not noticeable. Thus, diabetes may not be noticed for many years until it is in advanced stage or started to develop complications. This onset was only recognized in adults in the past, but nowadays children started to develop it as well (WHO, 2016.)

According to Ann Pietrangelo (2020), in type 2 diabetes, the reaction of the body cells to insulin is not as good as it should be, whereas in advanced phases of the onset the body may not produce sufficient insulin. Poorly treated diabetes can result into persistently high levels of sugar in the blood, producing many signs, and in the long run may lead to dangerous complications. Many people with type 2 diabetes may not experience noticeable symptoms or unwell being, that is why this condition remain for years undetectable.

Type 2 diabetes symptoms comprise of excessive urination during nighttime, feeling thirsty always, feeling exhausted/very tired, unintentional weight loss, feeling itchy in the penis or vagina area, or recurrently getting thrush, longer period of wound or cuts healing, blurred vision. The risk of developing type 2 diabetes is high if you are over 40 or 25 for people from south Asia,

immediate family members with diabetes or you are overweight/obese, or you are native Asian, African-Caribbean, or black African even if born in the UK (NHS 2020.)

Type 2 diabetes risk factors are mixture between genetic, and metabolic elements, such as family history, ethnicity, obesity, and overweight, poor diet, smoking and physical inactivity, all these increase the prospect of developing type 2 diabetes. Bigger BMI is also referred to as a risk factor for type 2 diabetes, with slight variation between populations of different continents (e.g., diabetes development in people from Southeast Asia happens at a lower BMI compared to people from European origin) (WHO 2016.)

In addition, excessive ingestion of saturated fatty acids, fatty food, and less intake of food rich with fibers, high sugar intake, and drinks full of sweeteners can increase the chances of gaining weight or being obese specially in children. New evidence proposes some relation between high sugar intake-drinks, rich with sweeteners, and type 2 diabetes. Effective smoking increases the risk of type 2 diabetes, for heavy smokers the risk of developing type 2 diabetes stays high for 10 years even after quitting smoking (WHO, 2016.)

Gestational diabetes (GDM) is short-term disorder that happens in pregnancy that represents high prospects of type 2 diabetes. This happens when the glucose levels in the blood are beyond standard values but not at diagnoses values. gestational diabetes put pregnant women at high risk of complications to some extent during pregnancy and delivery, this risk includes their babies as well. The method used for diagnosis in gestational diabetes is prenatal screening instead of related symptoms. Some factors that increase gestational diabetes are, pregnancy at advanced age, bigger BMI, excessive weight gain during pregnancy, hereditary factors, high Sugar levels during previous pregnancies, and defective previous pregnancies. Gestational diabetes elevates the risk of developing type 2 diabetes in the future (WHO, 2016.)

2.2 Diabetes risk factors and complications

Diabetes can cause a lot of problems to the body vital organs in the future, these complications are elaborated in the paragraphs bellow.

Cardiovascular disease, (CVD), diabetic people are at risk of developing cardiovascular disease if blood sugar levels are poorly controlled. This phenomenon increases the prospect of heart diseases and stroke among people with diabetes twice more than healthy people. Among diabetes complications this is number one to be careful with, but the good news is that if diet, exercise, and diabetes management is well combined, (CVD) complications can be significantly reduced (American Diabetes Association, 2021.)

Diabetes ketoacidosis and ketones (DKA), diabetic people are at risk of developing ketoacidosis, diabetic people are not able to use the energy, because their receptors are not sensitive to insulin to open to allow glucose pass on for use, due to this condition the body breaks down fats to use for energy. If this process continues, ketones start to build-up in the blood, and the blood becomes more acidic, this indicates that diabetes is poorly controlled, or the diabetic condition is getting worse (American Diabetes Association. 2021)

Eye complications/retinopathy (DR), diabetic people are at high risk of developing microvascular disease, which can cause eye problems that might lead to blindness. This risk can be reduced by proper diabetes control, and regular examinations. If major complication is developed, there are good treatments if they are started in the right time/earlier (Shukla & Tripathy, 2021.)

Oral health complications, diabetic people are at greater risk of developing oral problems, such as gingivitis, and periodontitis if proper oral health is not maintained (Kanjirath, Preetha P, Kim, Seung Eun, Inglehart, & Marita Rohr, 2011.)

Kindy disease/Nephropathy, kidneys function as filters through millions of very small blood vessels, kidneys eliminate metabolic waste products from the blood. Diabetes can affect this filtration process by damaging the filters/kidneys and make them to collapse. When kidneys failed to remove waste products a way, waste build-up and cause kidney problems (American Diabetes Association, 2021.)

Diabetic foot ulcer

Diabetic people are at greater risk of foot ulceration due to neuropathy, this condition has some factors such as, right size of fitting shoes, keeping your feet clean/washed and dried, toenails and their health/shape or foot deformities, use of alcohol, diabetes eye complications/disease, heart problems, kidney problems, being overweight, and smoking (Healthline 2021).

Diabetic neuropathy is a complication that many people with diabetes are prone to, it is still mysterious how diabetic neuropathy is developed, some clarifications have been made based on theories of change in the vasa nervorum or deformities in the metabolic system. Other theories reported that extra pilling of sorbitol due to excessive activity of polyol pathway create toxics that impair the function of the peripheral nerve conduction, and demyelination (Kalish & Hamdan, 2009).

According to NHS (2019), peripheral neuropathy has various indications such as, **Sensory neuropathy**, results when the nerve responsible for communicating sense messages is damaged due to diabetes. Symptoms related to this condition are, topical feeling of pinches and tingling, feeling numb and decreased sensation in your limbs, feeling sharp or burning pain in your limbs, being oversensitive to pain. Impaired sensation makes diabetic people lose balance because of not being sure about the extremities positioning (NHS 2019.)

Motor neuropathy, in this condition movements become difficult to control, symptoms associated with this condition are cramps of muscles and trembling, weak muscles or paralysis, muscles get diminished, having difficulties to raise the front part of the foot specially during walking (NHS 2019.)

Autonomic neuropathy, neuropathy causes many physical changes in the foot that exposes it to ulceration. Neuropathic people have skin tissue perfusion problems because the blood circulation is impaired as arteriovenous connection in the circulation is closed by neuropathy, when blood supply is hampered, oxygenation is reduced in the affected part of the skin of people with neuropathy. Diabetes makes physical and practical changes to the arteriolar and capillary mechanisms, in addition to significant thickening of basement membrane. Leukocytes need to defuse but they

cannot because of the thickened membrane, leucocyte restricted movement hampers hyperemic or vasodilatory response during injury, thus diabetic people lose their first line defense capability which increases their susceptibility to injuries and infections (Kalish & Hamdan, 2009.)

