

Knowledge, Attitude, and Practice Regarding Foot Care among Diabetic Patients: A Scoping Review

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ABSTRACT

Context: Diabetic foot is considered one of the most preventable complications among patients with diabetes mellitus. This problem is correlated with premature death and severe morbidity because of major long-term complications which affect patients' feet.

Aim: This review aims to identify the extent of current evidence regarding the level of knowledge, attitude, and practice of diabetic patients about foot care.

Methods: Studies published in the period from 2013 to 2020 were evaluated. International electronic databases such as Ovid MEDLINE, PubMed, Embase Classic, EMBASE (Ovid), The Web of Science (Thomson Reuters), The Cochrane Library (Wiley), and CINAHL and (EBSCO) were explored to find articles written in English-language using relevant keywords. All quantitative studies that focused on the knowledge, attitude and practice regarding diabetic foot care among diabetic patients have been searched.

Results: There are two main themes generated from this scoping review and seven subthemes. In this scoping review, 845 articles were searched. After checking for duplicates, 815 papers were left to evaluate titles and abstracts. This evaluation left 52 articles for reading of full texts. Of these, 21 papers did not meet the aim. Thirty-one studies were included in the present review.

Conclusion: Patients' knowledge, practices, and attitude toward foot care were not considered satisfactory in most study settings included in this review. Several factors affect patients' knowledge, attitude, and practices, including gender, income, age of patients, marital status, and educational level. Specific health education programs should be targeted toward patients with diabetes mellitus to enhance and improve their knowledge and practices regarding protecting them from future harmful complications as diabetic foot.

Keywords: Knowledge, attitude, practices, diabetic foot

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1. Introduction

Saudi Arabia is considered the second-highest country with the largest prevalence rate of Diabetes Mellitus (DM) within the Middle East. It is also considered the seventh country with this disease globally (Al Dawish et al., 2016). The World Health Organization (WHO) estimates the prevalence of diabetes at 14.4% as of 2016 (14.7% in males and 13.8% in females) and result in up to 5% from all deaths of all age groups in Saudis (WHO, 2016). Different research conducted in Saudi Arabia reported a variable prevalence of diabetic foot from 26.0% to 61.8%. (Al-Hariri et al., 2017; Goweda, 2017).

Diabetes is a major cause of mortality and morbidity worldwide. If it is not sufficiently diagnosed or treated, several chronic complications will develop, resulting in irreversible disability and death (WHO 2016). Saudi Arabia is not exempt from the global epidemic of diabetes, as it is the most demanding health problem facing this country. (Alotaibi et al., 2017). As manifested by the Saudi Ministry

of Health, the incidence of diabetes increased from 1992 to 2015; the incidence rate increased 2.7 times in less than two decades, and there were 4,660 cases with diabetes who presented at family and medical clinics over the Kingdom of Saudi Arabia (Ministry of Health, 2015).

The demanding burden of DM in Saudi Arabia is related to various factors, including the high incidence of obesity and an aging population rate (Ministry of Health, 2015). The treatment and management of DM is a long-lasting issue that is likely to be multidimensional and concentrates on obtaining higher control of sugar levels in the blood. (Srinatha et al., 2017). Most significantly, the practice of managing self-care for patients with diabetes is crucial to preserving diabetes under control, and approximately 95% of disease management is mostly undertaken by the patients themselves or by their families (Mariye et al., 2018).

The problem of diabetic foot is considered one of the common devastating and preventable consequences of DM among patients. A lower extremity disease, which involves peripheral neuropathy, foot ulceration, peripheral arterial disease, or amputation, is more common in DM than

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healthy people. In diabetes, the annual incidence rate of foot ulcers scales from 1.0% to 4.1% to 4%-10% of the prevalence, indicating that the lifetime incidence rate may be increased by 25% (Taksande et al., 2017).

Self-care practices involve frequent physical activity, proper dietary intake, practicing foot care, self-monitoring of blood glucose levels, and adherence to a treatment regimen (Raithatha et al., 2014). Self-care activities, like high physical activity and eating healthy nutrition, can influence disease progression and slow it (Shrivastava et al., 2013). Additionally, adherence to guidelines of treatment assists the patient to accomplish the target glucose level and minimize the possible complications of diabetes and even death; nevertheless, self-care measures of diabetes require a high level of inspiration and reliable efforts from patients (Polonsky & Henry, 2016).

2. Significance of the study

Despite the significance of self-care management practices for diabetes remains efficient and effective prevention and control over diabetes, the results of the prior studies in Saudi Arabia have proven that self-care management practices have been more difficult, in which the study of Al Johani et al. (2015) reported that just 15.0% of diabetic patients had management and control over their blood glucose level. Adherence to self-management practices was low (Al Johani et al., 2016). Therefore, this review aims to identify the extent of current evidence regarding the level of knowledge, attitude, and practice of diabetic patients about foot care.

3. Aim of the study

This review aims to identify the extent of current evidence regarding the level of knowledge, attitude, and practice of diabetic patients about foot care.

4. Subjects & Methods

4.1. Search Methods

This review aims to examine patients' knowledge, practices, and attitudes regarding foot care among diabetic patients in the context of previous studies. Different databases were used for search strategy and systematic literature search. Databases include PubMed, Ovid OLDMEDLINE, Embase Classic + EMBASE (Ovid), The Web of Science (Thomson Reuters), The Cochrane Library (Wiley), and CINAHL Plus (EBSCOhost).

This scoping review involves six steps which have been applied based on Arksey and O'Malley's 2005 framework, including identifying the research question, identifying the relevant studies, the study selection, charting the data, collecting, summarizing, and reporting the results, and consulting with the stakeholders (Arksey & O'Malley, 2005). Keywords for the search included: knowledge, attitude, practices, diabetes, diabetic, Mellitus, foot, diabetic foot.

4.2. Inclusion and exclusion criteria

4.2.1. Inclusion criteria

Studies conducted within the context of health journals and human field, studies conducted in the English language, studies conducted from 2013 to 2020, original quantitative studies and systematic reviews, full-access studies, and diabetic patients are the population of interest.

4.2.2. Exclusion criteria

Studies not published in the human field, studies not conducted within the context of a health journal, studies conducted by languages other than English, studies published earlier than 2013, not published, unpublished thesis and dissertations were excluded, and limited -access studies.

