Introduction

Diabetes mellitus (DM) refers to a chronic progressive metabolic disorder characterized by hyperglycemia, caused by either deficiency or resistance to the insulin hormone. It is a global public health problem. Its worldwide prevalence among adults aged 20–79 years in 2019 was approximately 463 million cases, which was expected to rise to 700 million by 2045. The World Health Organization (WHO) statistics ranked Saudi Arabia as second for diabetes prevalence in the Middle East, and seventh globally. Even more alarming, is the increasing pattern of diabetes in Saudi Arabia. Besides, WHO reports that the prevalence of diabetes was 14.4% (14.7% among males and 13.8% among females) leading to 5% of death in Saudi Arabia. Furthermore, local studies showed the prevalence of diabetes and prediabetes in males was 9.2% and 27.6%, respectively, whereas the prevalence in females was 3.8% and 18.8%, respectively, in the Alkharj study population.

The diabetic foot, which is one of the most common complications of diabetes, leads to considerable financial consequences on the care system. A study by the American Diabetes Association found that 40% of patients with diabetes will develop a foot ulceration at least once in their lifetime, and 15% of these patients will require an amputation. In addition, foot ulcers cost the healthcare system an estimated $10 billion per year in the United States alone.

The World Health Organization (WHO) has identified foot complications as a major cause of morbidity and mortality in people with diabetes. It is estimated that up to 85% of all lower limb amputations in people with diabetes are preventable. A study by the American Diabetes Association found that 40% of patients with diabetes will develop a foot ulceration at least once in their lifetime, and 15% of these patients will require an amputation. In addition, foot ulcers cost the healthcare system an estimated $10 billion per year in the United States alone.

In this study, we aim to assess the knowledge, attitude, and practices regarding diabetic foot care among Saudi and non-Saudi diabetic patients in Alkharj.

Methods and Materials

This is a cross-sectional study conducted from May 22nd, 2019, to April 1st, 2020, at Diabetic clinic, Military Hospital in Alkharj.

Non-randomized, non-probability convenience sampling technique was used to collect data from 224 patients by using a validated and confidential questionnaire in either face-to-face interviews or as an electronic survey. All adult patients over 18 years of age of both sexes having type 1 and 2 diabetes mellitus were included. The patients who were unable to provide the requested information were excluded.

The data were analyzed using SPSS version 24.
patients, their families, and society. Diabetic foot care cost reached up to $13 billion in the United States in addition to the cost of management of DM itself which clearly illustrates how much financial impact is laid on diabetic foot management. The risk factors of the diabetic foot include old age, duration of diabetes, and hypertension, however, neuropathy leading to sensory loss and peripheral vascular disease causing ischemia were major risk factors that result in foot ulcer and ultimately foot amputation. Other previous studies showed that diabetic patients demonstrated discrepancies between knowledge and practice which found good knowledge in contrast with poor practice as well as lack of education about a diabetic foot, hence, knowledge was gained through relatives or social media.

**Subjects and Methods**

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**Study design and duration**

It is a descriptive, cross-sectional study, conducted over 14 months from May 22nd, 2019 to April 1st, 2020.

**Study setting and subjects**

The study was conducted at Diabetic Clinic in the Military Hospital in Alkharj, Saudi Arabia. The inclusion criteria were: all adult patients over 18 years of age, Saudis as well as expatriates, of both sexes with type 1 and type 2 DM. The exclusion criteria were: patients who were unable to understand or provide requested information such as elderly patients or patients with cognitive impairment.

**Sampling technique and sample size**

A non-randomized, non-probability convenience sampling technique was used for data collection.

**Data collection**

The data was collected by using a validated and confidential questionnaire [Table 1] in a face-to-face interview and a part of that was obtained by an electronic survey to enlarge the circle of participants. The questionnaire contained four sections of questions: demographic information, patients’ knowledge about diabetes, its complications and management, patient’s attitude, and patient practices. The questionnaire was translated into the Arabic language with modifications to be culturally accepted. Informed consent was taken from all patients and confidentiality and privacy was ensured. An authorization letter was obtained from the hospital administration for the questionnaire distribution. The proposal was approved by the Ethics Committee of Prince Sattam Bin Abdulaziz University Institutional Review Board. Data from 160 participants were collected by a personal interview method, while for another 65 patients it was collected by an electronic survey among Al-Kharj populations.

