

## **Awareness of diabetic foot and its risk factors in the general population of Arar, Northern Saudi Arabia**

### **Abstract:**

**Background:** Foot ulcers may be complicated to toe amputation or limb amputation which can be prevented by patient education on self-management and appropriate foot care procedures. **Study objectives:** The objective of this study is to determine the awareness of diabetic foot and its risk factors among the general population of Arar city, Northern Saudi Arabia. **Methods:** An analytical cross-sectional study was carried out in primary health care centers in Arar, Northern Saudi Arabia, during the period from 1<sup>st</sup> September to 10<sup>th</sup> October 2021. Data was collected by personal interview with the attendees of the primary health care center, using a predesigned questionnaire. **Results:** Almost 60% of participants have knowledge about diabetic foot. The Source of information about diabetic foot was doctors and nurses in 13% and 11.9% social media in our study population. 62.7% know that diabetic foot risk may be reduced by controlling blood sugar level, 13% by checking the feet every day and several times a day, and 9.2% reported wearing shoes and socks on a daily basis. 65.6%, 66.7%, 48.4%, 82.6% and 62.1% knew that skin infections, foot abscess, bone infections, gangrene, and foot deformity are complications of diabetic foot respectively. Good knowledge of diabetic foot was significantly associated with age and educational level but not with marital status. **Conclusion:** The level of knowledge of diabetic foot and its related complications is relatively **average**. Due to the high incidence of diabetes mellitus (DM) in Saudi Arabia, it is vital that the population has appropriate information and awareness about this illness to enable continued promotion of public health measures to limit its prevalence. It is also crucial for DM patients to understand the medication and lifestyle modifications that may enable them to better regulate their blood glucose and prevent the complications.

**Key words:** knowledge, diabetic foot, diabetes mellitus, complications, Saudi Arabia, awareness, lifestyle modifications.

### **Introduction:**

Diabetes mellitus (DM) is known to be one of the most challenging problems in public health. Recent research in Saudi Arabia showed that more than 44% of people aged 55 or older had severe uncontrolled diabetes with long-term complications [1]. It is expected that the diabetes prevalence will increase to reach 333 million by the year 2025, with the highest prevalence occurring in developing countries [2]. The prevalence of diabetes differs between countries in Eastern Mediterranean Region (EMR). Rank of Saudi Arabia is the second-highest country with regard to the prevalence of diabetes mellitus (DM) in the Middle East and seventh in the world. The prevalence of diabetes in Saudi Arabia was reported as 13.4% in Saudis aged 15 years or older [3]. Diabetic foot complications are considered the most common diabetes complications with 4 to 10% prevalence in the diabetic population [4]. These diabetic complications are an increasing public health problem and constitute a leading cause of admission, amputation, and mortality in diabetic patients. Diabetic People are prone to get foot ulcers, amputations, and other lower limb clinical abnormalities if they do not have good knowledge about foot care practice [5]. Foot ulceration is one of the most common complications of diabetes [6]. Of diabetic people, 20% are at high risk of foot ulceration due to neuropathy [7]. In Saudi Arabia, there are several conducted studies showing the varying prevalence of diabetic foot ulcers from 26.0% to 61.8% [8]. The main factors that lead to the development of diabetic foot abnormalities are mechanical stress, neuropathy, and angiopathy. Sensory neuropathy results in a reduction of sensation making the foot more prone to trauma eventually leading to skin breakdown and foot ulcer formation [9]. Foot ulcers can cause severe disability and hospitalization to patients and a considerable economic burden to families and health systems [10]. Infection is a further complication that occurs in about half of diabetic foot ulcers. About 85% of diabetes-related amputations are preceded by foot ulcers, and it accounts for more than half of non-traumatic lower-limb amputations [11]. Foot complications increase the risk for amputation in diabetics by 12.3 folds as compared to the non-diabetic population [12]. More than 50% of lower limb amputations are performed on diabetic patients, around 3970 in KSA [13]. One of the most important ways to manage diabetic foot ulcers is the proper care and prevention of injuries to the foot. This requires patients and their caregivers to have proper education, awareness of proper care, and knowledge about the management of foot ulcers. [14].