4.3. Screening

The author screened the articles, including the title, abstract, and full-text articles that meet inclusion criteria.

4.4. Data Extraction

Data extraction was done by the researchers independently. Data that has been extracted in combination with the narratives were then tabulated to provide an overview of the obtained results and to explicate the interpretative process.

4.5. PICOT Question

PICOT	CONTENT	PICOT QUESTION
P	Patient with diabetes mellitus	Among adult patients with diabetes, what are their knowledge, attitude, and practice about diabetic foot care?
I	Not applicable	
C	Not applicable	
O	Foot care	
T	2013 to mid-2021	

4.6. Quality assessment

Quality assessment was conducted using the tool did use by Hawker et al. (2002).

4.7. Synthesis of evidence

Several national and international research studies related to diabetic foot care, patients' knowledge, attitude, and practice regarding this issue have been included in the results of the current review. These studies have been reviewed very well through investigating its objectives, methods, data analysis and results, and conclusion. The search revealed 845 articles. After checking for duplicates, 815 papers were left to evaluate titles and abstracts. After excluding 763, 52 articles, the remaining articles were left to read full texts. Of these, 21 papers did not meet the aim. Thirty-one studies were included in the present review. (Figure 1).

Table (1): Quality appraisal of the reviewed studies.

Author(s), year of publication	Abstract and title	Introduction and aims	Method and data	Sampling	Data Analysis	Ethics/ Bias	Findings / results	Transferability/ generalizability	Implications and usefulness	Total Score (36)
Alshammari et al. (2019)	4	4	3	4	3	4	4	4	4	34 Good
Pourkazemi et al. (2020)	4	4	4	4	4	4	4	4	4	36 Good
Al-Hariri et al. (2017)	4	4	4	4	4	3	4	3	4	34 Good
Pavithra et al. (2020)	4	4	4	4	4	4	4	4	4	36 Good
Sari et al. (2020)	4	4	4	4	4	4	4	3	4	35 Good
Ahmed et al. (2019)	4	4	4	4	3	4	4	4	4	35 Good
D Souza et al. (2016)	4	4	4	4	4	4	4	4	4	36 Good
Abougalambou et al. (2019)	4	4	4	4	4	3	4	4	4	35 Good
Kueh et al. (2015)	4	4	4	4	4	4	4	3	3	34 Good
Khawaga & Abdel-wahab (2015)	4	4	4	4	4	4	4	3	4	35 Good
Mohammadi et al. (2015)	4	4	4	4	4	4	4	4	3	35 Good
Abou-Qamar et al. (2015)	4	4	4	4	4	4	4	4	4	36 Good
Mohammad-Lutfi et al. (2014)	4	4	4	3	4	2	4	4	4	33 Good
Al-Aboudi et al. (2016)	4	4	4	4	4	4	4	4	4	36 Good
Karadag et al. (2019)	4	4	4	4	4	4	4	4	4	36 Good
Al-Asmary et al. (2013)	4	4	4	4	3	3	4	4	3	33 Good
Usta et al. (2019)	4	4	4	4	4	4	4	4	4	36 Good
Al-Jarallah et al. (2020)	4	4	4	4	4	4	4	3	3	34 Good
Ramirez-Perdomo et al. (2019)	4	4	4	3	4	4	4	3	3	33 Good
Goie & Naidoo (2016)	4	4	4	4	4	4	4	4	4	36 Good
Algshane et al. (2017)	4	4	4	4	4	4	4	4	4	36 Good
George et al. (2013)	4	4	4	4	4	2	4	4	4	34 Good
Solan et al. (2016)	4	4	4	4	4	3	4	3	4	34 Good
Abdulghani et al. (2018)	4	4	4	4	4	4	4	4	4	36 Good
Goweda et al. (2017)	4	4	4	4	4	4	4	4	4	36 Good
Srinath et al. (2017)	4	4	4	4	1	4	4	4	4	33 Good
Mariye et al. (2018)	4	4	4	4	4	1	4	4	4	33 Good
Taksande et al. (2017)	4	4	4	4	2	4	4	4	4	34 Good
Aljohani et al. (2015)	4	4	4	4	4	4	4	4	4	36 Good
Aljohani et al. (2016)	4	4	4	2	4	4	4	4	4	34 Good

