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Foot Care Education Among Patients With Diabetes Mellitus in China

A Cross-sectional Study

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ABSTRACT

PURPOSE: To investigate the foot care knowledge and behavior of patients with diabetes to determine effect and current challenges of foot care education, as a basis to improve education and reduce diabetic foot complications.

DESIGN: Quantitative, cross-sectional study.

METHODS: A convenience sampling method was used to recruit 200 patients with diabetes from the endocrinology clinic of a tertiary general hospital in Beijing between September 2014 and January 2015. Demographic and disease-related data, foot care education, foot risk stratification status, and knowledge and behavior (K&B) scores were collected using investigator-designed questionnaires.

RESULTS: Of the 200 patients, 128 (64.0%) patients received routine diabetes education, and 73 (36.5%) received foot care education. The mean ± standard deviation (SD) for K&B scores were 63.76 ± 14.85, and 59.78 ± 11.17, respectively. The K&B scores of patients who received foot care education (69.54 ± 14.32 and 65.27 ± 11.90) were significantly higher than those who received diabetic education only (60.75 ± 15.27 and 57.54 ± 10.25) and those with no diabetic education (60.21 ± 13.37 and 55.94 ± 8.74) ($P < .01$). The K&B scores did not differ for patients based on diabetic foot risk strata ($P > .05$).

CONCLUSION: The foot care K&B scores of patients with diabetes were low to moderate levels, particularly on items that pertained to self-foot examination, prompt treatment of foot problems, and regular foot inspection by professionals. Individuals with high risk of developing foot complications did not score higher on the K&B questionnaire. These data suggest there is need for improvement in instruction and patient uptake and application of knowledge. We recommend further study on the effectiveness of the delivery of foot care education based on foot risk stratification, and the implications of foot ulcer prevention in community settings.

KEY WORDS: Diabetes education, Diabetic foot, Foot care, Health education.

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INTRODUCTION

Globally, there is a growing number of individuals with type 2 diabetes, and as a consequence, the types and number of foot complications are on the rise.[1] One such complication, known as the diabetic foot, is defined as "the destruction of skin and deep tissue below the ankle joint in people with diabetes, often accompanied by infection and/or arterial occlusion of different degrees in the lower limbs, with serious cases involving muscle and bone tissue."[2(p93)] Care of patients with foot complications is challenging for patients themselves, care providers, and insurers, particularly in developing countries.[3,4] In China, a country highly impacted by diabetes, prevention and management of foot complications remains an urgent health care need.[5] Previous studies have shown that early intervention with targeted prevention measures could prevent approximately half of the cases of severe diabetic foot complications such as diabetic foot infections and amputations.[6] Foot care education is important for the prevention of diabetic foot; a systematic review, which included 12 s (RCTs), showed foot care education positively influenced knowledge and behavior (K&B) in the short term.[7,8] Outcomes of various education interventions, assessment methods, and duration of follow-up

varied widely between studies; thus, conclusions could not be drawn about long-term effects on foot complication reduction.

Diabetes education in China is incorporated into routine endocrinology practice as an important component of diabetes comprehensive management, with the content chiefly focused on medication management, nutrition, physical activity, and self-monitoring. However, it is difficult to directly measure whether this education, especially the foot care education component, is effectively integrated into knowledge and translated, more importantly, to self-care behavior.

The Knowledge-Attitude-Belief-Practice Paradigm (KABP) posits that knowledge is the first step toward behavior change and education is a key component to improve knowledge and guided the review of literature for our study.[9] In a systematic review of RCTs reported by Dorresteijn and colleagues,[8] a positive influence of education on improving foot care knowledge (5 of 8 RCTs) and behavior (7 of 9 RCTs) in the short term was noted.[8] Findings from several studies report consistently low scores on foot care K&B among patients with diabetes in Europe and South Asia; the researchers suggested improvements in education could be strengthened to enhance self-care outcomes.[10-13] Thus, the analysis of the status of foot care K&B could partially reflect the foot care education received by patients, and perhaps, more importantly, shed light on the need for foot care education implementation strategies and determine which aspects should be emphasized during patient education. In 2016, Xu and colleagues[14] reported a lack of foot care education among middle-aged and older Chinese adults with diabetes, suggesting that foot care education could be improved, although no specific recommendations about education were highlighted in their study. Therefore, there is a need to understand the current status of foot care K&B in order to deliver targeted interventions to improve foot care education.