**Study objectives:**

The objective of this study is to determine the awareness of diabetic foot and its risk factors among the general population of Arar city, Northern Saudi Arabia.

**Methods & participants:****Study design, setting and period:**

A cross sectional community based study was carried out in primary health care centers in Arar, Northern Saudi Arabia, during the period from September 1<sup>st</sup> to October 10<sup>th</sup> 2021.

**Inclusion criteria:** age between 18 and 75 years, both genders and all educational levels.

**Exclusion criteria:** Older than 75 or younger than 18 years and Non Saudi residents.

**Sample Size:**

The included sample was calculated using the following formula:

$$N = Z^2 \times P(1-P) / E^2$$

Where:

N = sample size

Z<sup>2</sup> = 1.96 (The critical value that divides the central 95% of the Z distribution from the 5% in the tail)

P= the prevalence, of awareness regarding diabetic foot and its risk factors among the general population of Arar.

E<sup>2</sup> = the margin of error (= width of confidence interval)

So, by calculation, the sample size is equal to 384 cases with 10% as drop-out rate, so total sample size must be more than 415 individual.

**Sampling Technique:**

The participants was selected using the systematic random sampling technique. Data was collected from all adult Saudi male and female attendees of 5 randomly selected primary health care centers (PHC) in Arar city. We included all the population attending the PHC centers for any cause, not only the patients. After identifying the first participant randomly, then every 3<sup>rd</sup> attendant was interviewed to be included in the study till the required sample is covered. Data was collected through personal interviews with the selected population and filled the questionnaire which guided us to the required data according to the study objectives.

**Data collection tool:**

A predesigned questionnaire was used for data collection. It is composed of two sections. Section 1 includes socio-demographic characteristics of the

participants (age, gender, marital status, educational level and occupation). The second section assessed the knowledge and awareness of the population about the diabetic foot and its risk factors. A written informed consent was obtained from all participants before the interview.

### **Ethical considerations:**

The research proposal was approved by the Regional Research and Ethics committee in Northern Border University, KSA(HAP-09-A-043), with letter number (3/43/H). Data collectors gave a brief introduction to the participants by explaining the aims and benefits of the study. Informed written consent was obtained from all participants. Anonymity and confidentiality of data was maintained throughout the study.

### **Data management and Statistical analysis:**

The collected data was entered and analyzed using the Statistical Package for the Social Science (SPSS Inc. Chicago, IL, USA) version 23. Descriptive statistics was performed. Percentages was given for qualitative variables. The determinant factors were determined using the Chi-square test. P-value was considered significant if  $P < 0.05$ .

### **Results:**

Table (1) shows the sociodemographic characteristics of participants. According to the table 39.8% of studied sample aged between 20- 30 years and 24.7% aged between 41- 50 years. 68.3% of sampled participants were married and 28.5% were single. 58.5% were females. 92.2% of participants were highly educated (university or more) almost 60% of participants have knowledge about diabetic foot.

Table (2) illustrates the knowledge of participants about symptoms and source of information about diabetic foot. In the table; the source of information about diabetic foot was doctors and nurses in 13% and 11.9% social media in our participants. 62.7% reported that diabetic foot risk may be reduced by controlling blood sugar level, 13% by check the feet every day and several times, and 9.2% reported wearing shoes and socks on a daily basis.

Table (3) shows the knowledge of diabetic foot variables among the participants. The data showed that 65.6%, 66.7%, 48.4%, 82.6% and 62.1% knew that skin infections, foot abscess, bone infections, gangrene, and foot deformity are complications of diabetic foot respectively.