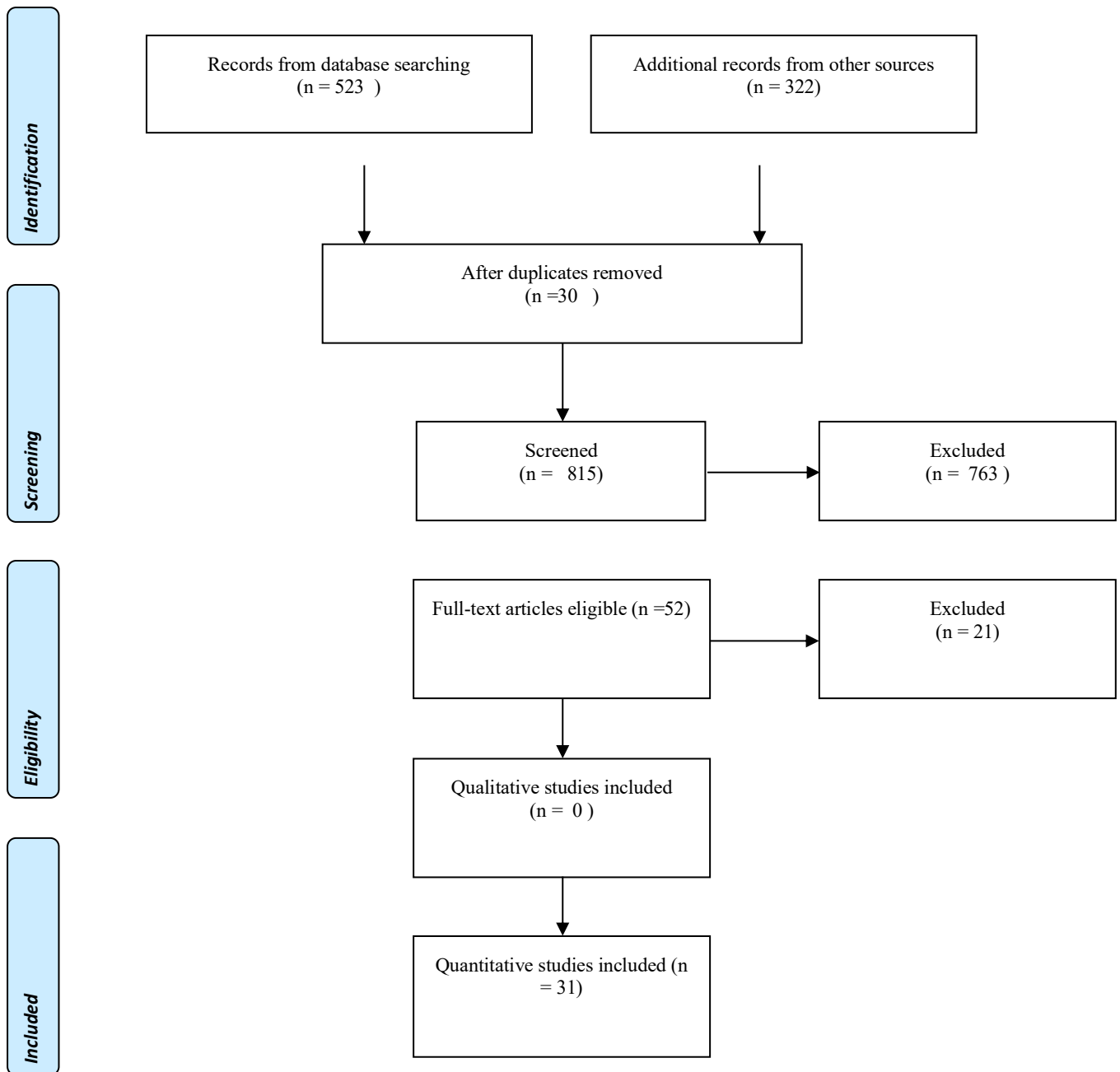


Figure (1): Flow diagram (PRISMA) of the process of identifying and including references.

5. Results

5.1. Diabetic patients' knowledge and attitudes regarding diabetic foot

This part includes literature considering DM patients' knowledge and attitudes about foot care in different international, regional, and national studies. In Saudi Arabia, the level of knowledge was good among 73.6% of the study participants, and their level of attitude was good among 87.7% of them (Abougalambou *et al.*, 2019). Taksande *et al.* (2017) noted the same results in their study in India, which indicated awareness of DM in 82.9% of the patients and awareness of DM complications in 23.2% of the patients. In 63% of patients, their treating physicians did not suggest foot care examination and education regarding foot complications. Taksande *et al.* (2017) also investigated if the DM population in India knows about annual foot tests by doctors and patient self-tests. Researchers concluded that the population did not know.

In their research in Saudi Arabia, Alshammari *et al.* (2019) indicated that approximately 76.6% of patients with DM had sufficient knowledge about diabetic foot and ulcers. Researchers found that most study participants frequently do foot hygiene daily. The study showed that 59.8% of participants looked inside their shoes before wearing them, and less than 46.7% did not carefully look over their shoes before wearing them. In contrast, Pourkazemi *et al.* (2020) reported that a mean score of diabetic foot knowledge in Iran was 8.63 of 15 and showed that most participants had a low level of knowledge. There was a direct correlation between knowledge and performance.

Two of the most significant factors of the treatment of diabetic foot are proper care and avoiding foot injuries. Patients need appropriate education and awareness to manage diabetic foot ulcers. In Saudi Arabia, research showed that more than 50% of patients with DM have a low level of knowledge about foot care (Algshanen *et al.*, 2017). Other researchers have reported that just 13.3% of the participants have good knowledge of diabetic foot care in Saudi Arabia (Al-Aboudi *et al.*, 2016).

In contrast, there was research showing a high percentage level of knowledge regarding self-care of diabetic foot among patients with DM in India (George *et al.*, 2013). Patients with DM who received adequate knowledge and education regarding diabetic foot care had more significant positive attitudes about self-care (Goweda, 2017; Solan *et al.*, 2016).

Ahmed *et al.* (2019) discovered that 41.3% of diabetic foot patients in Sudan achieved adequate glycemic control (HbA1c); 46.7% of study participants received good knowledge and education about self-care regarding their diabetic feet, 29.3% of patients possessed poor knowledge, and 24% of patients had moderate knowledge.

Researchers investigated a high number (more than 50%) of patients with DM known to have negative attitudes and little knowledge about foot care (Algshanen *et al.*, 2017; Muhammad-Lutfi *et al.*, 2014). However, in 2017 a study conducted by Al-Hariri *et al.* showed that most participants had favorable attitudes toward diabetic foot care. Study participants for D'Souza *et al.* (2016)

showed positive attitudes and high awareness of DM and its management.

Another study by Mohammadi *et al.* (2015) revealed that the mean score of DM patients' knowledge and attitude was considered medium level (17.37 out of 29). In Jordan, Abu-Qamar *et al.* (2014) noted that patients had high knowledge regarding diabetic foot. Muhammad-Lutfi *et al.* (2014) revealed different results in which most study participants had poor foot-care knowledge.

A study in Saudi Arabia revealed that type-2 DM patients had moderate knowledge and positive attitudes about diabetic foot care (Al-Aboudi *et al.*, 2016), while Abdulghani *et al.* (2018) revealed that 70% of Saudi patients had good knowledge of diabetic foot care. In contrast, D'Souza *et al.* (2016) revealed that 37.86% had good knowledge about foot care, while Al-Asmary *et al.* (2013) revealed that patient knowledge about diabetic foot care was generally unsatisfactory.

A study in Saudi Arabia by Al-Jarallah *et al.* (2020) showed that the overall mean score of DM patients' knowledge and attitude about foot care was low. In Sudan, Ahmed *et al.* (2019) revealed that 46.7% of patients had good knowledge about diabetic foot self-care, 46.7% had poor knowledge, and 29.3% had moderate knowledge. Different results were noted in Colombia by Ramirez-Perdomo *et al.* (2019), in which there was a low to an average level of knowledge among patients with DM aimed at preventing problems with diabetic foot care. In Iran, most patients with diabetes had insufficient knowledge regarding diabetic foot care (Pourkazemi *et al.*, 2020).