Mononeuropathy, in this condition one peripheral nerve is impaired due to which neuropathic people can experience the following symptoms, finger's sensations get weaker, your vision is impaired (difficulties to have focused eyes or double vision or pain in the eyes), feeling weak at one side of your face, pain in the lower extremities. This condition has many types, the most known one is called carpal tunnel syndrome (NHS 2019.)

Diabetic foot ulcer is a wound or an inflammation that does not cure easily, because blood circulation is hampered to reach the extremities/legs as it should, due to the damage caused by high glucose levels to the blood vessels (peripheral neuropathy) (NHS 2019.)

Diabetic foot can be categorized as follows: ischemic, neuro ischemic or neuropathic. Diabetic foot ulceration can be triggered mainly by neuropathy, it is estimated to affect 30% to 70% diabetic people. When diabetic people develop peripheral arterial disease their chance to develop neuropathy is much higher. This combination increases the risk of amputation which places a lot of burden on health care system and people. (Smanioto et al 2014).

Diabetic foot complications place huge burden on health care systems. "The lifetime risk that a diabetic patient will acquire foot lesions (ulcers/gangrene) has been estimated at 15% to 25%, with an annual incidence of 1.0% to 4.1%.⁶ The incidence of these lesions appears similar in type 1 vs type 2 diabetic patients, although type 2 diabetic patients comprise approximately 90% of the total diabetic population. In 15% of these patients, ulcers will ultimately lead to amputation" (Kalish and Hamdan, 2009).

Diabetic foot ulceration can be avoided by aggressive control of sugar levels, but if sugar levels are poorly controlled, and you have some other comorbidities such as renal, retinal, or cardiovascular impairment, the chance of foot ulceration increases. (Kalish & Hamdan, 2009).

According to Kalish & Hamdan (2009), diabetic foot pathogenesis is caused by the following three factors, ischemia, neuropathy, and infection, usually they coincide. Ischemia results when the macrovascular is blocked in the legs arteries because of atherosclerosis. In this case, it is widely understood that many diabetic people would need amputations if revascularization were not possible. Further studies were made, and it is confirmed that people with diabetes usually develop tibial and peroneal arterial occlusive disease, and Ischemia because of atherosclerotic macrovascular disease in addition to microcirculatory malfunction (Kalish & Hamdan, 2009).

To treat diabetic foot wound you need to categorize the ulceration so that we know at what stage is the ulceration, some international classification tools are in use by which we will be able to place the wound in the right category. Diabetic foot ulceration has many classification tools, but the most common international tools are two, Meggitt-Wagner and University of Texas systems (Kumar, 2012).

The Meggitt-Wagner classification system (see Table 1) is used for diabetic foot ulceration classification. It is developed in 1970s, and the primary system has six grading stages for the ulceration lesions. It is divided into two, first division is from one to four which is based on the lesion depth in the foot tissues. Second division is from four to five here it describes the degree of the gangrene and loss of perfusion in the foot. Grade 4 the foot is not completely gangrened but in grade 5 the foot is totally gangrened. This classification does not address all types of diabetic foot ulcerations and infections (Kumar, 2012). Another problem with this system is that it is not qualified to recognize and report vascular disease separately as risk element, furthermore this system is not qualified to classify superficial wounds with vascular problems or infections (Kumar, 2012).

Table 1. Meggitt-Wagner classification system (Kumar, 2012).

Grade 0	Foot symptoms like pain, only
Grade 1	Superficial ulcers
Grade 2	Deep ulcers
Grade 3	Ulcer with bone involvement
Grade 4	Forefoot gangrene
Grade 5	Full foot gangrene

Another classification tool used is University of Texas Wound Classification (Table 2). This grading system is widely used by clinicians and in diabetic foot care centers, it is sophisticated in diabetic foot ulcer classification, it has 4 grading scale, and each grade has own description of infection presence or ischemia (Kumar, 2012).

Table 2. University of Texas classification system (Kumar, 2012).

	GRADE-0	GRADE-1	GRADE-2	GRADE-3
STAGE-A	Pre ulcerative or post ulcerative lesion completely epithelialized	Superficial wound, not involving tendon, capsule, or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone or joint
STAGE-B	Infection	Infection	Infection	Infection
STAGE-C	Ischemia	Ischemia	Ischemia	Ischemia
STAGE-D	Infection and Ischemia	Infection and Ischemia	Infection and Ischemia	Infection and Ischemia

2.3 Nursing interventions to prevent diabetic foot ulcers

Nursing intervention is a procedure performed by nurses to carry out a plan for nursing care. Diabetic people are at greater risk of foot ulceration if their sugar levels remain poorly controlled. Diabetic foot can be avoided or delayed by aggressive glucose levels management, diet, and lifestyle change. This condition can lead to amputation which can significantly reduce diabetic people quality of life. (Subrata & Phuphaibul, 2018)

Diabetic people suffer foot ulcers at some point in their lifetime, neuropathy being the main risk factor for foot ulcers, 85% of foot ulceration is caused by neuropathy. Diabetes is number one chronic disease that causes amputations of lower extremities (Dominic, Visovsky & Rice, 2015).

Diabetes management places huge burden on healthcare facilities every year, because it needs multidisciplinary approach to deal with diabetes management, the focus is on foot ulceration prevention to avoid future complications such as amputations. This multidisciplinary approach involves patients and their families. Patient education is the focal point, and nurses are responsible for to educate patients as well as their family's (Dominic, Visovsky & Rice, 2015).

2.3.1 Diabetes foot assessment

In this phase nurses need to identify patient's precise foot problem /category of ulceration. This step should be performed by an experienced healthcare nurse to get the right classification. A plan should be made according to the established category. When nurses look at the patient's foot for assessment they should focus on the following deformities, neurological, vascular, sensation, footwear, and any malformations (Subrata & Phuphaibul 2019).

Visual assessment allows early detection of any foot abnormalities. Nurses need to make thorough inspection by examining patients' foot for deformities such as redness, blisters, calluses, fissures, dry skin, and toenail appearance. Healthcare personnel or other volunteers can help people with sight problems to inspect their foot. If a patient with impaired vision has no one to help them inspect their foot for deformities, they can use touch sense or use a magnifying glass. Nurses are the first line counsellors for diabetic people and their families. Nurses need to be fully equipped with

diabetes etiology to help clients avoid foot complication development and cost reduction, (Dominic, Visovsky & Rice, 2015).

In the vascular assessment phase, nurses need to look at diabetic people's foot to determine if their foot looks healthy and pulses are present by palpation. If pulses are reduced, it indicates that there is a high risk of ulceration, if pulse is not detected this means that blood circulation is impaired. This puts diabetic people at high risk of amputations, therefore diabetic people who are at high risk of foot complications should be assessed on a regular basis 3-6 months by a professional vascular specialist (Robert & Newton, 2011).