Table (4) presents the association between good knowledge about diabetic foot and sociodemographic variables. Good knowledge about diabetic foot was significantly associated with age and educational level but not with marital status

*Table (1): Sociodemographic characteristics of participants (n=1046).*

Parameter		No.	Percent
Age (years)	• <b>Less than 20</b>	78	7.5
	• 20-30	416	39.8
	• 31-40	202	19.3
	• 41-50	258	24.7
	• 51-60	88	8.4
	• <b>More than 60</b>	4	.4
Gender	• <b>Males</b>	435	41.5
	• <b>Females</b>	611	58.5
Marital status	• <b>Widowed</b>	6	.6
	• <b>Divorced</b>	28	2.7
	• <b>Single</b>	298	28.5
	• <b>Married</b>	714	68.3
Educational level	• <b>Illiterate</b>	10	1.0
	• <b>Primary</b>	14	1.3
	• <b>Intermediate</b>	58	5.5
	• <b>University or more</b>	964	92.2

*Table (2): Knowledge of participants of symptoms and source of information about diabetic foot (n=1046).*

Parameter		No.	Percent
Source of information about diabetic foot	• Doctors or nurses	136	13.0
	• Relatives or friends	86	8.2
	• TV or radio	38	3.6
	• Awareness campaigns	52	4.9
	• Social media or the Internet	124	11.9
	• else	168	16.1
	• I do not know	442	42.3
How to reduce the	• Wear shoes and socks	96	9.2

<b>possibility of developing diabetic foot?</b>	on a daily basis.		
	• Check the feet every day and several times.	136	13.0
	• Maintaining blood flow to the feet.	58	5.5
	• Controlling blood sugar levels.	656	62.7
	• Pay attention to feet toes and nails.	24	2.3
	• Protect the feet from high and low temperatures.	28	2.7
	• Toenail clipping	48	4.6
<b>Symptoms of diabetic foot (bias may occur)</b>	• Swelling in the foot and ankle	380	36.3
	• open pest	102	9.7
	• open sores (sores)	338	32.3
	• Sensation of numbness or tingling	230	21.9
	• Wounds with or without bleeding	204	19.5
	• cracks	270	25.8
	• pus	280	26.8
	• Ankle pain	148	14.1
	• An unpleasant smell that does not go away	224	21.4
	• All that is beyond	300	28.7
	• Loss of sensation in the feet	332	31.7
	• skin discoloration	286	27.3
	• Foot temperature change	178	17.0
	• Fever	90	8.6
	• Toenails infected with fungus.	198	18.9
	• redness	292	27.9

	<ul style="list-style-type: none"> <li>• Dry cracks in the skin or around the heels</li> </ul>	148	14.1
	<ul style="list-style-type: none"> <li>• shudder</li> </ul>	78	7.4

*Table (3): Knowledge of diabetic foot variables among participants (n=1046).*

Attitude parameter	Yes	No
Having diabetic patient in the family?	670 64.1%	376 35.9%
Having diabetic foot patient in the family?	122 11.7%	924 88.3%
Do you know have good knowledge of diabetic foot?	604 57.7%	442 42.3%
Did you know that foot ulcers and wounds that do not heal are a complication of diabetic foot?	894 85.5%	152 14.5%
Did you know that skin infections are a complication of diabetic foot?	686 65.6%	360 34.4%
Did you know that a foot abscess is a complication of diabetic foot?	698 66.7%	348 33.3%
Did you know that bone infections are a complication of diabetic foot?	506 48.4%	540 51.6%
Did you know that gangrene is a complication of diabetic foot?	864 82.6%	182 17.4%
Did you know that foot deformity is a complication of diabetic foot?	650 62.1%	396 37.9%
Did you know that Charcot foot is a complication of diabetic foot?	404 38.6%	642 61.4%