5.2. Patient practices regarding diabetic foot

This section considers studies about the level of foot care practices by patients with DM. In Saudi Arabia, the practice level was low among 45% of the patients (Abougalambou *et al.*, 2019). Abdulghani *et al.* (2018) noted similar results, which revealed that only 41.7% of patients always examined their feet, 41.4% washed their feet with warm water, 31.4% carefully dried between the toes, and 33.1% were using foot-moisturizing substances. Many patients (60.9%) do not dry their feet after washing, and 34.0% walk barefooted at home, according to Goweda *et al.* (2017). In contrast, 288 patients (78.3%) practice good foot care. Patients who have a longer duration of diabetes (>5 years) significantly have a better practice of diabetic foot care (Alshammari *et al.*, 2019).

Different results were noted in a study by Karadag *et al.* (2019) in Turkey. It showed that 29.5% of patients had inadequate foot care, 49.6% had moderate foot care, and 20.8% had good foot care. A study conducted by Usta *et al.* (2019) revealed that Turkish patients' foot care behavior score was above average. In Jordan, acceptable practices were noted among patients with DM regarding their foot care (Abu-Qamar *et al.*, 2014). Muhammad-Lutfi *et al.*'s (2014) study revealed different results, in which most of the patients had poor diabetic foot care practices.

In contrast, a study by D'Souza *et al.* (2016) revealed that 87.86% of patients with type-2 DM washed their feet daily; 53.57% walked barefoot; and 24.29% used medication on warts, corns, or calluses. Nearly 33.57% of the patients wore special footwear and shoes, and 25%

wore socks. Many participants in the *D'Souza et al. (2016)* study were physically active (73.57%).

In Sudan, *Ahmed et al. (2019)* revealed that 42.6% of patients with diabetes had good self-practice toward diabetic foot self-care, 36.7% had moderate practices, and 36.7% had poor practice. In Colombia, *Ramirez-Perdomo et al. (2019)* noted different results, in which there was a moderate level of foot care practice among patients with DM. In Iran, half of the patients with DM had poor performance regarding diabetic foot care (*Pourkazemi et al., 2020*). Furthermore, *Pourkazemi et al. (2020)* showed that the mean practice score was 7.6 out of 15, indicating that half had poor performance (49.6%). In India, *Pavithra et al. (2020)* showed good practice levels and awareness scores obtained between 69.1% and 41.6% of study participants, respectively.

Sari et al. (2020) in Indonesia showed that self-care practices and behaviors regarding diabetic foot were low; the indicators of foot self-care practice were age, diabetes stress, educational level, knowledge, and family support. *Ahmed et al. (2019)* showed that 42.6% had acceptable self-care practices regarding diabetic foot, with a low care practice by 20.7%. Furthermore, in Indonesia, *Sari et al. (2020)* research found that foot self-care practices and foot care education were low. *Ahmed et al. (2019)* showed that 42.6% of the patients with DM practiced good self-care of their feet. Research showed that just 22.2% of patients examined their feet only when they felt something was wrong, and some studies indicated that 61.8% of patients had a low level of care for their diabetic foot (*Goie & Naidoo, 2016*).

5.3. Factors affecting knowledge, attitude, and practice

Different factors discussed in the following section are considered contributors to patients' knowledge, attitudes, and practices about diabetic foot care.

5.3.1. Patient age and marital status

Research by *Alshammari et al. (2019)* in Saudi Arabia revealed that approximately 81% of patients with diabetes who are married had significantly more sufficient knowledge regarding diabetic care than other patients. *Pourkazemi et al. (2020)* in Iran also showed that marital status was an indicator of practice levels. *Alshammari et al. (2019)* in Saudi Arabia revealed no significant differences in patients' knowledge levels and attitudes among several age groups.

Moreover, in India, *Pavithra et al. (2020)* indicated that age was an indicator of acceptable self-care practices regarding diabetic foot. *Alshammari et al. (2019)* indicated that age was not a factor. *Ahmed et al. (2019)* showed that care practices and self-care awareness in diabetic foot patients did correlatively with advanced ages. *Muhammad-Lutfi et al. (2014)* revealed different results, showing no significant association between knowledge and practice with patient age and marital status. *Ahmed et al. (2019)* revealed that the awareness and practices of patients with diabetes regarding foot care correlated significantly with an increase in age, while patients younger than 65 and highly educated had a significantly higher score regarding foot care (*Goie & Naidoo, 2016*).

5.3.2. Patient gender

In Saudi Arabia, *Alshammari et al. (2019)* revealed no significant differences in the knowledge and attitudes regarding the care of diabetic foot among male and female patients. *Pavithra et al. (2020)* showed a positive connection between the male gender and good knowledge scores of patients with diabetic foot. Male patients, recently unmarried, with a socioeconomic status below the poverty line and existing foot ulcers, had good awareness scores, according to *Pavithra et al. (2020)*. *Usta et al. (2019)* revealed that patients' gender was significantly a predictor of foot care behaviors. A study by *Al-Jarallah et al. (2020)* showed that female patients appeared to have significantly higher levels of knowledge and more positive attitudes than males.

5.3.3. Patient education

In India, *Pavithra et al. (2020)* revealed that good practice was linked with secondary education and taking insulin, and there was an intermediate correlation between practice scores and awareness. According to *Alshammari et al. (2019)*, in Saudi Arabia, there were significant differences in the level of knowledge and practices regarding the care of diabetic feet among different levels of education.

Moreover, *Pavithra et al. (2020)* indicated that self-care practices regarding diabetic foot were associated with education. In Saudi Arabia, *Alshammari et al. (2019)* indicated that patients with DM were affected by different educational levels. *Ahmed et al. (2019)* showed that the care practices and self-care awareness of diabetic foot patients were significantly correlated with advanced educational levels (*Ahmed et al., 2019*). More significantly, *D'Souza et al. (2016)* reported that good self-care practices of diabetic foot were associated with advanced educational level, good attitudes, and increased awareness regarding diabetes and the appropriate care and management.