Sensation inspection is important for people with diabetes, particularly when they are at high risk of developing foot ulceration. Also, to determine peripheral neuropathy impairment, sensory test is highly recommended. (Semmes Weinstein monofilament test) this is a very useful tool for clinical test performance, it is easy to use, the cost is affordable, and noninvasive tool for assessment, the current practice recommendation is 5.07 gauge/10g monofilament for the test performance (Dominic, Visovsky & Rice, 2015).

To perform this test, patients should close their eyes during the monofilament test, (about one second duration), patients are instructed to say yes or raise their hands if they felt the monofilament. But if they did not feel the testing monofilament, this indicates that the sensation is significantly reduced. It is recommended to apply this testing monofilament in five different sites in each foot for evaluation (figure 1), (Dominic, Visovsky & Rice, 2015).

Figure 1, Monofilament & testing sites (Wounds Canada 2017).

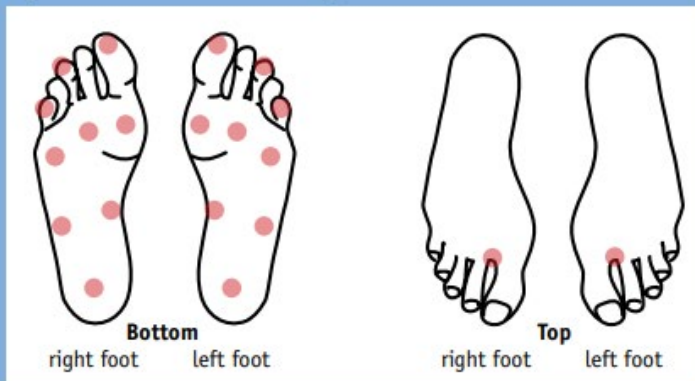
How to Use a Monofilament

The Semmes-Weinstein monofilament uses a 5.07 monofilament that exerts 10 grams of force when bowed into a C-shape against the skin for one second.

1. Touch the monofilament to the patient's arm or hand (avoid the hand if the person with diabetes has glove and stocking neuropathy) so they understand what to expect when monofilament testing is performed on the foot.
2. Before you touch the monofilament to their foot, have the patient close their eyes and instruct them to say "yes" when they feel the sensation of the monofilament on their foot.
3. Hold the monofilament perpendicular to the foot and touch the skin only once, until the monofilament bends into a C-shape. Do not apply over ulcer, callus, scar or necrotic tissue.
4. Test the 10 sites indicated in the diagram (Figure 3).
5. Record the response on the foot screening form with "+" for yes and "-" for no.
6. If the monofilament is not felt in an area on the foot, this indicates loss of protective sensation (LOPS) in that area.



Figure 3: Monofilament Testing Sites



Diabetic foot complication is associated with poor glycemic level controls, the most effective nursing intervention for preventing neuropathic ulceration is to control the sugar levels. (Dominic, Vissovsky & Rice, 2015).

2.3.2 Patient education and practices to promote selfcare

Diabetic people need to be motivated to adhere to medication, and life lifestyle changes. Nurses play crucial role to support diabetic people by educating them about diabetes and it is risks. Patient education influences patient's adherence to the care plan, it helps them continue as planned, but it might be only for a short period of time. Patient Education nursing intervention method is found unhelpful in the long term; however, some evidence was found to confirm that, this nursing intervention help to prevent neuropathic ulcers (Dominic, Visovsky & Rice, 2015).

Patient education is a focal point in avoiding diabetes complications, particularly foot ulceration that can lead to amputation in the future, many diabetic people are not fully aware of foot complications, that is why foot problems occur. One the other hand, healthcare personnel also should be educated about foot complications and problems associated with it, to convey the right message to patients, and their loved ones (Martin &Turn, 2012).

Nurses should have the obligation to Educate patients and their family members how to check their feet every day, be alert for any problems, good care of their nails, monitor their feet for any corns or calluses, moisturize their feet, and the use of comfortable footwear. Nurses should inform patients about where to report in case of any abnormal observations. Some patients might not recall all the measures, so it is advisable if the instructions are given in a written form (Martin &Turn, 2012).

The use of protective footwear was tested to determine whether it helps diabetic people to avoid primary neuropathic ulcers, and it is recurrences. This protective footwear method was found to help with the re-ulceration Dominic (Visovsky & Rice, 2015).

3 Aim and purpose

The aim of this thesis was to conduct a literature review to find out preventative measures that should be performed by nurses to prevent foot ulcers in people with type 2 diabetes. The purpose of this thesis was to provide updated information about diabetic foot prevention to help nurses, diabetic people, and their families to avoid or delay type 2 diabetes foot complications.

Research question is: How can nurses support type 2 diabetic people to avoid diabetic foot complications?

4 Methods

When writing an academic research, it is important to make it clear which method will be used. In the writing process a lot of theories are dealt with, so it is essential to understand what method is extracted from theories. The selection of method relies on three components: "the type of phenomenon to be studied, the research objectives and the analytical perspective of the research" (Abreu 2014, 195-204.)

4.1 Literature review

Literature review is a way of making a summary of information published about particular subject. To describe why the literature is conducted you should have an introduction that states the objectives of the review and justifies why this work is important for healthcare practices, (Kowalczyk & Truluck, 2013, p 219).

According to Patricia, Frances, and Michael (2008), writing a literature review has many reasons among them is obtaining information to be used for evolving policies and healthcare on Evidence-based information. A literature review is a factual, rigorous abstract and critical analysis of a research in the same field that has been searched before for updated summary and synthesis. The aim of the literature review is to generate updated Evidence-based information for readers and to validate a reason for further studies in the future by highlighting gaps in the current research.

According to Ward smith (2016), good literature review is extracted from many existing research, neutral and written in a good way. The selection process should be clearly defined in the review, terms should also be clearly defined no jargon use if possible and proper referencing.

This bachelor thesis was conducted according to literature review by reading through research that has been conducted about the same field, analyze the existing results detect gaps to fill in by new recommendations to enhance nursing interventions to prevent type 2 diabetic foot ulcers.

4.2 Article selection process

In this literature review articles were researched from Cinahl, PubMed, and Medline databases. In the process of selecting article form the forementioned databases, key words were used to find the most relevant articles to this thesis topic (Table 3).

Table 3. Key words used in the research process.

nurse OR nurses OR nursing
diabetic foot ulcer OR diabetic foot sore OR diabetic foot OR diabetic foot wound
prevention OR intervention OR treatment OR program

This data-base searching process conducted between February and May 11, 2021. The inclusion and exclusion criteria were used in searching for relevant data. Initially the key words were entered to check the number of articles available on the searched topic, then limitation was set to meet the most relevant articles for this study, limiters used were Full Text, References Available, Publication Date, English, and Finnish Language (see table 4).

