Knowledge of Diabetic Foot Among Nurses at a Tertiary Hospital in Saudi Arabia

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ABSTRACT

Background: Diabetic foot is the leading cause of hospitalization among patients with diabetes mellitus (DM). Nurses have a significant role in helping diabetic foot patients by educating them about their condition. Therefore, assessing the knowledge of diabetic foot among nurses will help provide better healthcare services to these patients. Objective: This study aimed to assess the knowledge of diabetic foot care among the nursing staff at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia. Methods: This cross-sectional study was conducted at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia, from March to May 2020. A total of 172 nurses from different departments of the hospital were randomly selected. A validated questionnaire including 68 yes-or-no questions about diabetic foot management was used for the assessment. Results: The average total score of the entire questionnaire was 59 (standard deviation, ±7). During our study, the nursing school curriculum was found to be the major source of knowledge for nurses. Statistical significance (p=0.031) was found for the association between educational background and answers to the risk factor questions. According to our results, most nurses indicated that they believed that reporting any changes to the feet and toes and signs of infection to the physician was the best way to prevent the development of DM foot. Conclusion: Specialized training programs beyond basic nursing education will reinforce knowledge and skills, resulting in an expected lower risk of amputation for DM patients. Keywords: Diabetes, Nurses, Education, Diabetic Foot, Saudi Arabia.

1. BACKGROUND

Diabetes mellitus (DM) is a common disease that results in patient morbidity and mortality. It occurs with either inadequate insulin secretion or resistance to insulin at the receptor level (1). Obesity, sedentary lifestyle, and family history are considered risk factors for DM development (1). Stroke, ischemic heart disease (coronary artery disease), peripheral arterial disease, and chronic kidney disease are known as chronic complications resulting from DM. Furthermore, retinopathy, neuropathy, and nephropathy are acute complications of DM (2, 3).

In 2019, 500 million individuals globally were diagnosed with DM (4). Moreover, it has been estimated that by 2030, a total of 578 million individuals will have DM (4). Saudi Arabia is considered to have the most prevalent cases of diabetes, with 7 million individuals with diabetes and 3 million individuals with prediabetes, thus ranking first in the Arabian Gulf region and second in the Middle East for diabetes (5).

Uncontrolled and poorly managed DM and a history of peripheral arterial disease result in a higher risk of microvascular complications, including diabetic foot (6, 7). Diabetic foot is considered the leading cause of hospitalization for patients with DM (6). It results from complex pathogenesis related to increased plantar pressure and impaired cellular wound healing, eventually resulting in chronic foot lesions, and is commonly observed in patients with polyneuropathy and angiopathy (6). The risk of diabetic foot is 2.5% per year for DM patients, and the majority of these individuals will require amputation within 4 years of the initial diagnosis (7). A recent study conducted in Saudi Arabia found that 3.3% of patients had diabetic foot (8).

The preoperative role of nurses in the management of diabetic foot involves providing patients with information about proper nutrition to strengthen their immunity. Intraoperatively, their role is to prepare the sterilized equip-
ment needed to perform any procedures. Postoperatively, their role is to prevent the wound from becoming infected (9, 10). Additionally, nurses who manage diabetic foot cases help control the progression of disease and select the appropriate dressing that will help treat the ulcer or wound (11).

Nurses can educate patients before they leave the hospital by providing them with information about controlling their condition, for example, by teaching them how to change the wound dressing and the appropriate way to use their medications (10, 12). Because nurses have a significant role in helping diabetic foot patients by educating them about their condition, assessing their knowledge about this disease will help us provide better healthcare services to these patients (13). Although similar studies have been conducted, none has been performed in Saudi Arabia.

2. OBJECTIVE

Therefore, this study aimed to assess the knowledge of diabetic foot care among the nursing staff at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia.

3. METHODS

This was a cross-sectional study involving nurses at KAUH in Jeddah, Saudi Arabia, that was conducted from March to May 2020. Jeddah is one of the largest cities in the western region of Saudi Arabia (near the Red Sea) and has a population of 3.5 million. With a capacity of 800 beds, KAUH is one of the largest tertiary referral and teaching centers in the western region of the country. Our sample consisted of 172 nurses randomly selected from different departments of the hospital.