**Table (4): Association between good knowledge of diabetic foot and sociodemographic variables (n=1046).**

		Good knowledge of Diabetic foot		Total (N=1046)	P value		
		Yes	No				
Age	Less than 20	26	52	78	<b>.0001</b>		
		4.3%	11.8%	7.5%			
	20-30	264	152	416			
		43.7%	34.4%	39.8%			
	31-40	114	88	202			
		18.9%	19.9%	19.3%			
	41-50	154	104	258			
		25.5%	23.5%	24.7%			
	51-60	42	46	88			
		7.0%	10.4%	8.4%			
	More than 60	4	0	4			
		0.7%	0.0%	0.4%			
	Marital status	Widowed	2	4		6	<b>0.561</b>
			0.3%	0.9%		0.6%	
Divorced		16	12	28			
		2.6%	2.7%	2.7%			
Single		178	120	298			
		29.5%	27.1%	28.5%			
Married		408	306	714			
		67.5%	69.2%	68.3%			
Educational		uneducated	8	2	10	<b>.001</b>	

<b>level</b>		1.3%	0.5%	1.0%
	<b>Primary</b>	2	12	14
		0.3%	2.7%	1.3%
	<b>Intermediate</b>	26	32	58
		4.3%	7.2%	5.5%
	<b>University or more</b>	568	396	964
		94.0%	89.6%	92.2%

### Discussion:

According to the International Diabetes Federation, Saudi Arabia has the highest rate of DM in the MENA region (prevalence rate of 17.7%). Saudi Arabia has the fourth highest incidence of T1DM in the world, at about 33.5/100,000 persons per year. A registry-based data of Saudi estimated foot complications among 3.3% of diabetic patients with majority having foot ulcer. The foot ulcer is often succeeded by complications and deterioration of quality of life [15]. In addition, lower extremity amputation is associated with prolonged hospitalization and rehabilitation and also require home care and social support. Overall, the rate of lower limb amputation in diabetic patients is 10–30 times higher than non diabetics. The studies showed that every 30 seconds one leg is amputated due to diabetes in the world. In the first two years after amputation, there is a 50 percent risk of re-amputation and three years after lower limb amputation, 50% of patients may be dead.

According to our results; almost 60% of participants have knowledge about diabetic foot. On the contrary to a study which showed that a large number (>50%) of participants were found to have poor knowledge of diabetic foot care [16], but in accordance with another Saudi study which found that (76.6%) of patients had good knowledge of diabetic foot and foot ulcers [17]. Pourkazemi, Aydin et al. reported that only 57 participants (15.2%) had good knowledge, most of them (84.8%) had poor knowledge, and the mean score of patients' knowledge was  $8.63 \pm 2.65$  [18]. Desalu, O O et al. found that (78.4%) of patients with poor practice had poor knowledge of foot care [19]. Findings from UK, Iran, Netherlands, India and USA reported inadequate knowledge of self-foot-care among diabetic patients [20].

Source of information about diabetic foot was doctors and nurses in 13% and social media in 11.9% of our participants. Compared to another Saudi study; (11.1%) of patients have attended a class on diabetic foot care, and 81 (22.0%) received education on diabetic foot care from a doctor and 38 (10.3%) from a nurse [21, 22]. Diabetic persons who had been to the diabetic clinic several times may have gathered information over the course of several years of having diabetes, or they may have spent more time with their doctors and nurses to search for and ask for possible explanations that were probably ignored by diabetic persons

who had diabetes for a shorter period of time. When patients with long-term diabetes develop complications such as diabetic foot, physicians and nurses may have taken more time to care for them, according to a new study. Regardless of the length of diabetes, physicians and nurses must understand the significance of educating diabetic patients and their relatives about diabetic complications, such as diabetic foot [23].

In our study; 62.7% reported that diabetic foot risk may be reduced by controlling blood sugar level, 13% by checking the feet every day and several times, and 9.2% reported wearing shoes and socks on a daily basis. Similar results are found in another study, most of the patients were aware that diabetic feet could be prevented by diet, exercise and regular medication (91.1%) and that diabetic foot needed special care (85.7%) [19].