Similar results from *Ahmed et al.'s (2019)* study in Sudan revealed that the awareness and practices of patients with diabetes regarding foot care were correlated significantly with an increase in patients' higher levels of education. DM patients who receive adequate knowledge and education regarding diabetic foot care had a higher level of attitudes about self-care (*Goweda, 2017; Solan et al., 2016*), and poor knowledge and education were linked with poor attitude (*Algshanen et al., 2017; Solan et al., 2016*).

5.3.4. Patient income

Income affects patients' knowledge and practices regarding diabetic foot care. In India, *Pavithra et al. (2020)* revealed that good knowledge scores of patients with diabetic feet were associated with a socioeconomic status under the poverty line. *Alshammari et al. (2019)* indicated that patients affected by DM for a long time have greater awareness and care practices of their feet and showed no differences between different employment and visits to several diabetic clinics.

Ahmed et al. (2019) showed that the care practices and self-care awareness of diabetic foot patients vitally correlated with middle-income level. More significantly,

D'Souza *et al.* (2016) reported that good self-care practices of diabetic foot correlated with high-income levels.

Karadag *et al.* (2019) showed that higher income contributes to patients' knowledge and practices regarding diabetic foot care in Turkey. In Oman, positive foot care behaviors correlated with higher incomes (D'Souza *et al.*, 2016). Moreover, in Sudan, Ahmed *et al.* (2019) revealed that the awareness and practices of patients with diabetes regarding foot care were significantly and progressively correlated among patients with medium incomes.

5.3.5. Other Factors affecting knowledge, attitude, and practice

Other factors contribute significantly to patients' knowledge and practices regarding the care of their feet. Abougambou *et al.* (2019) revealed a significant positive linear correlation between knowledge and attitude. Besides, a significant correlation between knowledge and practice. Other factors include urban residency, disease duration, work, and positive family history (Khawaga & Abdel-Wahab, 2015).

Kueh *et al.* (2015) noted different results that diabetes knowledge was a significant predictor for attitudes and self-management in terms of blood glucose testing, and the patients' attitudes were significant predictors for self-management in terms of diet. Muhammad-Lutfi *et al.* (2014) showed no significant association between knowledge and practice with any of the variables.

Karadag *et al.* (2019) showed that patients in Turkey who were good at foot care lived in a city, had been trained about foot care, and were more likely to have type-1 DM. Also, in Turkey, Usta *et al.* (2019) revealed that patients' history of a foot wound, nephropathy, and the duration subscale of the illness perception scores were significant predictors of foot care behaviors.

In Oman, positive foot care behaviors correlated with lower body weight, a positive attitude, and a higher awareness of diabetes and its management (D'Souza *et al.*, 2016). Al-Jarallah *et al.* (2020) showed that patients who had previous training or attended workshops on diabetic foot care had significantly higher knowledge and attitude scores.

Ahmed *et al.* (2019) revealed that the awareness and practices of patients with diabetes regarding foot care were correlated significantly with an increase in patients with unemployment, longer duration of diabetes, family history, and controlled DM. In Iran, knowledge level and history of admissions due to diabetic foot were predictors of the diabetic foot practice score (Pourkazemi *et al.*, 2020).

6. Discussion

This scoping review has shown differences in knowledge and attitude about diabetic foot care among different populations. Differences between the study's results could be attributed to the differences in the study sample and differences in the study setting and the participants' educational background. Some studies show patients have good knowledge and low attitude score, which may reflect bad behaviors in practice about a

diabetic foot. Also, poor attitudes about foot care could be attributed to the lack of educational programs that should be conducted for them. Complications of disease may interfere with patients' quality of life; thus, it may affect their attitude toward the disease and its self-care practice. Diabetes education is important, but it must be transferred to action or self-care activities to enhance patients' health status (Shrivastava *et al.*, 2013).

This review shows differences in the practice of diabetic foot care. Differences and similarities between them could be attributed to the differences in the total number of samples, the sampling process, differences in the education level of the participants, and differences in cultural background. Association between patients' education and self-care practices regarding diabetic foot could be attributed to the fact that with an increase in educational level, practices of patients might be increased and improved. Thus, education plays a significant role in determining patients' self-care practices. It is essential to assess patients' beliefs and behaviors to offer education and utilize educational methods that efficiently improve care for their feet (Chiwanga & Njelekela 2015).

Attitudes of people with diabetes can play an important role in their emotional response, affecting the management of their diabetes in daily life. Researchers have proposed that individuals who have positive attitudes toward managing their diabetes will be more likely to adjust their self-care behavior to control their blood glucose levels than those who have negative attitudes. In addition, knowledge of diabetes can become a cornerstone in decision-making on the diet, exercise, blood glucose monitoring, use of medication, weight control, and foot care (Kueh *et al.*, 2015). Prevention and prophylactic foot care have been advocated to decrease patient morbidity, the use of expensive resources, and the risk for amputations (Alasmay *et al.*, 2013).

Diabetic patients usually are dependent on medications for disease control while ignoring other healthy lifestyle modifications in practice (Mohammadi *et al.*, 2015). Good knowledge and attitude for foot care will lead to good practice and improve the foot for diabetic patients, leading to enhanced health status, less cost for countries, and fewer disabilities among patients. Pavithra *et al.* (2020) showed that the indicators of self-care practices regarding diabetic foot were associated with age, stress, complications of diabetes, receipt of support from family and surrounding loved ones, and the appropriate knowledge

7. Conclusion

Patients' knowledge, attitudes, and practice levels relating to diabetic foot were not satisfactory in most of the study settings in this study review. This scoping review includes most of the factors contributing to a DM patient's knowledge, attitude, and practices about foot care. Most published reviews did not include issues such as disease duration and place of residence.

Factors that affect patients' knowledge, attitudes, and practices include gender, income, age, educational level, and marital status. Additionally, it should be noted that there are different settings, and therefore, the level of patient knowledge, attitude, and practice and factors affecting it are varied.

8. Recommendations

Implications for nursing practice, nurse managers, and nursing education:

Health care providers, especially nurses, should provide specific health education programs for patients with diabetes about caring for their feet, regulating their blood sugar levels, and exercising regularly to prevent complications. Nursing managers should provide technical instructions and provide effective policies toward special care for patients with diabetic foot. Nursing educators should provide a unique curriculum about the problem of the diabetic foot because this disease is prevalent in Saudi Arabia. Students and nurses should receive this intensive education as much as possible.