Google Forms software was used to create the questionnaire, and Google Sheets software was used to distribute and collect data. After acquiring permission from the author of the questionnaire, it was adapted according to the study by Kaya et al. and used for our study (13) to examine the knowledge among nurses regarding diabetic foot. The questionnaire was self-administered, standardized, and confidential. To the best of our knowledge, this is the only questionnaire that tests the knowledge of diabetic foot management among healthcare practitioners. The questionnaire was divided into two sections. The first section collected the sociodemographic information and diabetes management-related knowledge of the nurses. The second section comprised 68 yes-or-no questions about diabetic foot management; these questions were divided into the following four subsections: risk factors, foot examination, foot complications, and footwear selection. The subsections contained 16, 10, 32, and 10 questions. A score of 1 was given for each correct answer, and each incorrect answer was given a score of 0, resulting in an overall score between 0 and 68. The higher the total score, the greater the nurse’s knowledge of diabetic foot management.

The validity and reliability of the questionnaire were tested using Cronbach’s α test, which indicated high reliability (0.89). The reliability coefficients for the subscales were 0.72 for the risk factors subscale, 0.64 for the foot examination subscale, 0.84 for the foot complications subscale, and 0.63 for the footwear selection subscale.

Data were analyzed using IBM SPSS Statistics for Windows (version 21). Demographic data and diabetic foot management practices of nurses were the independent variables, and the dependent variables were their knowledge of diabetic foot management based on their questionnaire scores. Descriptive statistics (means, standard deviations, frequencies, and percentages) were calculated for the demographic variables. Associations between background factors and the foot care knowledge test results were analyzed using a t-test for paired group comparisons; a one-way analysis of variance was performed to analyze more than two factors. The relationship between variables was examined using the Pearson chi-square test. Statistical significance was set at P<0.05. The internal consistency of the scale was tested using Cronbach’s α test.

This study was approved by the Research Committee of the KAUH Department of Biomedical Ethics. Partic-

| Characteristic | N | %  |
|----------------|----|----|
| Average age, years | 38 (SD, ±9; range, 22-61) |  |
| Average time working as a nurse, years | 12.8 (SD, ±7.6; range, 0.3-30) |  |
| Average time working in the department, months | 74 (SD, ±89; range, 1-100) |  |
| Sex |  |  |
| Male | 24 | 14.0% |
| Female | 148 | 86.0% |
| Marital status |  |  |
| Single | 40 | 23.3% |
| Married | 128 | 74.4% |
| Divorced | 2 | 1.2% |
| Widowed | 2 | 1.2% |
| Nationality |  |  |
| Saudi | 28 | 16.4% |
| Indian | 80 | 46.8% |
| Philippine | 62 | 36.3% |
| Jordan | 1 | 0.6% |
| Education |  |  |
| Bachelor’s degree | 102 | 59.3% |
| Diploma | 63 | 36.6% |
| Master’s degree | 7 | 4.1% |
| Department |  |  |
| Surgery | 27 | 15.7% |
| Mixed services | 13 | 7.6% |
| Operating room | 7 | 4.1% |
| Obstetrics and gynecology | 2 | 1.2% |
| Daycare unit | 10 | 5.8% |
| Dialysis | 7 | 4.1% |
| Medicine | 35 | 20.3% |
| Pediatrics | 6 | 3.5% |
| Intensive care | 47 | 27.3% |
| Wound care | 13 | 7.6% |
| Endoscopy | 5 | 2.9% |
| Position |  |  |
| Student/intern | 10 | 5.8% |
| Registered nurse | 151 | 87.8% |
| Supervisor | 11 | 6.4% |

Table 1. Nurse Characteristics SD, standard deviation.
Nurses were not offered any incentive to participate. Oral consent was obtained from each participant before participation in this study was voluntary. Participants were informed of the aim, purpose, and course of the study. Nurses were not offered any incentive to participate. Oral consent was obtained from each participant before its collection.

### 4. RESULTS

**Sociodemographic and Professional Characteristics of Nurses**

Most of the nurses working at KAUH were female (86%), and the majority were married (74.4%). The mean age of the nurses participating in the study was 38 years (standard deviation [SD], ±9 years), 59.3% of the participants received their bachelor’s degree, 27.3% worked in the intensive care unit, and 87.8% were registered nurses. The mean duration of working as a nurse in their department was 74 months (SD, ±89 months) (Table 1).