**Statistical analysis**

The data record was initially made in Microsoft Office Excel and later transferred to Statistical Package for the Social Sciences (SPSS) version 24 for statistical analysis. Each response regarding knowledge, attitude, and practice were assigned a score (0–2): correct knowledge 1, no knowledge or incorrect knowledge 0, positive attitude 1, negative attitude 0, full practice 2, incomplete practice 1, and no practice 0. The means were calculated from a total KAP score of 43, knowledge score 12, attitude score 5, and practice score 26. One-way analysis of variance (ANOVA) was used to plot means. The means were observed with a 95% confidence interval (CI) and a P value of <.05 was considered significant.

**Results**

The demographic characteristics are summarized in Table 2. A total of 224 participants were interviewed with a response of 100%. The age range was 20–90 years, with a mean of 49.37 (SD 1.165), while the sex distribution was 131 (58.5%) male and 93 (41.5%) female, with the majority of patients being...

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**Table 1: Questionnaire items for knowledge, attitude, and practices regarding diabetic foot care**

| Knowledge                                                                 | Attitude                                                                 |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Diabetics are likely to develop foot ulcers:                               | Can you perform regular exercise and change your food habits to prevent further diabetic complications? |
| Diabetics are likely to develop reduced blood flow in their feet:          | Can you take the responsibility of daily examination of your feet and foot-wear, as well as regular foot-care specialist consultation? |
| Diabetics are likely to develop reduced sensation in their feet:          | Can you use special foot-wear advised by the foot-care specialist?        |
| It is important to look at the soles because diabetics have reduced sensations | Will you wear footwear indoors as advised by your foot-care specialist? |
| It is important to inspect the feet, as wounds and infections may not heal quickly: | Can you be able to live a normal life with appropriate measures for diabetes? |
| Poor circulation in feet may result from smoking:                         | Practices                                                                 |
| Taking medication regularly will reduce DM complication:                  | Do you examine your feet daily?                                          |
| It is important to examine the inside of footwear for any object or tear: | Do you use comfortable, closed, and soft footwear?                       |
| Foot gangrene is one of the diabetic foot complication:                   | Do you examine your shoes before wearing them?                           |
| Do you think doing exercise will help you prevent diabetic foot?          | Do you walk barefoot, outside?                                           |
| Uncontrolled diabetes can lead to foot deformity?                         | Do you continuously wear cotton socks?                                   |
| Can you perform regular exercise and change your food habits to prevent further diabetic complications? | Do you change your socks daily?                                          |
| Can you take the responsibility of daily examination of your feet and foot-wear, as well as regular foot-care specialist consultation? | Do you examine your feet for any marks resulting from shoes/socks?      |
| Can you use special foot-wear advised by the foot-care specialist?        | Do you daily wash your feet with warm water?                             |
| Will you wear footwear indoors as advised by your foot-care specialist?  | Do you carefully dry the cleft between toes after washing?               |
| Can you be able to live a normal life with appropriate measures for diabetes? | Do you apply moisturizer daily on your feet?                             |
|                                                                                | Do you cut your toenails regularly?                                      |
|                                                                                | Do you regularly visit a physician for foot check-ups?                   |
|                                                                                | Do you regularly change footwear, even without damage?                  |
Saudis 220 (98.2%) and non-smokers (82%). Most patients (42%) had a diabetes history of fewer than 10 years, followed by 33.5% for 11–20 years, 24.6% for more than 20 years. About half of the patients (50.4%) had uncontrolled diabetes in terms of hemoglobin A1c (HbA1c).

Moreover, only 6.3% of patients reported diet only as their treatment modality, while about 45.1% required oral agent(s) only, and 48.7% of patients required insulin injection. Regarding foot problems, more than half had foot sensations problems, while 9.4% of patients had an ulcer (either active or healed), with 2.2% ends in amputation. Besides, many patients had other body systems affected as well: retinopathy (26.8%), dyslipidemia (59.4%), heart disease (14.3%), renal disease (7.1%), and hypertension (46.9%). About half of the patients (52.2%) had received advice and education regarding the management of diabetes and its foot complications, whereas 39.3% did not receive any advice.

The statistical analysis of KAP regarding diabetic foot care is summarized in Table 3. Some of the important highlights from the questionnaire data are given below. The mean knowledge score (8.576) from a maximum of 12 indicates that the majority of patients have sufficient knowledge about diabetes and its foot complications. About 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. About 71.4% were aware of the risk of reduced foot sensations, 70.5% of patients knew the importance of regular sole inspection, and 74.5% of patients knew the importance of inside footwear inspection. About 87.5% of patients knew the importance of taking medicines regularly as it can reduce diabetic complications, and 81.7% of patients knew that foot gangrene is one of the diabetic complications. About 81.3% of patients acknowledged the importance of exercise in preventing diabetic foot.