Table 4 inclusion and exclusion method

Inclusion Criteria	Exclusion Criteria
Articles in English or Finnish	Articles in other languages rather than English
Articles with full text access	Full text not available
Peer-reviewed, empiric research articles	Not primary research
Articles answer the research question	Articles not related to diabetic foot ulcers or nursing
Published after 2011	Duplicates

Table 5 data selection Method

Database used	Search terms used	Primary results	Articles chosen based on title and abstract	Articles chosen based on full text
Cinahl 1	nurse OR nurses OR nursing AND diabetic foot ulcer or diabetic foot sore OR diabetic foot OR diabetic foot wound AND prevention OR intervention OR treatment OR program.	102	8	2
Cinahl 2	nursing interventions OR nursing care OR nursing support OR best practice. AND diabetic foot ulcer AND prevention OR intervention OR treatment OR program.	6	2	2
PubMed	Prevention of diabetic foot ulcers	33	10	3
Medline	nurse OR nurses OR nursing, diabetic foot ulcer, prevention, and control	6	3	1

4.3 Method of Analysis

Data analysis start by collecting relevant raw data for the research, how the text is interpreted by the researcher, the connection between the research question and the gathered data, coding of the collected data, theme formation according to the coding, and data validation (Ganapathy, 2016). The method of data analysis used is content analysis. This method is generally used in nursing science research; currently there is a continuous request for efficient evaluating plans to content analysis approaches (Elo, Kääriäinen, Kanste, Tarja, Utriainen & Kyngäs, 2014).

There are many methods for data analysis, content analysis is one of them. An effective requirement for content analysis is that data can be summarized to perceptions that define the research phenomena (Thomas, 2016). Content analysis include three main stages: preparation (whereby relevant data is collected), organization (sensible data), and reporting of results (Elo, Kääriäinen, Kanste, Tarja, Utriainen & Kyngäs, 2014).

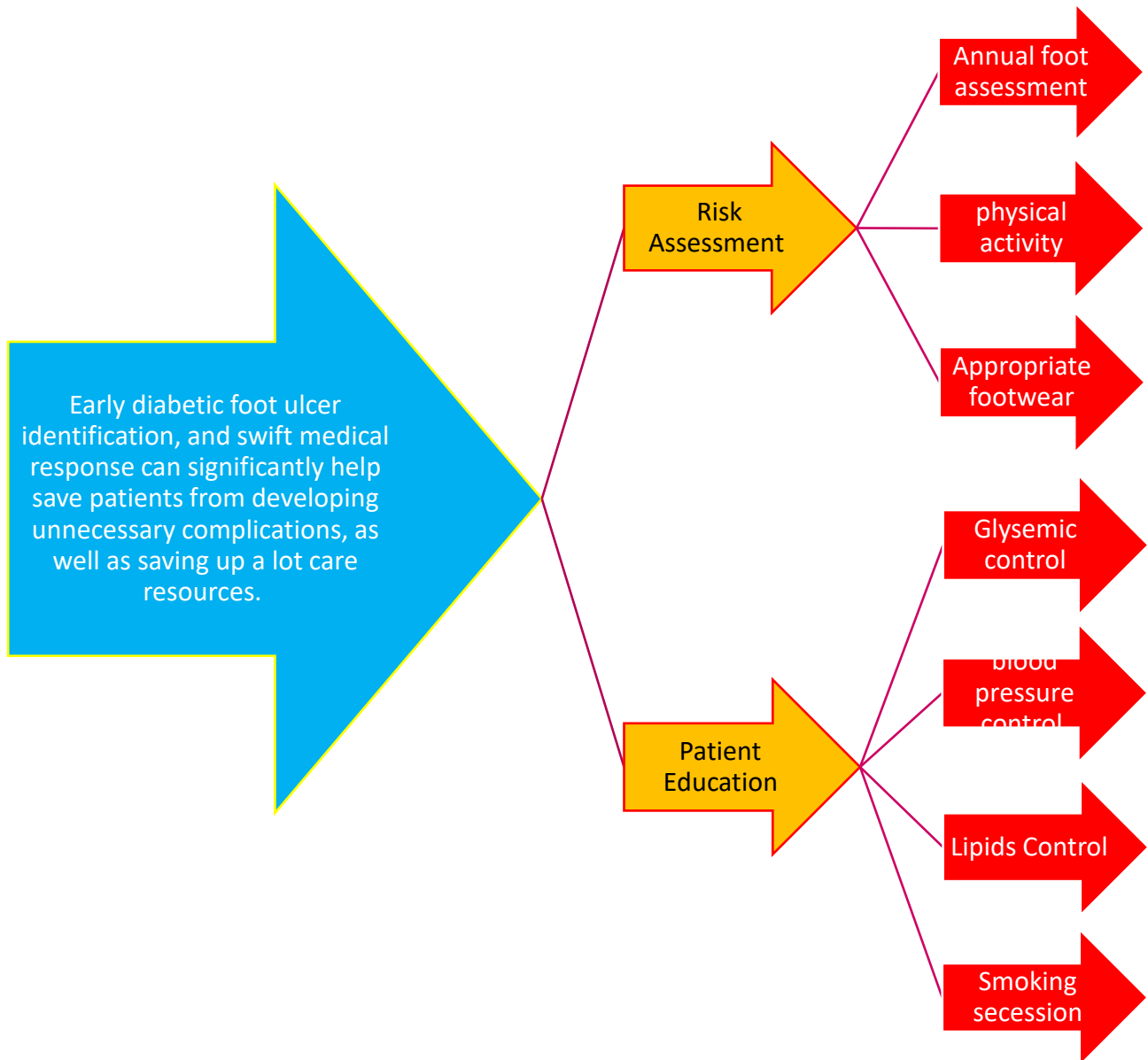
For writing this thesis, Evidence-based articles were carefully collected, read, and critically analyzed to select the best articles that answer the research question. Eight articles were selected after careful examination. The collected raw data were put together to form themes that addressed the research question (Elo, Kääriäinen, Kanste, Tarja, Utriainen & Kyngäs, 2014). Content analysis was used to analyze findings, coding was done where two sub-themes, and main-them were determined (see appendix 2).

Articles have been read several times, and answers for the research question was looked for from the results of each article, then findings were coded, and similar codes were put together for sub-category formulation, and then main category (Elo, Kääriäinen, Kanste, Tarja, Utriainen & Kyngäs, 2014), (see figure 1).

5 Results

The articles used in this literature review were critically analyzed to ensure that the results of the findings answer the research question and the purpose of this thesis. However, each article addressed the matter in question in different ways. The focus was on the roles of nurses as counselors for patients, (nurses' knowledge of diabetes and the complications involved in poor glycemic control), and patients as bearers of the burden, (information about diabetes, complications development avoidance, daily practices, diet, and support centers). The identified factors that promote effective diabetes foot ulceration prevention was described in two main categories and seven sub-categories.

Figure 2: Data analysis process illustration.