In our study 65.6%, 66.7%, 48.4%, 82.6% and 62.1% of participants knew that skin infections, foot abscess, bone infections, gangrene, and foot deformity are complications of diabetic foot respectively. This was on the line with a study which reported that 69.2% of patients were aware that diabetics are likely to develop foot ulcers and 62.5% were aware of the risk of reduced blood flow in their feet and 66.1% knew that smoking would compound poor circulation [19].

According to our results; good knowledge of diabetic foot was significantly associated with increasing age and educational level but not with marital status. One study showed that in Saudi Arabia; being married, having a secondary and university level of education, and being a government employee had significantly better knowledge of diabetic foot compared with their counterparts [17]. Another study reported that gender, duration of disease, occupation, place of residence, level of education, having diabetic foot ulcer, history of hospitalization, amputation, and other complications had significant relationship with knowledge [24]. In the study by Muhammad-Lotfi, age, gender, level of education, and duration of diabetes had no significant relationship with knowledge, which is in agreement with our current study [25], and also another study indicated a significant relationship between the level of education and knowledge [26]. In Morocco, educational level and socioeconomic status had an impact on awareness of good foot health and care. Poor knowledge of the degenerative complications of diabetes was associated with age, low educational level and low socioeconomic status [27]. Also, a previous study reported that women and those above the age of 50 were less knowledgeable about foot care, although these associations were not statistically significant. Similarly, in some third world countries due to socio-cultural beliefs women are not allowed to attain higher educational status compared with their male counterparts in the family, eventually resulting in women having less knowledge of diabetic foot care [28].

### **Risk Factors for DM in Saudi Arabia:**

The risk factors of DM can be classified into 2 categories: modifiable and non-modifiable. Modifiable risk factors include diets rich in fat, low physical activity, high BMI, high blood pressure (above 140/90), metabolic syndrome and high plasma levels of triglycerides. Non-modifiable risk factors include age (above 40 years) and family history of DM. The high prevalence of T2DM in the Saudi population is attributed to high levels of obesity as the rapid urbanization of the country has led to physical inactivity and the adoption of a more

western diet rich in fat. Midhet et al [29]. performed a case-control study to investigate lifestyle-related risk factors of T2DM in Saudi Arabia. They found a strong association between lifestyle and T2DM: a maternal history of diabetes, education level, lack of exercise and dietary habits were significant risk factors. The adjusted odds ratios for these risk factors were: regular eating of Kabsa OR = 5.5 (95% CI 2.3 to 13.5), eating vegetables OR = 0.4 (95% CI 0.2 to 0.7), eating dates OR = 1.8 (95% CI 1.0 to 3.3) and sedentary lifestyle OR = 2.5 (95% CI 1.2 to 5.0).

Murad et al [30]. performed a case-control study in Jeddah to investigate the risk factors of T2DM. They found that smoking, hypertension, increased weight/obesity and age (above 40 years) were significant risk factors for T2DM among the studied population. Alfadhli et al [31]. found that older maternal age, high BMI, high blood pressure, previous gestational diabetes (GDM), history of delivering a malformed child and family history of diabetes were the main risk factors for GDM.

## **Conclusion:**

Comparing to previous national and international figures, level of knowledge of diabetic foot and related complications is average. Due to the high incidence of diabetes mellitus (DM) in Saudi Arabia, it is vital that the population should have appropriate information and awareness of this illness to enable continued promotion of public health measures and to limit its prevalence. It is also crucial for DM patients to understand the medications and lifestyle modifications that may enable them to better regulate their glucose levels and postpone the onset of problems. DM pathophysiology, risk factors, management, and consequences must be well-understood by patients, families, nurses, and physicians in order to assist patients reach their desired outcome.