The mean attitude score (4) from a maximum of 5 indicates that most patients have a positive attitude towards the management of diabetes and its foot complications. About 70.5% of patients agreed to change food habits and perform regular exercise. About 77.2% of patients were willing to take the responsibility of self-foot examination, 81.3% of patients were willing to use special foot-wear, and 82.1% were willing to wear footwear indoors. About 88.8% of patients thought that they can live a normal life with appropriate measures for diabetes.

### Table 2: Patients’ demographics and diabetes-related clinical characteristics

| Characteristics                          | All (n=224)                  |
|------------------------------------------|------------------------------|
| Age, y, mean (SD)                        | 49.37 (1.165)                |
| Gender, n (%)                            | Male 131 (58.5) Female 93 (41.5) |
| Nationality, n (%)                       | Saudi 220 (98.2) Non-Saudi 04 (1.8) |
| Smoking, n (%)                           | 18 (8)                       |
| Duration of diabetes, n (%)              | ≤10 years 94 (42) 11-20 years 75 (33.5) 21-30 years 32 (14.3) >30 23 (10.3) |
| HbA1c, n (%)                             | Controlled (<7.0%) 59 (26.3) Uncontrolled (7.0%-8.5%) 61 (27.2) Highly uncontrolled (≥8.6%) 52 (23.2) Unknown 52 (23.2) |
| Diabetes treatment, n (%)                | Diet 14 (6.3) Oral agent (s) 101 (45.1) Insulin 39 (17.4) Insulin and oral agent 70 (31.3) |
| Foot complains, n (%)                    | History of healed ulcer 10 (4.5) Current foot ulcer 11 (4.9) Flat foot 5 (2.2) None 198 (88.4) |
| Sensation problem in foot, n (%)         | Numbness 31 (13.8) Foot pain during walking 14 (6.3) Foot pain at rest (especially at night) 14 (6.3) Tingling or pricking 13 (5.8) Multiple problems 50 (22.3) None 102 (45.5) |
| Amputation, n (%)                        | 5 (2.2)                      |
| Hypertension, n (%)                      | 105 (46.9)                   |
| Renal disease, n (%)                     | 16 (7.1)                     |
| Heart disease, n (%)                     | 32 (14.3)                    |
| Dyslipidemia, n (%)                      | 133 (59.4)                   |
| Retinopathy, n (%)                       | 60 (26.8)                    |
| Received advice on foot care, n (%)      | 117 (52.2)                   |
| Source of advice, n (%)                  | Physicians 74 (33) Media 22 (9.8) Relative 26 (11.6) Multiple sources 14 (6.3) None 88 (39.3) |

### Table 3: Statistical analysis of Knowledge, Attitude, and Practice (One-Sample Test and ANOVA)

|                        | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference |
|------------------------|----------------|-----------------|------------------------------------------|
| Knowledge score        | <.001          | 8.576           | 8.15 – 9.01                              |
| Attitude score         | <.001          | 4.000           | 3.82 – 4.18                              |
| Practice score         | <.001          | 13.004          | 12.33 – 13.68                            |
| Total KAP score        | <.001          | 25.580          | 24.56 – 26.60                            |
The mean practice score (13) from a maximum of 26 indicates that the patients were lagging in the management of diabetes and its foot complications, despite better understanding and positive attitude. Only 26.8% of patients were performing the daily self-foot examination, whereas 43.3% of patients had never examined their feet. About 49% of patients reported the use of comfortable, closed, and soft footwear, and only 37.9% were checking shoes before wearing. Most patients (54%) never walked outside barefoot. Only 32.1% of patients regularly wore cotton socks, whereas 17.9% never wore cotton socks. About 30.4% of patients were changing socks daily. Only 29% of patients were checking whether their shoes/socks left any marks on their feet, and 27.7% of patients were regularly changing footwear even without damage. About 38.4% of patients were washing their feet daily with warm water, and only 27.2% were careful in drying between toes after the wash. Most (73.7%) patients were regularly cutting their toenails, and 30.8% of patients were using moisturizing cream regularly. About 73.2% of patients were not visiting physicians for foot check-ups. Figures 1, 2, and 3 show the plotting of means of knowledge, attitude, and practice against the total KAP score.