5.1 Risk assesement

People living with Diabetes are at high risk of developing foot ulceration. Healthcare professionals' priority in diabetic foot ulcer prevention is to identify diabetic people who are at risk of developing foot ulceration. There are several strategies used for the identification and each strategy relies on

patients' pathophysiology. Therefore, nurses need to establish the risk assessment for every diabetic according to their health condition specifications, underlying diseases, previous ulceration history, age, sex, and other needs (Haesler E, Frescos N. & Rayner R, 2018).

5.1.1 Annual foot assessment

Diabetic people who are at risk of foot ulceration should be screened annually for, peripheral neuropathy, foot deformities, artery disease as well their history for previous ulceration (Chapman, & Sarah, 2017). It is also important to assess diabetic people's medical history, surgical history, and medication in use, hemoglobin values are important to know, glucose measuring values history. Some other factors are also important to count for such as living conditions, alcohol consumption or smoking, and are they able to take care of themselves or not (Turns & Martin 2011).

To screen diabetic foot for risk assessment, nurses should conduct the following:

Inspection

Inspection is the part where patients and healthcare professionals use simple visual examination to diabetic people's feet for abnormalities, and or deformities, these abnormalities include dry skin, redness, calluses, fissures, blisters, toenails, and the overall appearance of the foot (Dominic, & Sara K, 2015).

Pulse Evaluation

Diabetic people should have their feet examined by experienced healthcare nurse for the presence of dorsalis pedis, and posterior tibialis pulse, pulse quality signals how greater the risk of neuropathy is. Diabetic people with peripheral artery disease should have their feet examined by nurses in a shorter intervals (3–6) month (Roberts, Peter, Newton, & Veronica 2011).

Sensory Testing

Nerve damage is a potential threat to diabetic people. To detect any damage in progress, nurses should conduct sensory testing using a simple tool called the Semmes Weinstein Monofilament; this device is simple cheap, easy to use, effective and noninvasive (Dominic, & Sara K, 2015).

5.1.2 Physical activity

Physical activities are crucial for all kind of people as it enhances cardiovascular performance. Diabetic people need more physical activities to improve glucose levels to avoid complications resulted from high glucose levels in the circulatory system, and failure to making any physical activities will increase diabetic people's chance to cardiovascular impairment.

There are not specific recommended moves to be done, but all kind of physical movements that consume energy. All type of physical activities improves glucose levels in the blood and decreases the risk of cardiovascular disease. Being active also helps in weight loss, muscles health, and improves the general wellbeing for people with type 2 diabetes (Colberg, Sigal, Yadley, Riddell, Dunstan, Dempsey, Horton, Castorino & Tate 2016).

5.1.3 Appropriate footwear

Footwear is crucial for diabetic people, and choosing appropriate shoes are important to prevent any pressure to the fragile feet. It is hard to find perfect shoes for all patients, but it is recommended to avoid certain types of shoes for diabetic people to avoid any pressure application or comfortlessness. In some cases, medical shoes are recommended (Roberts, Peter, Newton, & Veronica 2011).

Poor footwear for diabetic people is one of the reasons for ulceration as it increases plantar foot pressure, inappropriate shoes increase friction, and irritates patient's feet. Inappropriate footwear contributes to formation of calluses, blisters, and in the end pressure ulcers (Dominic, & Sara K, 2015).

Diabetic neuropathies affect sensation of the feet therefore, shoes should be inspected before wearing them, new shoes should be used carefully. Neuropathic people should not walk bare-footed at all to avoid any injuries from sharp or hot objects due to impaired sensation. Heels and peep toes are not recommended as they may be pressure source (Meaney & Beverley 2012).

5.2 Patient education

This is the most important part of the nursing care because it consists of negotiations, and agreements with patients to adhere to certain practices that help put their condition under control. Nurses should be well educated (having good knowledge of diabetes and the complications associated with hyperglycemia) to be able to best counsel patients and their families in a simple way (not all patients are in the same level of education or awareness). Patients require education about their health problem (diabetic pathophysiology) and the danger of uncontrolled glucose levels. Clear and simple explanation about potential complications should be outlined as well as quality of life and the cost burdens (Roberts, Peter, Newton, & Veronica 2011).

Information's to patients are given verbally, but a brief and clear written version should also be given to help clients remember the guidelines given by the counselling nurse (translated version for international clients if possible). A notebook might be needed to jot down all observations to report them to healthcare personnel during home or visits or healthcare facilities (Meaney, Beverley 2012).

Nurses need to construct some relation with their clients, which makes it easier for them to cooperate in implementing the care plan (trust building). long term health conditions can make patients desperate, and reluctant, therefore they need support to adhere to lifelong battle. Nurses are in a good possession to fill this gap. Motivational coaching is very important, because it enables both patient and nurses to find the most practical selfcare strategies for making some lifestyle changes to cop up with diabetes (Roberts, Peter, Newton, & Veronica 2011).

5.2.1 Glycemic control

Glycemic control should be the nursing care priority for diabetic people to avoid complications due to hyperglycemia. Patients should be fully educated about what hyperglycemia is, and what negative impacts does it has on the body vital organs. Nurse should also Educate patients that foot ulcers are caused by neuropathy, and neuropathy is caused by high sugar levels in the blood and other factors). Nurses should also educate patients how to maintain steady glucose values, and their impact on the healing process in case of foot ulceration (Roberts, Peter, Newton, & Veronica 2011).

Diabetic people are at risk of vascular complications, hyperglycemia increase their risk of micro and macrovascular complications, so to avoid this risk diabetics should maintain reasonable glucose levels. Hemoglobin values should be 7 mg/dl for good glucose control to decrease amputation prospects and (Hgb) should be observed by healthcare professionals 4 times a year (Sheridan & Stephanie 2012).

5.2.2 Blood pressure control

Diabetic people are at greater risk of developing many complications such as kidney disease and eye disease due high blood pressure, and they are also prone to other complications like, problems in the circulatory system and the heart. High glucose levels in the blood causes hypertension, and hypertension damages the blood vessels (atherosclerosis) which ultimately damages the heart and kidneys. Nurses need to educate diabetics about hypertension risk and support them to maintain moderate blood pressure values by taking good control of the sugar levels, smoking cessation, healthy diet, physical activity, alcohol and salt reduction, and weight control (Dansinger Michael 2021).

5.2.3 Lipid control

lipids control in very important for diabetic people. Type 2 diabetes is associated with elevated LDL lipids, triglyceride, and low HDL lipids. These elevated levels can increase cardiovascular problems. Increased amount of triglyceride (rich VLDL/ Very-low-density lipoprotein) by the liver is typical to triglyceride pathophysiology. Nursing interventions should focus on maintaining adequate values of HDL and reduction of LDL lipids hence it is recommended to focus on diet, exercise and

or physical activities, smoking cessation, and healthy BMI. These recommendations work along with the diabetic management intervention to maintain good glucose values. It is proved that medication and physical activities improve the intervention outcomes. Weight loss is also recommended to help improve lipoprotein levels and lipids, this could be achieved by ingesting food with low carbohydrates and rich in fibers, bearing in mind that lifestyle change, diet, and medication work side by side in achieving adequate lipid values for diabetic people (Ronald & Krauss 2021).