**Characteristics of Nurses and Training to Perform Diabetic Footcare**

When evaluating the nurses’ training, we found that the majority received training as part of their nursing school curriculum (59.9%), whereas 15.7% relied on their in-service training program as their source of knowledge. Blood sugar was the most common topic discussed with the patients (77.3%), and applying initiatives to prevent diabetic foot was the main duty of KAUH nurses (70.3%) (Table 2).

#### 5. DISCUSSION

Diabetic foot is a macrovascular complication of DM, and the majority of these patients will require amputation (14). Diabetic foot is considered the leading cause of hospitalization among individuals with DM (6). In addition to regular preventive care and treatment, a crucial aspect of diabetic foot prevention is the frequent education of all individuals with DM at every healthcare visit.

| Characteristic                                      | Answer   | N    | %    |
|-----------------------------------------------------|----------|------|------|
| Have You Received Any Training to Perform Diabetic Footcare? | No       | 69   | 40.1%|
|                                                     | Yes      | 103  | 59.9%|
| Within the curriculum of nursing education         | No       | 145  | 84.3%|
|                                                     | Yes      | 27   | 15.7%|
| Within an in-service training program               | No       | 127  | 73.8%|
|                                                     | Yes      | 45   | 26.2%|
| I attended courses, seminars, and symposium programs related to performing diabetic footcare | No       | 154  | 89.5%|
|                                                     | Yes      | 18   | 10.5%|
| Do You Discuss the Following Topics With Diabetic Patients? | Blood sugar control | No | 39 | 22.7% |
|                                                     | Foot examination | No | 88 | 51.2% |
|                                                     | Footcare | No | 63 | 36.6% |
|                                                     | Footwear selection | No | 104 | 60.5% |
|                                                     | Amputation | No | 148 | 86.0% |
|                                                     | None | No | 110 | 64.0% |
| Do You Perform the Following For Diabetic Patients in Your Department? | Provide information about diabetic foot risk factors and etiology | No | 62 | 36.0% |
|                                                     | Perform foot examinations | No | 99 | 57.6% |
|                                                     | Apply initiatives to prevent diabetic foot | No | 51 | 29.7% |
|                                                     | Help with footwear selection | No | 101 | 58.7% |

| Characteristic                                               | Mean | SD  | Lowest Score | Highest Score |
|--------------------------------------------------------------|------|-----|--------------|---------------|
| Risk factors                                                | 14   | 2   | 8            | 16            |
| Foot examination                                             | 9    | 1   | 5            | 10            |
| Foot complications                                           | 27   | 4   | 14           | 31            |
| Footwear selection                                          | 8    | 2   | 4            | 10            |