## **COMPETING INTERESTS DISCLAIMER:**

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## **References:**

1. Abuyassin B, Laher I. Diabetes epidemic sweeping the Arab world. *World J Diabetes*. 2016;7(8):165-174.
2. Vatankhah N, Khamseh ME, Noudeh YJ, Aghili R, Baradaran HR, Haeri NS. The effectiveness of foot care education on people with type 2 diabetes in Tehran, Iran. *Prim Care Diabetes*. 2009;3(2):73-7. <https://doi.org/10.1016/j.pcd.2009.05.003>.

3. Bcheraoui C, Basulaiman M, Tuffaha M, et al. Status of the diabetes epidemic in the kingdom of Saudi Arabia, 2013. *Int J Public Health*. 2014;59:1011–1021. doi: 10.1007/s00038-014-0612-4.
4. Haq NU, Durrani P, Nasim A, et al. Assessment of Knowledge and Practice of Diabetes Mellitus Patients Regarding Foot Care in Tertiary Care Hospitals in Quetta, Pakistan. *Specialty J Med Res Health Sci*. 2017;2(4):35–43.
5. Abbas ZG, Archibald LK. Epidemiology of the diabetic foot in Africa. *Med Sci Monit*. 2005;11:RA262–RA270.
6. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. *Lancet*. 2005;366:1719–24.
7. Paisey R, Abbott A, Levenson R, et al. Diabetes-related major lower limb amputation incidence is strongly related to diabetic foot service provision and improves with enhancement of services: peer review of the south-west of England. *Diabet Med*. 2018;35(1):53–62. doi: 10.1111/dme.13512.
8. Alshammari ZJ, Alsaid LA, Parameaswari PJ, Alzahrani AA. Attitude and knowledge about foot care among diabetic patients in Riyadh, Saudi Arabia. *J Family Med Prim Care*. 2019;8(6):2089-2094. doi:10.4103/jfmpc.jfmpc\_248\_19
9. Rahman S. Diabetic Foot Ulcer. Predisposing factors and Management. *BMJ*. 2006;332:407–10.
10. Dang CN, Boulton AJ. Changing perspectives in diabetic foot ulcer management. *Int J Low Extrem Wounds*. 2003;2:4–12.
11. The diabetic foot. Position statement. International Diabetes Federation. [Internet] [Last cited on 2012 May 2]. Available from: <http://www.idf.org/position-statement-diabetic-foot>.
12. Morris AD, McAlpine R, Steinke D, Boyle DI, Ebrahim ER, Vasedev N, Stewart CP. Diabetes and lower-limb amputations in the community. A retrospective cohort study. DARTS/MEMO Collaboration. Diabetes Audit and Research in Tayside/Scotland/Medicines Monitoring Unit. *Diabetes Care*. 1998;21(5):738–743.
13. Alzahrani H (2012):Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3595872>.
14. Goie T, Naidoo M. Awareness of diabetic foot disease amongst patients with type 2 diabetes mellitus attending the chronic outpatient's department at a regional hospital in Durban, South Africa. *Afr J Prim Health Care Fam Med*. 2016;2071: 2928–36.
15. Aalaa M, Malazy OT, Sanjari M, Peimani M, Mohajeri-Tehrani M. Nurses' role in diabetic foot prevention and care; a review. *J Diabetes Metab Disord*. 2012;11(1):24. Published 2012 Nov 21. doi:10.1186/2251-6581-11-24.
16. Muhammad-Lutfi AR, Zaraihah MR, Anuar-Ramdhan IM. Knowledge and practice of diabetic foot care in an in-patient setting at a Tertiary Medical Center. *Malays Orthop J*. 2014;8:22–6.
17. Alshammari ZJ, Alsaid LA, Parameaswari PJ, Alzahrani AA. Attitude and knowledge about foot care among diabetic patients in Riyadh, Saudi Arabia. *J Family Med Prim Care*. 2019;8(6):2089-2094. doi:10.4103/jfmpc.jfmpc\_248\_19