5.2.4 Smoking cessation

Smoking puts people at risks of developing a lot of health problems, diabetic people are among them but with greater risk prospects because of diabetes. peripheral neuropathy is high among diabetic people, smoking increases arterial disease development which put diabetics at risk of atherosclerosis. Beside arterial disease smoking slow down wound healing process which can lead to amputations (this is 3-4 times higher in smoking people than nonsmoking) (Purland & Paul 2012).

Nurses need to construct some relation with their clients, this makes it easier for both to co-operate in implementing the care plan (trust building), long term health conditions always make patients desperate, and reluctant to adhere to care plans, they need support to adhere to lifelong battle, nurses are in a good possession to fill this gap. Motivational coaching is very important, it enables both patient and nurses to find the most practical selfcare strategies to make some lifestyle changes to cope up with diabetes (Roberts, Peter, Newton, & Veronica 2011).

5.3 Discussion

5.3.1 Nursing Implications

Diabetes is a chronic disease which has many facets that need an integration of various practices, and choices concerning nutrition, physical activity, and the use of medicine. Diabetic people need to have knowledge about diabetes, and it is potential danger to their health, they also need to be skillful on how to cope up with the condition they are living with. This needs education by healthcare professionals and or nurses (Cynthia Olson, Stacey L & Rosenberg 2019).

The number of diabetic people who maintain moderate sugar levels are quite few, poorly controlled sugar levels increases diabetic people's chance of acquiring harmful complications such as:

nerve damage, cardiovascular disease, foot ulcers, eye complications, teeth complications amputations and so forth). The international diabetic management states that, people with diabetes should be educated to self-management, and the use of dietary counselling as part of the multidisciplinary teamwork from a dietitian (Trish Carney, Susan E Stein & Jennifer J Quinlan 2013).

Diabetic people and their care givers should pay special attention to the foot health. Any foot ulceration possesses high risk of developing harmful complications, these complications can result in amputations and or death. Diabetic foot ulceration lifespan is 15 to 25% in people living with diabetes. The IDF states that diabetic people's prospect of requiring lower limb amputation is 15 to 40 times higher in contrast to the general population. It is estimated that about 85% of amputations are caused by acquiring neuropathic foot ulcers. After limb amputations, diabetic people experience the loss of their lower limb because of clinical intervention and they also have a high rate of mortality 50% during the coming five years, which is considered higher than breast cancer in women, and prostate cancer or lymphoma in men (Mariam Botros, Janet Kuhnke, John Embil, KyleGoettl, Christian Morin, Laurie Parsons, Brian Scharfstein, Ranjani Somayaji & Robyn Evans 2019).

Diabetic foot ulcers can be healed up to 60-80%, whereas small portion of 10-15% will remain invigorate, even though 5-24% of foot ulcers will result in limb amputation between 6-18 month following the initial assessment. Diabetic foot ulcers are classified into neuropathic which can heal over a period of 20 weeks, whereas neuroischemic ulcers are more complicated, it takes more time to heal, and more likely results in amputation. There are two types of lower limbs amputations : traumatic, and nontraumatic, research established that 40-70% of nontraumatic amputations happen in diabetic people. As population ages the prospect of acquiring diabetes, foot sores, duration of diabetes, and limb amputations increases. Therefore preventative measures of decreasing foot sores is pivotal, if we take into consideration the effect of patients decreased quality of life, and the burden of nursing care on families, and healthcare facilities (Kleopatra Alexiadou, John Doupis 2012).

The aim of this thesis was to conduct a literature review to find out the most preventative measure that should be followed or performed by nurses to prevent foot ulcers in people with type 2

diabetes. The purpose of this thesis was to provide updated information about diabetic foot prevention to help nurses, diabetic people, and their families to avoid or delay type 2 diabetes foot complications.

The results of the thesis back up the previous research on diabetic foot ulcers, the emphasis is on patient Education (most diabetic lack information about diabetes complications), nurses need to have the most updated information about the matter in question to convey the right message to patients and their loved ones. Annual foot screening is a cornerstone for the detection of any changes on the foot which can signal prompt intervention, knowledgeable nurses, Educated diabetic people and their family members can make a huge difference in preventing diabetic foot ulcers.

Diabetic patient education is aimed to raise diabetic people awareness about diabetes, and its complications, neuropathic ulcers are the main goal. Nurses should concentrate on people at high risk of developing neuropathic foot ulcers, people with previous peripheral neuropathy and PAD, malformations on the foot such as high arches and clawing toes, and diabetic people with poorly controlled glucose. Nurses' role is to educate diabetic people and their family members on how to monitor their sugar levels by measuring, having knowledge on whether their blood sugar is high or low, the use of protective footwear, orthotics, and insoles. During the intervention's nurses need to monitor sugar levels, inquire records on glucose values as well as glycosylated hemoglobin. Nurses should also assess the potential neuropathic patients for tibial arterial and distal peroneal pulses, function of sensation and how they walk. All the above-mentioned methods are aimed for assessing potential diabetic foot ulceration (Dominic, Visovsky & Rice, 2015).

Diabetic people should be examined for foot complication per-year by their general practitioner or podiatrist in clinical settings to check for any signals of potential foot ulceration, or any risk factors that might lead to foot sores. People with high risk should be examined in shorter intervals every 1-6 month taking into consideration how high the ulceration risk is. Diabetic people with higher risk acquiring foot ulceration should promptly be referred to specialized care to hamper the occurrence of the skin break down which can lead to ulcers (Rebecca Reardon, Dominic Simring, Boyoung Kim, James Mortensen, Deepak, Williams & Anthony Leslie).

During diabetic foot assessment, nurses should look for any deformities on the diabetic foot which might lead to ulceration such as calluses, fissures, redness or blisters, and ankle joint also needed to be checked for mobility deformities. Nurses should confirm that diabetic people receive adequate counselling, and they must ensure that patients understood what was said to them very well by repetition of the process, this helps patients know their role in this lifelong process, and it motivates them to adhere to control their glucose levels ((Dominic, Visovsky & Rice, 2015).

Based on the research conducted, and the results reached in the findings, all the discussed and mentioned nursing intervention that was recommended for the multidisciplinary team is crucial in preventing diabetic foot ulcers in question which is this study's focus. This emerging type 2 diabetes need a lot of effort to deal with it, e.g., multidisciplinary team consumes a lot of efforts and money. This process must be backed by the government to help the institutions engaged more effectively in providing nursing care and help researcher to work more harder in finding more advanced Evidence-based ways to halt development of diabetic foot complications.