Table 3. Scores for the four subsections of the questionnaire, SD, standard deviation.
| Do You Considering the Following as Risk Factors? | N  | %  |
|-------------------------------------------------|----|----|
| Poor glycemic control                           | No | 2  | 1.2% |
|                                                 | Yes| 170| 98.8%|
| Presence of the sense of chill, pain, burning, tingling, and tenderness in the foot | No | 28 | 16.3% |
|                                                 | Yes| 144 | 83.7%|
| Neuropathic foot (loss of sensory motor function) | No | 5  | 2.9% |
|                                                 | Yes| 167 | 97.1%|
| Peripheral vascular disease                     | No | 12 | 7.0% |
|                                                 | Yes| 160 | 93.0%|
| Inadequate foot care and lack of hygiene        | No | 10 | 5.8% |
|                                                 | Yes| 162 | 94.2%|
| Presence of foot edema                          | No | 24 | 14.0% |
|                                                 | Yes| 148 | 86.0%|
| Presence of foot callus                         | No | 41 | 23.8% |
|                                                 | Yes| 131 | 76.2%|
| Dry and cracked foot skin                       | No | 31 | 18.0% |
|                                                 | Yes| 141 | 82.0%|
| Diabetic foot history or diabetic ulcer on the opposite extremity | No | 24 | 14.0% |
|                                                 | Yes| 148 | 86.0%|
| Infection (redness, tenderness, and temperature increase of the foot) | No | 10 | 5.8% |
|                                                 | Yes| 162 | 94.2%|
| Trauma (barefoot walking, poor-quality shoes, accident, foreign body in the shoes) | No | 12 | 7.0% |
|                                                 | Yes| 160 | 93.0%|
| Foot deformity (mallet toes, claw toes, hallux valgus, amputation, Charcot deformity, low foot, etc.) | No | 36 | 20.9% |
|                                                 | Yes| 136 | 79.1%|
| Smoking                                         | No | 28 | 16.3% |
|                                                 | Yes| 144 | 83.7%|
| Obesity                                         | No | 19 | 11.0% |
|                                                 | Yes| 153 | 89.0%|
| Age 65 years or older                           | No | 24 | 14.0% |
|                                                 | Yes| 148 | 86.0%|
| Patients not trained to recognize or care for diabetic foot | No | 13 | 7.6% |
|                                                 | Yes| 159 | 92.4%|
| Do You Perform the Following During Foot Examinations? | | |
| Foot skin (color change, edema, atrophy, dryness, crack, callus, ulcer, etc.) is evaluated | No | 1 | 0.6% |
|                                                 | Yes| 171 | 99.4%|
| Color (pale, cyanosis, red) is evaluated         | No | 5  | 2.9% |
|                                                 | Yes| 167 | 97.1%|
| Temperature (temperature, coldness) is evaluated  | No | 13 | 7.6% |
|                                                 | Yes| 159 | 92.4%|
| Presence of foot neuropathy (pain, tingling, burning, tenderness, sensory loss) is evaluated | No | 4  | 2.3% |
|                                                 | Yes| 168 | 97.7%|
| Muscle functions (atrophy caused by motor damage in the muscles) are assessed | No | 16 | 9.3% |
|                                                 | Yes| 156 | 90.7%|
| Circulation (foot is pale and cyanosis) is evaluated | No | 6  | 3.5% |
|                                                 | Yes| 166 | 96.5%|
| Presence of foot ulcers (temperature increase, redness, edema, and tenderness of the foot) is evaluated | No | 3  | 1.7% |
|                                                 | Yes| 169 | 98.3%|
| Presence of deformity (hammer finger, claw, hallux valgus, amputation, Charcot deformity, low foot, etc.) is evaluated | No | 22 | 12.8% |
|                                                 | Yes| 150 | 87.2%|
| Toenails (thickening, ingrowth, and length of the nails) are evaluated | No | 22 | 12.8% |
|                                                 | Yes| 150 | 87.2%|
| Shoe suitability is assessed                     | No | 9  | 5.2% |
|                                                 | Yes| 163 | 94.8%|
| Do You Provide the Following Advice for Preventing Foot Complications? | | |
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| Practice                                                                 | Yes | No  | %     |
|--------------------------------------------------------------------------|-----|-----|-------|
| Feet should be checked every day by the patient or a relative using the eyes, hands, and a mirror (callus, crack, redness, bulla, open wound, etc.) | 171 | 1   | 99.4% |
| Feet should be washed with warm water every day                           | 149 | 23  | 86.6% |
| The water temperature used for washing feet should be checked             | 163 | 9   | 94.8% |
| Feet, especially the spaces between the toes, should be dried very well after each wash | 171 | 1   | 99.4% |
| Moisturizing cream should be applied to feet                              | 160 | 12  | 93.0% |
| Moisturizing cream should be applied to the spaces between the toes       | 145 | 27  | 84.3% |
| Toes should be kept dry to prevent fungal growth                          | 163 | 5   | 94.8% |
| Cutting tools and chemicals should not be used to remove calluses or hardened skin areas | 161 | 11  | 93.6% |
| Callus and skin stiffness should be thinned with a pumice stone           | 132 | 40  | 76.7% |
| Exercise in the form of twisting and stretching the toes several times per day should be performed to prevent the formation of foot corns and calluses | 145 | 27  | 84.3% |
| It is beneficial to use a callus band and plaster                         | 127 | 45  | 73.8% |
| Only socks should be worn to warm feet                                   | 130 | 42  | 75.6% |
| Direct heat sources (radiators, hot water bottle, electrical appliances, etc.) should be used to warm feet | 80  | 92  | 46.5% |
| Socks should not be torn, wrinkled, or oversized                          | 156 | 16  | 90.7% |
| Socks should be checked for wetness and darkness                          | 156 | 16  | 90.7% |
| Socks should be changed every day                                         | 165 | 7   | 95.9% |
| Rubber socks that restrict the circulation should not be worn             | 148 | 24  | 86.0% |
| Wool socks should be worn during winter and mercerized socks should be worn during summer | 162 | 10  | 94.2% |
| You should not walk with bare feet                                       | 163 | 9   | 94.8% |
| Relieve foot pressure by not standing for long periods                    | 163 | 9   | 94.8% |
| Legs should not be crossed when sitting                                  | 146 | 26  | 84.9% |
| If there is clawing of the toes, then massage should not be performed to prevent joint stiffness | 122 | 50  | 70.9% |
| Toenails should be controlled in terms of thickening, ingrowth, and length | 159 | 13  | 92.4% |
| Toenails should be cut flat                                               | 151 | 21  | 87.8% |
| Skin around the toenails should not be cut                                | 152 | 20  | 88.4% |
| Thickened nails should be cut with a special scissors after they are softened in warm water | 159 | 13  | 92.4% |
| Blind patients must never cut their own toenails                          | 166 | 6   | 96.5% |
| Toenails should be rounded                                                | 123 | 49  | 71.5% |
| Any changes to the feet and toes (color, temperature, or shape) and signs of infection should be reported to the physician immediately | 172 | 1   | 100.0% |
Diabetic foot management requires a multidisciplinary approach with an emphasis on the role of nurses because they are in direct communication with patients for long periods (13).