18. Pourkazemi A, Ghanbari A, Khojamli M, et al. Diabetic foot care: knowledge and practice. *BMC Endocr Disord.* 2020;20(1):40. Published 2020 Mar 20. doi:10.1186/s12902-020-0512-y
19. Desalu OO, Salawu FK, Jimoh AK, Adekoya AO, Busari OA, Olokoba AB. Diabetic foot care: self reported knowledge and practice among patients attending three tertiary hospital in Nigeria. *Ghana Med J.* 2011;45(2):60-65. doi:10.4314/gmj.v45i2.68930.
20. AlOwais MM, Shido OA. Knowledge and practice of foot care in patients with diabetes mellitus attending primary care center at Security Forces Hospital, Riyadh, Saudi Arabia: A cross-sectional study. *J Family Med Prim Care.* 2020;9(12):5954-5960. Published 2020 Dec 31. doi:10.4103/jfmpc.jfmpc\_943\_20.
21. Almalki TM, Almalki NR, Balbaid K, Alswat K. Assessment of diabetes knowledge using the Michigan brief diabetes knowledge test among patients with type 2 diabetes mellitus. *J Endocrinol Metab.* 2017;7:185–189.
22. Shah VN, Kamdar PK, Shah N. Assessing the knowledge, attitudes and practice of type 2 diabetes among patients of Saurashtra region, Gujarat. *Int J Diabetes Dev Ctries.* 2009;29:118–22.
23. Saurabh S, Sarkar S, Selvaraj K, Kar SS, Kumar SG, Roy G. Effectiveness of foot care education among people with type 2 diabetes in rural Puducherry, India. *Indian J Endocrinol Metab.* 2014;18(1):106-110. doi:10.4103/2230-8210.126587
24. Chiwanga FS, Njelekela MA. Diabetic foot: prevalence, knowledge, and foot self-care practices among diabetic patients in Dar es Salaam, Tanzania—a cross-sectional study. *J Foot Ankle Res.* 2015;8(1):20. doi: 10.1186/s13047-015-0080-y.
25. Muhammad-Lutfi A, Zaraihah M, Anuar-Ramdhan I. Knowledge and practice of diabetic foot care in an in-patient setting at a tertiary medical center. *Malays Orthop J.* 2014;8(3):22. doi: 10.5704/MOJ.1411.005.
26. Lamchahab, F. Z., et al. "Factors influencing the awareness of diabetic foot risks." *Annals of physical and rehabilitation medicine* 54.6 (2011): 359-365. **PubMed : 2011; 54(6):359-365.**
27. Shamim M, Alhakbani MSA, Alqahtani MSB, Alharthi OSO, Alhaqbani YJN. Knowledge, attitude, and practice regarding diabetic foot care among Saudi and non-Saudi diabetic patients in Alkharj. *J Family Med Prim Care.* 2021;10(2):859-864. doi:10.4103/jfmpc.jfmpc\_1681\_20
28. Desalu OO, Salawu FK, Jimoh AK, Adekoya AO, Busari OA, Olokoba AB. Diabetic foot care: self reported knowledge and practice among patients attending three tertiary hospital in Nigeria. *Ghana Med J.* 2011;45(2):60-65. doi:10.4314/gmj.v45i2.68930
29. Midhet FM, Al-Mohaimed a a Sharaf FK. Lifestyle related risk factors of type 2 diabetes mellitus in Saudi Arabia. *Saudi Med J.* 2010;31:768–774. **[PubMed] [Google Scholar]**
30. Murad MA, Abdulmageed SS, Iftikhar R, Saga BK. Assessment of the common risk factors associated with type 2 diabetes mellitus in Jeddah. *Int J Endocrinol.* 2014;2014:1–9. **[PMC free article] [PubMed] [Google Scholar]**
31. Alfadhli EM, Osman EN, Basri TH, Mansuri NS, Youssef MH, Assaedi SA, et al. Gestational diabetes among Saudi women: prevalence, risk factors and pregnancy

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