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Review Matrix

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
1.	Alshammari et al. (2019)	Saudi Arabia	This study was conducted to determine the knowledge, attitude, and practice of diabetic foot care among patients attending a diabetic clinic in Riyadh, Saudi Arabia	Descriptive cross-sectional	368 Diabetic patients in the diabetic clinic in Riyadh	A structured questionnaire on knowledge, attitude, and practices was used and was tested for its reliability and validity with a Cronbach's alpha 0.86.	A high proportion of the population surveyed has good knowledge and practice of diabetic foot care but poor foot care behavior. Some limited patients had taken formal education about diabetic foot care.
2.	Pourkazemi et al. (2020)	Iran	Determining the knowledge and practice of patients with diabetes regarding the prevention and care of DFUs	Analytical, cross-sectional	375 Diabetic patients at a clinic in Razi Hospital	A three-section questionnaire was used. The questionnaire's content validity ratio (CVR) and content validity index (CVI) were assessed. Mean scores of CVI and CVR were higher than 0.80. Cronbach's α coefficients were computed to evaluate the reliability of knowledge and practice, which were 0.80 and 0.85, respectively	The patients' knowledge score was 8.63 out of 15, indicating poor knowledge. Patients' practices score was 7.6 out of 15, indicating poor practices. Knowledge is correlated with practices. Factors affecting knowledge include residence, marital status, and history of admissions.
3.	Al-Hariri et al. (2017)	Saudi Arabia	Assess the knowledge, attitudes, practices, and risk factors influencing diabetic foot ulcers among diabetes patients attending a diabetic clinic in a Saudi hospital	Cross-sectional	229 Diabetic patients in diabetic clinic of the outpatient department of King Fahd Hospital of the University of Dammam	A pre-tested structured questionnaire was administered.	26% of patients have diabetic foot ulcers. Most patients had a good education and good attitudes regarding foot care. Despite these characteristics, a high percentage of the participants ignored very important information and instructions before buying new shoes.
4.	Pavithra et al. (2020)	India	Assess the awareness and practice about foot care and associated factors among admitted patients in a teaching hospital of coastal Karnataka, India	Cross-sectional	317 Diabetic patients in a teaching hospital of coastal Karnataka.	Validated structured questionnaire for awareness and practice regarding foot care. The questionnaire's mean content validity index (CVI) was 0.927, and Cronbach's α coefficient for reliability was 0.808.	Good practice and awareness scores were obtained between 69.1% and 41.6% of study participants, respectively. Good awareness scores were liked with male patients, recently unmarried, socioeconomic status below the poverty line, and existing foot ulcers. Good practice outcomes were associated with secondary education and insulin reception.
5.	Sari et al. (2020)	Indonesia	Investigate foot self-care behavior and identify its predictors in Indonesia	Cross-sectional	546 Diabetic patients registered in 22 primary healthcare centers in Banyumas Regency, Central Java, Indonesia.	The questionnaires used in this study included the Diabetes Distress Scale, Cronbach's alpha is (0.78–0.83), Beck Depression Inventory-II has been validated Cronbach's alpha of 0.90, Family APGAR Cronbach's alpha (0.83), Foot-Care Knowledge and Modified Diabetic Foot Care Behaviors.	It reported that the self-care practice and behavior regarding diabetic foot were poor. Foot self-care practice indicators were age, diabetes stress, educational level, knowledge, and family support.

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
6.	Ahmed et al. (2019)	Sudan	Assess knowledge of individuals with diabetes about self-foot care.	Descriptive cross-sectional	150 Diabetic patients in Alamel Centre of diabetes and endocrinology in Khartoum.	Pre-designed standardized questionnaire. Pretested.	This study revealed that the participants with proper knowledge regarding foot care were 46.7%. On the other hand, the participants with poor knowledge were 29.3%, intermediate knowledge was 24%. Good self-care practices regarding diabetic foot were indicated by 42.6% and low-practice of care by 20.7%. The care practices and related awareness were correlated significantly with an increase in age over 51 years, medium-income level, high education level, long duration of suffering from diabetes, unemployment, family history, received education about diabetes and the care practices of the diabetic foot and controlled diabetes mellitus.
7.	D'Souza et al. (2016)	Oman	Determine factors influencing foot care behaviors among adults with type 2 diabetes	Correlational descriptive	160 Diabetic patients from the public hospital	Diabetes Knowledge Test (DKT) was developed and validated by the Michigan Diabetes Research and Training Centre. The Diabetes Foot Care Questionnaire (DFQ) measured foot care behaviors. The reliability of the DFQ tool was 0.76.	Positive foot care practices and behaviors were correlated with higher income, higher educational attainment, lower body weight, positive attitude, and higher awareness of diabetes and its management.
8.	Abougambou et al. (2019)	Saudi Arabia	Determine the level of diabetes-related knowledge, attitude, and practice among adult diabetic patients in the central region and find a correlation between knowledge, attitude, and practice regarding diabetes	Cross-sectional	Online by using the Survey Monkey website on 300 diabetic patients in the central region of Saudi Arabia.	Self-administer electronic questionnaire through a survey Monkey web link. Validation of the questionnaire by a group of experts.	The overall knowledge and attitude were good, while diabetes-related practice was poor. There were good correlations between knowledge, attitude, and practice, and a significant positive linear correlation between knowledge and attitude, knowledge and practice.