Discussion

The risk of developing diabetic foot ulcers is high among DM patients, with the potential of leading to infection, gangrene, amputation, and ultimately death due to sepsis and multiorgan failure syndrome. Therefore, a proactive approach is required to prevent the development of diabetic foot ulcers by appropriate education of patients and clinicians. This study shows that our diabetic patients have good knowledge as well as attitude regarding their diabetic foot care; however, they are lagging behind the diabetic foot care practices, as reflected by the mean score of knowledge, attitude, practice of 8.576 out of 12 (71.6%), 4 out of 5 (80%), and 13 out of 26 (50%), respectively. The gap between the knowledge and practice score could be due to poor compliance of the patients. Similar findings of lower practice scores than the knowledge score were also noted by other relevant studies. The majority of patients (77%) in this study did not receive proper advice about diabetic foot management from the physicians, which may reflect poor foot care. This may be attributed to a low level of diabetic foot education among physicians, and so there is a need to reinforce it by regular refresher courses or workshops. Also, we found other previous local studies show similar results which indicate the lack of education of patients about foot care.

In this study, the prevalence of comorbidities such as dyslipidemia, neuropathy, heart disease, hypertension, and retinopathy were relatively high. Besides, the synergism effect of these diseases with long-term diabetes has an either direct or indirect impact on blood vessels and blood flow, especially the peripheral one, which is increasing the risk of ischemic changes and foot ulcer incidence and amputations. Moreover, in our study the rate of foot ulcers (healed or active) was moderately high 9.4% which is relatively close to the range of the prevalence of foot ulcers in Asia and Europe (10%-15%). However, the global incidence of diabetic
foot ulcers is (6.3%) which is lower than in this study (9.4%), according to the systemic review and meta-analysis.\cite{16}

The current issues draw attention to the need for educating and giving advice to all patients with DM to prevent the complications of the diabetic foot. Moreover, with each clinic visit, it is necessary to encourage and motivate the patients to improve their practice of foot care. Several studies reveal the impact of patient education regarding diabetic foot which leads to an improvement in their practices and changes in patient's behavior and motivation, as well as a decrease in the burden of diabetic foot ulcers. Education is also critical to help diabetic patients’ families to handle the lifestyle needed to modify and giving psychological and dietary support.\cite{17-20}

Unfortunately, the majority of patients were not visiting physicians for foot check-ups. Also, the majority acknowledges taking the responsibility of self-foot examination and use special foot-wear. However, only 26.8% of patients were performing the daily self-foot examinations, whereas 43.3% of patients had never examined their feet. Fortunately, visiting the diabetic clinic early can reduce the risk for patient’s admission and amputation. Our study suggests patients want the doctors to examine their foot willingly rather than ask them to do it.\cite{21,22} Therefore, it is being emphasized that the physicians need to give time to the patient and advise them about diabetic foot practices to improve practice scores. One study from India also recommended a diabetic foot education program for doctors so that they can develop effective clinical practice and best use the clinical tools for the diagnosis, prevention, and treatment of the diabetic foot.\cite{23} As primary care physicians are usually the first station in the management pathway of diabetic foot patients, they must understand the risk factors, pathogenesis, assessment, and management of diabetic foot. This paper will serve as a good medium to raise the understandings of primary care physicians to better manage diabetic foot patients. In summary, this study shows adequate knowledge and attitude about a diabetic foot by the patients themselves. However, there is a need to increase the level of practice, which can be achieved by providing refresher courses to primary care physicians.

**Conclusions**

Our study population has sufficient knowledge about diabetes and its foot complication, and they also had a positive attitude towards its management. However, they were lagging in the practices required for diabetic foot management.

**Recommendation and limitation**

This study was mainly performed at a single hospital at Al Kharij, so it is not a true reflection of the whole city; however, we did try to address this issue by internet survey among the Alkharij population.

Another limitation of this study was the questionnaire answer design for knowledge and attitude, asking only yes or no. We believe that it would be easy for the patients to answer a close-ended question; however, the participant may give agreement answers (yes) to these yes/no questions when they did not know the answer, therefore, this is may be the possible cause of why they had good knowledge and attitude. We have tried to reduce this bias as much as possible by providing a choice “I do not know.”