According to one study, education provided by nurses to patients at high risk for diabetic foot about proper foot care resulted in the prevention of foot ulcers and reduced amputations (17). Therefore, nurses must have sufficient knowledge and practical training to have an important role in the prevention of diabetic foot (18).

This study assessed the knowledge of several aspects of diabetic foot management among nurses at KAUH. Our results showed that most of the nurses received training regarding diabetic footcare through their school curriculum when they were nursing students. However, some nurses did not receive any training. Reinforcing that training to perform diabetic foot management as part of an in-service training program would compensate for any previous missed opportunities to receive training. One study mentioned that the low levels of knowledge of diabetic foot care were attributed to the lack of proper training and several other important factors, such as imprecise communication between different parties involved in the management plan and insufficient time allotted for each visit (19).

According to the International Diabetes Federation Report, the optimal management plan for the prevention and treatment of diabetic foot consists of regular foot evaluations, determination of the at-risk foot, education provided to the patients and healthcare staff, appropriate footwear, and early treatment of foot problems (20). Most of our participants reported that they educate their patients about blood sugar control and general footcare, perform diabetic foot risk factor assessments, and apply preventive initiatives. Other topics, such as the importance of regular foot examinations, footwear selection, and the risk of amputation, were not discussed with patients by the majority of nurses. Additionally, regular foot examinations were not performed.
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by the nurses. Therefore, an optimum diabetic foot management plan was not implemented, as suggested previously.

Nurses were greatly concerned about poor glycemic control because it is a significant risk factor for diabetic foot; in one study, this concern led to a 1% decrease in glycated hemoglobin and can lead to a 35% reduction in diabetic complications (21). However, they were not as concerned with peripheral vascular disease, peripheral neuropathy, and infection, which are the three major factors for diabetic foot ulcers (22). The majority of nurses agreed that patients who are not educated about diabetic foot are at risk for its development. A systemic review concluded that patient education has an overall short-term positive impact on the foot care knowledge and behaviors of patients (23). However, it is uncertain whether patient education can prevent foot ulceration and amputation.

There was a significant relationship between the educational background of the nurses and their knowledge of the risk factors for diabetic foot. Most of the nurses had a high average questionnaire score compared to those reported by other studies (24–30). The majority of those studies attributed the poor knowledge and scores to the lack of formal educational and training programs because of limited access. The higher average score in our study could be attributed to the relatively better backgrounds of nurses reflect their knowledge of diabetic complications (21). However, they were not with patients, specialized training programs beyond basic nursing education will reinforce their knowledge and skills, resulting in an expected lower risk of amputation in the long term.

6. CONCLUSION

Nurses’ knowledge of diabetic foot is a crucial factor in the prevention of diabetic foot. The educational backgrounds of nurses reflect their knowledge of diabetic foot. Because nurses are in direct and frequent contact with patients, specialized training programs beyond basic nursing education will reinforce their knowledge and skills, resulting in an expected lower risk of amputation in the long term.

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