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
9.	Kueh et al. (2015)	Australia	Examine a model describing the relationship between diabetes knowledge, attitudes, self-management, and QoL of people with T2DM based on previous research linking pairs of these variables.	Cross-sectional	291 Diabetic patients from The Alfred Hospital and the Western Hospital in Melbourne, Australia.	The Diabetes Knowledge (DKN) scale (Has strong psychometric criteria of reliability and validity). The Diabetes Integration Scale-19 (The internal consistency of the ATT 19 is alpha = 0.84) The Summary of Diabetes Self-Care Activities (SDSCA) The Diabetes Quality of Life questionnaire (QoL) is reliable and valid.	Diabetes knowledge was a significant predictor for attitudes and self-management in terms of blood glucose testing. Attitudes were a significant predictor for self-management in terms of diet.
10.	Khawaga and Abdel-Wahab (2015)	Egypt	Assess knowledge, attitude, practice, and compliance of rural diabetic patients, identify the predictors of good knowledge and patient's compliance and determine the impact of diabetes on patients' daily work.	Cross-sectional	750 Diabetic patients from three family health centers: Shawa, Meniat Al-Nasr, and Al-Kebab Al-Soghra, were chosen randomly in Dakahlia Governorate.	A structured and pre-tested questionnaire.	Good knowledge predicted by an urban resident, longer disease duration, working, and positive family history.
11.	Mohammadi et al. (2015)	Iran	Evaluated the knowledge, attitude, and practices on diabetes among Iranian type 2 diabetic patients to assess their needs for further educational interventions.	Cross-sectional	100 patients attending the diabetes clinic in Golestan hospital in Ahvaz, a city in southwest Iran	A KAP (Knowledge, Attitude & practice) questionnaire was developed and validated by Mukhopadhyay and her colleagues. The reliability of the questionnaire was considered satisfactory after discussion with experts.	The overall mean score of patients' knowledge, attitude, and practice (KAP) was medium. There was a significant association between a low level of education (primary) or not having formal education with a poor KAP score. There was no significant association between the KAP scores and HbA1c level. It was found that the knowledge scores of 78 participants (7.2%) were below 9, so they were classified as having poor knowledge. At the same time, those classified as exercising poor practice amounted to 42%. Statistically significant associations were established between level of education and knowledge and practice.
12.	Abu-Qamar et al. (2015)	Jordan	Examine knowledge and practice of foot care among Jordanian patients with diabetes.	Cross-sectional	1085 Diabetic patients from nine healthcare facilities located in five Jordanian governorates.	A questionnaire was developed from the literature. Experts established the face and content validity for the developed questionnaire, including diabetic foot clinicians and researchers.	

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
13.	Muhammad-Lutfi et al. (2014)	Malaysia	Assess patients' knowledge and compliance with diabetic foot care.	Cross-sectional	157 in-patient population at Hospital Sultanah Nur Zahirah, a tertiary medical center in Kuala Terengganu	The diabetic foot care questionnaire was tested and validated.	Most of the patients had poor foot care knowledge, while 61.8% had poor diabetic foot care practice compared to the median score. There was no significant association between knowledge and practice with any variables.
14.	Al-Aboudi et al. (2016)	Saudi Arabia	Investigate the association between knowledge and attitude with health-related quality of life (HRQoL) among patients with type 2 diabetes mellitus in Riyadh, Saudi Arabia.	Cross-sectional	75 patients were attending the University Diabetic Center at King Abdulaziz University Hospital	The EuroQoL-five-dimension (EQ-5D) scale was used to assess HRQoL(Cronbach's alpha 0.83) Questionnaire format developed by the University of Michigan Diabetes Research and Training Centre (Cronbach's alpha 0.66) The reliability and validity of the questionnaires were tested	Patient attitude toward the disease was positive, and this was positively associated with their quality of life.
15.	Karadag et al. (2019)	Turkey	Assess diabetic patients' knowledge and practices regarding foot care.	Cross-sectional	1030 patients with diabetic foot disease in eleven different medical faculty hospitals.	The investigators developed the descriptive survey instrument. Survey content and format were based on prior surveys and guidelines.	The study revealed that 29.5% of patients had bad foot care, 49.6% had moderate foot care, and 20.8% had good foot care. There were no significant differences between patient groups regarding age, gender, foot infection history, and having undergone amputation surgery.
16.	Al-Asmary et al. (2013)	Saudi Arabia	Assess knowledge and practice of diabetic patients as regards their feet care.	Cross-sectional	432 Diabetic patients from three primary health care centers (PHCCs) in Abha City.	The researcher designed a study questionnaire. The researcher also designed a patient examination sheet.	Good fasting blood sugar control was achieved only in 14.1% of diabetic patients. Only 41.4% of patients underwent feet examination by primary health care (PHC) physicians, and one-third of patients received educational brochures about foot care.

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
17.	Usta et al. (2019)	Turkey	Evaluate the predictors of foot care behaviors in individuals with diabetes and the role of these variables.	Descriptive analytical	368 outpatients with diabetes in a public hospital.	The foot care behavior questionnaire (The Cronbach alpha 0.83). Diabetes attitude scale (alpha coefficients 0.73), Illness perception questionnaire (alpha coefficients 0.71), Health belief model scale (Cronbach's alpha coefficient 0.83) The multidimensional scale of perceived social support (the reliability coefficients 0.93).	The foot care behavior score of the participants was above average. Gender, history of a foot wound, nephropathy, duration subscale of the illness, perception scores, and personal control subscale of the health belief scores were significant predictors of foot care behaviors.
18.	Al-Jarallah et al. (2020)	Saudi Arabia	Examine the knowledge and attitude of diabetic patients towards diabetic foot care and complications in Aseer, Saudi Arabia	Cross-sectional	351 Diabetic patients from Aseer Central Hospital.	A self-administered structured questionnaire.	The overall mean score for both knowledge and attitude was found low. Females appeared to have a significantly higher level of knowledge, as well as attitude, compared to males. Patients who had previous training or attended workshops on diabetic foot care had a significantly higher score in both knowledge and attitude.
19.	Ramirez-Perdomo et al. (2016)	Colombia	Describe the knowledge and practices performed by people for diabetic foot prevention	Cross-sectional correlational	Three hundred four patients registered in the Cardiovascular Risk Program.	The researchers designed the instrument. Experts on the subject validated it.	In the diabetic foot care prevention assessment, there was a low and average level of knowledge, whereas practices were moderately adequate.
20.	Goie & Naidoo et al. (2016)	South Africa	Assessing the clinical profile of T2DM patients and evaluating their knowledge, attitudes, and practices concerning DFD.	Descriptive cross-sectional	280 Diabetic patients from regional hospital in the city of Durban in KwaZulu-Natal.	Validated questionnaires used to assess DFC in previous studies were adapted for the present study	Only 22.2% of participants reported examining their feet, but only when they experienced a problem.
21.	Algshanan et al. (2017)	Saudi Arabia	Evaluate knowledge, education, attitude, and practice with diabetic foot among diabetic patients all over Saudi Arabia.	Cross-sectional	1289 Diabetic patients from diabetic clinic visitors among Primary Health Care Centers (PHCs).	A research questionnaire has been made.	A large percentage of our participants (69%) had a very low score of 0-2 out of 6 in the assessment of previous education of diabetic foot. More than half of the participants (56.5%) had a score of 6-10 out of 15 in the evaluation of practice with diabetic foot.