Periodical Educational programs for all staff members involved in the care plan is important to help them educate their patients and families about the danger of uncontrolled glucose levels in the circulatory system. Knowledgeable nurses can help lead their patients and families towards maintaining moderate glucose levels, and early detection of abnormalities (Simon O'Neill 2014). This helps in avoiding foot sores or ulcers, amputations, improve patients' quality of life, and cut down the huge burden on both diabetic people and healthcare facilities which was the focus of this review.

Nurses are the first line advocates for their patients, they are in a position where nursing care and information flow is through them. Patient education is lead by nurses, a good relationship between them and their patients is key to interexchange information's, mutual trust and respect makes both parties collaborate to give relevant information's for the care plan composition. Not all patients are cooperative or shy to open up and share all information's they have, also they could be those type of silent people who speak out very little. This could be challenging to nurses to obtain adequate information. eHealth/messaging intervention is suggested to be the solution for better relationship between nurses and patients, this eHealth method could be a bit challenging as it is new intervention method specially to traditional patients, but it is proofed very helping

in terms of openness and flexible flow of information. Patients who do not feel comfortable to share much with nurses during face-to-face conversations, they felt much more comfortable to express their opinions which is required for better assessment and nursing care implementation, where in the end the goal is adherence to guides given by caching nurse (Sije S. Lie, Bjorg Karlsen, Marit Graue & Bjorg Oftedal, 2019).

5.3.2 Ethical considerations

Ethics

Conducting literature review or any other research must be governed by certain rules, ethics code of conduct in nursing care is considerably important norm to abide by to make distinctions between nursing care practices (Clark, 2019). Before the research is done permission should be obtained from the ethics committee accompanied by written consent from participants. The researcher should make a clear explanation about the process to all parties included in the research process (nurses and clients), participants should also be informed that they can cancel the consent and their participation at any time they want to, the researcher should be able to answer questions from the participant about the research topic (Clark, 2019). The purpose of this thesis was to conduct a literature review to find an answer to the research question set by the author. To achieve this, ethics and scientific research were adhered to, honesty, meticulousness, and correctness. Scientific criteria and ethical sustainability were strongly followed by the writer. during the work presentation the writer did not state their own opinions as a research results. All the work done, and the articles used for the review were valued by intext citation and shown on the references list. No funding or permits were needed as the work was conducted as a literature review.

Validity and reliability

Nurses have legal and moral obligation to protect participants, and their families involved in the research from any harm or exposure to their personal information without their written consent (Nursing and Midwifery Board of Australia 2012). Validity and reliability, the research validity relies on fair results, genuine and applicable (El-Masri, 2013). The research was carefully planned, Evidence-based articles were used, evaluated, analyzed, and finally the results were documented, the research was done according to Jyväskylä University of Applied science principles of ethics and

credibility (JAMK, 2013). All data used in the thesis was acknowledged by in-text and on the list of references to avoid plagiarism (Bierer and Barnes 2014). Data was carefully analyzed, and results were presented in accordance with the original articles to ensure reliability of the literature (Elo & Kyngäs, 2008). While writing this thesis the tutor teacher was always referred to for review to ensure that my work complies with JAMK thesis reporting guidelines. And articles were carefully selected from reliable sources (mostly JAMK library) to ensure validity and reliability.

Limitations

The aim, and purpose of this thesis were achieved despite the limitations that have been set by the author during writing this thesis. Articles used were limited to English or Finnish, abstract, full text, and the date was restricted between 2011-2021, therefore some articles might not have been used even though they might be relevant and of important information. Most of the articles used in this study were obtained from JAMK online library database CINAHL (EBSCO), and some other free online Journals. All articles used were Evidence based or of high quality to ensure accuracy.

5.4 Conclusion and recommendations

Diabetic foot complication is a major concern that places huge burden on both parties, healthcare facilities, patients and their families. It causes disabilities and decreases patients quality of life if complications are developed. To improve diabetic peoples quality of life, multidisciplinary team approach is required. The first defence line is patient Education where a lot of up to date information is needed to be given to patients with regard to their condition, diabetes is life long disease where alot of effort is needed to adhere to the medication and practices that promote healthy life with steady glucose values. Nurses also need to be educated about diabetes to be able to convey the right information and answer questions raised by patients and their families, nurses need to identify patients at risk and when to refer them to healthcare facilities.

If people at risk of ulceration are identified and promptly been referred to nursing care, appropriate footwear is used further complications will be avoided, most amputations are avoidable if the problem is identified earlier and responded to.

Continuous education is recommended for nurses caring for diabetic people in general, and an indepth Education about diabetic foot ulcers to keep them up to date. Diabetic people are lacking informations and knowledge about this metabolic disease and it is complications, therefore international conferences are also recommeded for nurses to share their experiences and knowledge.

All researches equally presented diabetic foot ulcers prevention measurs and or standerds indeapth, but this thesis writer beside looking for nursing interventions that help nurses to best help diabetic people avoid foot complications, was also looking for psychological effects of diabetes on people living with this chronic disease, some diabetic people are ddesperate or hopeless to use medication regularly or make regular inspections to their feet or visit healthcare centers on plea that they will develop complications in some degree and or die for diabetes?), therefor they refrain from taking good care of themselves. This is an immense reason why most of the complications develop silently. The author presses hard on the psychological effects of diabetes in genenral, and type 2 in question because it shows suddenly in most cases, it changes patients life dramatically. Most patients get shocked when diagnosed positive, this huge change in their health and life style places significant burden on them financially and psychologically. Nurses should be trained on how to counsell diabetic people and motivational discussions are strongly recommended, taking into consideration the psychological effects on patients and the careplan application by patients.

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Appendices

Appendix 1. The reviewed articles in alphabetical order

Author (s)	Publishing year and Country	Title	Research method	Main Findings
Annersten Gershater, M; Pilhammar,E. and Alm Roijer, C.	2013 USA, Philadelphia, Pennsylvania.	Prevention of foot ulcers in patients with diabetes in home nursing.	qualitative interview study.	The results are presented according to the themes: leadership; nursing practice (assessment, planning, action, and evaluation); education; and research and development.
Chapman, Sarah.	2017 UK	Foot care for people with diabetes: prevention of complications and treatment.	Evidence-based practice review.	Treatment and prevention of diabetic foot complications, it is prevalence in the UK, diabetics life expectancy, and foot problems associated with risk factors.
Gifford, Wendy A.; Davies, Barbara L.; Graham, Ian D.; Tourangeau, Ann; Woodend, A. K. and	2013 Malden, Massachusetts, USA	prevention of foot ulcers in patients with diabetes in home nursing.	Pilot study and descriptive qualitative interviews.	This study showed variable outcomes, some trials are feasible, others need some further studies.