We recommend providing a structured educational program about diabetic foot care for both patients and physicians lead by the Saudi Ministry of Health. Besides, providing a diabetic foot care clinic in each healthcare facility is also a critical point.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Key Message**

As the patients are lagging behind the practices for diabetic foot management inspite of sufficient knowledge and positive attitude, there is a need for special education regarding diabetic foot management.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract 2018;138:271-81.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract 2019;157:107843.
3. Al-Dawish MA, Robert AA, Braham R, Al Hayek AA, Al Saeed A, Ahmed RA, et al. Diabetes mellitus in Saudi Arabia: A review of the recent literature. Curr Diabetes Rev 2016;12:359-68.
4. Aldossari KK, Aldiab A, Al-Zahrani JM, Al-Ghamdi SH, Abdelrazik M, Batais MA, et al. Prevalence of prediabetes, diabetes, and its associated risk factors among males in Saudi Arabia: A population-based survey. J Diabetes Res 2018;2018:2194604.
5. Al-Zahrani JM, Aldiab A, Aldossari KK, Al-Ghamdi S, Batais MA, Javad S, et al. Prevalence of prediabetes, diabetes and its predictors among females in Alkharij, Saudi Arabia: A cross-sectional study. Ann Glob Health 2019;85:109.
6. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. Lancet (London,
7. Rice JB, Desai U, Cummings AK, Birnbaum HG, Skornicki M, Parsons NB. Burden of diabetic foot ulcers for medicare and private insurers. Diabetes Care 2014;37:651-8.

8. Al-Rubeaan K, Al Derwish M, Ouizi S, Youssef AM, Subhani SN, Ibrahim HM, et al. Diabetic foot complications and their risk factors from a large retrospective cohort study. PLoS One 2015;10:e0124446.

9. Abdulghani HM, AlRajeh AS, AlSalman BH, AlTurki LS, AlNajashi NS, Irshad M, et al. Prevalence of diabetic comorbidities and knowledge and practices of foot care among diabetic patients: A cross-sectional study. Diabetes Metab Syndr Obes 2018;11:417-25.

10. Abu-Qamar MZ. Knowledge and practice of foot self-care among Jordanians with diabetes: An interview-based survey study. J Wound Care 2014;23:247-50, 52-4.

11. Algshanen MA, Almuhanna MF, Almuhanna AM, Alghobaish FF, Bari OS, Alajji NA, et al. Diabetic foot awareness among diabetic patients in Saudi Arabia. Egypt J Hosp Med 2017;68:1289-90.

12. Wui NB, Bin Azhar AA, Bin Azman MH, Bin Sukri MS, Harbaksh Singh AS, Wahid AMBA. Knowledge and attitude of nurses towards diabetic foot care in a secondary health care centre in Malaysia. Med J Malaysia 2020;75:391-5.

13. Rubio JA, Jiménez S, Lázaro-Martínez JL. Mortality in patients with diabetic foot ulcers: Causes, risk factors, and their association with evolution and severity of ulcer. J Clin Med 2020;9:3009.

14. Alshammarri 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;8:2089-94.

15. Ferguson TS, Tulloch-Reid MK, Younger NO, Wright-Pascoe RA, Boyne MS, McFarlane SR, et al. Diabetic foot complications among patients attending a specialist diabetes clinic in Jamaica: Prevalence and associated factors. West Indian Med J 2013;62:216-23.

16. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: A systematic review and meta-analysis (dagger). Ann Med 2017;49:106-16.

17. Mohammad NA, Khresheh RM. Evaluate the effect of education interventions in the prevention of diabetic foot ulcers through knowledge of the disease and self-care practices in Saudi Arabia. Open Access Muced J Med Sci 2018;6:2206-13.

18. Vatankhah N, Khamseh ME, Jahangiri Noudedeh Y, Aghili R, Baradaran HR, Safai Haeri N. The effectiveness of foot care education on people with type 2 diabetes in Tehran, Iran. Primary Care Diabetes 2009;3:73-7.

19. 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;18:106-10.

20. Alnani FK, Alotaibi JS, Paliadelis P, Alqarawi N, Alsharari A, Albagawi B. Knowledge and awareness of diabetes mellitus and its risk factors in Saudi Arabia. Saudi Med J 2018;39:981-9.

21. Hicks CW, Selvarajah S, Mathioudakis N, Sherman RE, Hines KF, Black JH 3rd, et al. Burden of infected diabetic foot ulcers on hospital admissions and costs. Ann Vasc Surg 2016;33:149-58.

22. Williams DT, Majeed MU, Shingler G, Akbar MJ, Adamson DG, Whitaker CJ. A diabetic foot service established by a department of vascular surgery: An observational study. Ann Vasc Surg 2012;26:700-6.

23. Das A, Pendsey S, Abhyankar M, Malabade R. Management of diabetic foot in an Indian clinical setup: An opinion survey. Cureus 2020;12:6-13.