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
22.	George et al. (2013)	India	Assess the knowledge and practices regarding foot care and estimate the proportion of peripheral neuropathy among people with diabetes.	Cross-sectional study	212 Diabetic patients from Community Health and Development (CHAD) base hospital, a secondary level hospital run by the Community Health department of a medical college.	The knowledge questionnaire was developed based on a review of foot care knowledge questionnaires. It was pilot tested before use. The Michigan Neuropathy Screening Instrument (MNSI)	There exist deficiencies in knowledge and practices regarding foot care. Male gender, low education, and lesser duration of diabetes are associated with poor knowledge scores. The prevalence of diabetic peripheral neuropathy is high.
23.	Solan et al. (2016)	Saudi Arabia	Determine the knowledge and practice of foot care among diabetes patients attending the Diabetic Center in Jazan Region, Saudi Arabia.	Observational cross-sectional	250 Diabetic patients from Jazan Diabetes Center.	A pre-tested structured questionnaire.	Prevalence of diabetic foot (DF) among males and females was 58.0% and 52.9%, respectively, without significant difference between both genders. Of the type 2 diabetes mellitus patients, 32.5% had highly uncontrolled glycosylated hemoglobin (HbA1c) levels ($\geq 8.6\%$), and 62.8% had diabetes >10 years. The patients had comorbid complications, such as hypertension (61.4%), dyslipidemia (58.6%), retinopathy (23.3%), heart disease (14.4%), and severe foot complications (3.9%).
24.	Abdulghani et al. (2018)	Saudi Arabia	Evaluate the risk of comorbid complications with glycosylated hemoglobin levels and diabetes duration. Also, assess patients' diabetic foot-care knowledge and practices	Cross-sectional descriptive study	360 Diabetic patients who attended two primary health care centers at King Khalid University Hospital and King Abdulaziz University Hospital	A standard bilingual questionnaire was prepared based on previous studies. It was reviewed by expert physicians and piloted	The patients had comorbid complications, such as hypertension (61.4%), dyslipidemia (58.6%), retinopathy (23.3%), heart disease (14.4%), and severe foot complications (3.9%).
25.	Gowda et al. (2017)	Saudi Arabia	Assess the knowledge and practices of diabetic patients regarding foot care and diabetic foot complications.	Cross-sectional	350 Outpatients from clinics of three secondary healthcare hospitals (Alzahir, Security Forces, and Al-Nour) in Makkah	A questionnaire adopted from the Diabetic Foot Care Questionnaire of Diabetes Care Program Nova Scotia 2009 was used. A pilot study was done for the reliability of the questionnaire	There is a significant statistical association between foot education, practices, and diabetic foot ulcer. Patient knowledge and practices regarding diabetic foot care are significantly associated with reducing diabetic foot ulcers.
26.	Alotaibi et al. (2017)	Saudi Arabia	Report on the trends in incidence and prevalence rates of diabetes mellitus in Saudi Arabia over the last 25 years (1990–2015).	Systematic search	8 Studies	A systematic search was conducted for English-language, peer-reviewed publications of any research design via Medline, EBSCO, PubMed, and Scopus from 1990 to 2015.	Findings indicated that the incidence and prevalence rate of diabetes is rising, particularly among females, older children/adolescents, and urban areas.

Ser.	Author/year	Country	Aim	Study design	Sample/ Setting	Instrument with validity and reliability	Findings
27.	Srinath et al. (2017)	India	Assess the self-care activities of patients with Type II diabetes mellitus in a rural area of the Mysuru district	Community-based cross-sectional study	Four hundred patients were residing in the PHC areas Suttur and Hadinaru.	Pre-designed and tested questionnaire.	The rural diabetic patients are more adherent and compliant to medication and diabetic diet and less compliant to physical activity, foot care, and self glucose monitoring. Around 82.9% of the patients were aware of the complications of DM. In 63% of the patients, foot care examination and education regarding foot complications were not suggested by their treating physicians.
28.	Taksande et al. (2017)	India	Analyze the knowledge, attitude, and practice of foot care in patients with DM in central rural India	Hospital-based cross-sectional study	200 Diabetic patients at a rural educational hospital in the central part of India.	A structured and validated questionnaire was administered.	Only 15% of participants had a blood glucose level indicative of good glycaemic control (glycosylated hemoglobin ≤ 7 mmol/L). Most reported that they took their medication as prescribed, but many demonstrated low levels of compliance with other self-management practices.
29.	Al Johani et al. (2015)	Saudi Arabia	Estimate the frequency of self-management activities among people with type 2 diabetes in Saudi Arabia	Cross-sectional study design	Two hundred ten diabetic patients were attending the clinic	Summary of Diabetes Self-care Activities questionnaire was used to identify self-management practices. its validation In addition, a blood sample was drawn to obtain a recent HbA1C or FBG level.	
30.	AlJohani et al. (2016)	Saudi Arabia	Translate and examine the psychometric properties of the Arabic version of the Summary of Diabetes Self-Care Activities	An instrument translation and validation study	243 Diabetic patients from four primary health care centers in Saudi Arabia	SDSCA questionnaire reliability scores of .91 and .90,	The SDSCA-Arabic measure can evaluate diabetes self-care activities in Saudi Arabia and has the potential to be used in other Arabic-speaking populations
31.	Abdulaziz et al. (2016)	Saudi Arabia	This review discusses the range of aspects related to T2DM in Saudi Arabia from the literature published.	Review of the Recent Literature	This review discusses all the aspects of DM in Saudi Arabia, drawing from the published literature currently available.	NA because it is a review paper.	According to the previous studies from Saudi Arabia, we recommended that every Saudi above 30 years of age be screened for both type 2 diabetes and prediabetes to contain the disease.