Lefebre, Nancy				
Luco- veis, Maria do Li- vramento Saraiva; Ro- lim, Luiz Clemente de Souza Pereira; Pedrosa, Hermelinda Cordeiro; Roberto de Sá, João; Armstrong, David G.; Boccaro de Paula, Ma- ria Angela and Gamba, Mônica An- tar	2021 UK	Development and validation of a pocket guide for the preven- tion of diabetic foot ulcers.	Adaptation of the IOWA method of Evi- dence-based practice to pro- mote high- quality care was em- ployed.	Development of a pocket guide model for health care personnel to promote the five cornerstone for ulcera- tion prevention (foot exam- ination; risk assessment for ulceration; education in di- abetes; appropriate foot- wear; and treatment of pre-ulcerative lesions).
Lucoveis MDLS, Gamba MA, Paula MAB,	2018 Brazil	Degree of risk for foot ulcer due to diabetes: nursing assessment.	Exploratory, descriptive study.	This study established the importance of careful feet examination for diabetic people by nurses for early

Morita ABPDS.				ulceration risk detection to avoid them.
Ramirez-Perdomo C, Perdomo-Romero A, Rodríguez-Vélez M.	2019 Brazil	Knowledge and practices for the prevention of the diabetic foot.	Cross-sectional, descriptive study.	After diabetic foot care prevention assessment was conducted it is established that diabetic people are not fully aware of the prevention process, nurses need to be more effective in-patient education regarding foot complication development.
Scain SF, Franzen E, Hirakata VN.	2018 Brazil	Effects of nursing care on patients in an educational program for prevention of diabetic foot.	Retrospective longitudinal study	In this study cumulative mortality was related to peripheral-polyneuropathy 44.7%, artery disease 71.7% to both 62.4%, and to amputation 67.6%. it was finalized that nursing follow-ups remain on top of all protective factors to reduce mortality.
Wilson, Barbara; Lawrence, Julie Ann.	2013 Canada	Implementation of a foot assessment program in a regional satellite hemodialysis setting	Setting and sample/ action research.	Diabetic foot ulcer screening and self-management is important for early detection of foot problems, prompt response and referrals help interventions.

Appendix 2. Example of Content analysis

Original Text / Raw Data	Codes	Sub-Category	Main Category
<p>In the risk assessment process, it is important to look for foot deformities, peripheral neuropathy, and medical history of the patients (Chapman, & Sarah, 2017), (Turns & Martin 2011).</p>	<p>abnormalities detection starts from quest for deformities.</p>	<p>Annual foot assessment.</p>	<p>Risk assessment</p>
<p>Foot inspection is very important because it helps detect any abnormalities on patient's feet (Dominic, & Sara K, 2015).</p>	<p>Physical activity is beneficial.</p>		
<p>Being active physically help the body function better, it is healthy for the heart and circulatory system, it also helps burn calories and glucose, so diabetic people will benefit more for physical activities even more than normal people because it helps them enhance their cells reception of glucose, thus they will maintain steady levels of sugar (Colberg, Sigal, Yadley, Riddell, Dunstan, Dempsey, Horton, Castorino & Tate 2016).</p>			
<p>Pressure and friction are one reason for foot ulceration, so it is recommended for diabetic people to choose shoes that are mild to their</p>	<p>Pressure application to the</p>	<p>Physical activity.</p>	

<p>feet (Roberts, Peter, Newton, & Veronica 2011).</p>	<p>feet should be avoided.</p>		
<p>As circulation is impaired in diabetic feet, formation of calluses, and blisters is easy, so it is recommended to avoid footwear that increases plantar foot pressure (Dominic, & Sara K, 2015).</p>	<p>Plantar foot pressure should be avoided.</p>	<p>Appropriate footwear.</p>	
<p>Due to neuropathy foot sensibility is decreased, there for diabetics should check their shoes all the time before us (Meaney & Beverley 2012).</p>	<p>Shoes should be clear from sharp objects.</p>		
<p>Patient Education can significantly help prevent unwanted diabetic foot complications or delay recurrence of foot ulceration. Nurses can provide diabetic people with basic foot care advice, such as footwear that suits them best as well as wound care. Some surveys proofed the importance of patient education on diabetic foot care, weight reduction, and blood pressure control. Annual assessment to people with diabetic foot ulcers prospect is recommended to help early detection of complications (Jonathan Zhang Ming, Natasha Su Lynn Ng, & Cecil Thomas, 2017).</p>	<p>Diabetic people should have adequate knowledge about diabetes and complications associated with poorly glycaemia.</p>		

<p>Uncontrolled high glucose levels in the circulatory system puts diabetic people at high risk of diabetic complications. Patient education help them put their glucose levels under control (Roberts, Peter, Newton, & Veronica 2011).</p>	<p>Diabetic people are advised to have control their sugars.</p>	<p>Glycemic control.</p>	<p>Patient Education</p>
<p>Patient information is important, it should be simplified, and in a written form to avoid misunderstandings or forgetfulness (Meaney, Beverley 2012).</p>			
<p>Nurses should focus during patient education on how to keep/control the glucose as steady as possible and inform patients about the benefits of good sugar levels to their patients' health (Roberts, Peter, Newton, & Veronica 2011).</p>			
<p>High glucose levels in the circulatory system causes hypertension, hypertension and hyperglycemia are direct risk to the heart and kidneys. Nurses are obliged to educate diabetic people about risks associated to hypertension (Dansinger Michael 2021).</p>			
<p>Moderate BMI is important for diabetic people, it helps maintain good values of glucose, blood pressure and lipids (Ronald & Krauss 2021).</p>	<p>Weight control.</p>	<p>Blood pressure control.</p>	

<p>Smoking increases the chance of developing arterial disease for diabetic people which in the long run can trigger atherosclerosis. In addition, it can make wound healing slow (Purland & Paul 2012).</p>		<p>Lipid's control.</p>	
<p>Diabetes is a long-life condition, it needs a lot of efforts to adhere to care plans, smoking adds to the existing diabetes problems, nurses need to place a lot of efforts to motivate patients not to give up, smoking cessation, need a lot of support to cease it, nurses also need to inform diabetic people about risks associated with smoking to the general health and for diabetics (Roberts, Peter, Newton, & Veronica 2011).</p>	<p>Motivational discussions are recommended to encourage diabetics to adhere to their care plan.</p>	<p>Smoking cessation.</p>	

Abbreviations

DT1 and DT2 diabetes type 1 and 2

(IGT) Impaired glucose tolerance

(IFG) impaired fasting glycaemia

(GDM) Gestational diabetes

(CVD) cardiovascular disease

(DKA) Diabetes ketoacidosis and ketones

(PAD) Peripheral arterial disease

(DPN) Diabetic peripheral neuropathy

(VLDL) Very-low-density lipoprotein

(HDL) high density lipoprotein

(LDL) low density lipoprotein

(Hgb) Haemoglobin