China is currently undergoing a medical insurance system reform to enhance resource allocation and accessibility. Due to the limited resources, health care has focused on treatment of diseases rather than prevention; therefore, the prevention of foot complications has not been a priority of existing health care programs. Furthermore, data from the systematic review reported by Dorresteijn and colleagues[8] showed that brief patient education did not result in a beneficial effect on the prevention of foot ulceration and amputation; thus, future studies are needed to provide guidance for the development of intensive and comprehensive education programs on foot complications associated with diabetes.[8] Compared with a brief education intervention, intensive and comprehensive education programs require considerable resources including human resources, time, and medical service provision. The International Working Group of the Diabetic Foot (IWGDF) 2015 guidelines suggested that foot care education, along with other preventive measures, could be delivered at various follow-up intervals during clinical care and should be based on different foot risk levels.[15] Thus, patients with higher risk levels should be allocated more intensive clinical and diabetes education and time to improve their foot care K&B.

There exists a need to understand the allocation of foot care education and the current K&B status of patients with diabetes regarding foot care education. Beijing, the capital city of China, has greater resources than other regions of the country. Thus, studying the achievements and challenges associated with foot care education in this setting may provide a good reference for understanding and improving the allocation of foot care education resource throughout China. As a result, the purpose of this study was to investigate the K&B status among patients with diabetes, with the long-term objective of guiding future improvements to foot care education.

METHODS

This study was conducted among adults with diabetes attending an endocrinology clinic affiliated with a tertiary Class A educational hospital, Peking University First Hospital, in Beijing, China. We did not restrict the type of diabetes; however, all patients had type 2, which is consistent with its predominance in China.[16] A descriptive cross-sectional design was used to collect data from questionnaires and physical examination. The sample size was determined according to the detection rate of risk for developing foot complication using the formula established for cross-sectional studies, where $n = t_{\alpha}^2 P(1-P)/\delta^2$, setting α as 0.05, and δ as 5%. The current literature reports a detection rate of risk ranging from 27.2% to 62.9%[17-23]; thus, our final sample size (N = 200) was adjusted during the middle of the data collection period to reflect the actual detection rate of 66.7%.

A convenience sampling method was used to recruit patients from the endocrinology clinic. Inclusion criteria were a diagnosis of diabetes at least 1 month prior to study enrollment, age 18 years and over, and provision of written informed consent. Participants were excluded if they had a diagnosis of gestational diabetes mellitus, a previous amputation above the ankle, nondiabetic neuropathy such as central nervous system injury, prolapse of lumbar intervertebral disc, congenital neuropathy, previous diagnosis of diabetic foot ulcers, currently undergoing wound treatment, and communication difficulties such as patients with sequelae of cerebral infarction, visually- or hearing-impaired, and developmentally disabled. Patients were recruited from the clinical either by poster advertisements or by the researchers involved in this study. The study purpose, significance, and procedures were explained to potentially eligible individuals and written informed consent was required for enrollment. Enrolled participants were then led to a separate room for physical examinations and completion of the questionnaires. Data were collected between September 2014 and January 2015.

Ethical approval (IRB#00001052-14050) was given by the Peking University Biomedical Ethics Committee.

Demographic and Disease-Related Data

The demographic and disease-related data were collected using a questionnaire developed by the investigators. Demographic data included sex, age, marital status, educational level, family income, and residence. Disease-related data included type of diabetes, date of diagnosis, current blood glucose control methods, smoking history, and presence of diabetes complications. Height and weight were measured in order to calculate body mass index (BMI kg/m^2).

Foot Care Education

In the endocrinology clinic, routine patient education has been carried out for many years, provided at the time of initial diagnosis or once a treatment plan is determined. The education content includes medication, nutrition, physical exercise, and self-monitoring modules. Monthly free lectures are open to all registered patients. Foot care is not specifically or systematically provided as part of the education curricula. Thus, the foot care education status of the participants for this study

was assessed using questionnaires. Patients were asked to recall whether they had received any form of education from medical staff about diabetes mellitus and/or diabetic foot care. Participants who reported receiving foot care education were also asked to recall the content of foot care education, including the selection of shoes, foot hygiene and maintenance (daily self-inspection, use of moisturizers for dryness, drying well between toes after bathing), risk behaviors for injuries, foot examination by health care professional, and treatment of foot problems. If the patient did not know the specific meaning of the questions, the researcher (L.J.) showed examples of the K&B items listed on the questionnaire.

Foot Care K&B

Data regarding foot care K&B were collected using the investigator-developed questionnaire that was comprised of recommendations from 2011 IWGDF Diabetes Foot International Clinical Guidelines and Chinese foot care behavior questionnaires, which had been widely used.[24-28] The final version of both K&B questionnaires contains the same 17 items, with each item describing 1 action related to diabetic foot prevention; the questionnaires were administered separately, with different scoring methods.[29] The knowledge questionnaire contained action items that elicited a response of correct or protective, while the behavior questionnaire asked the patients to report the frequency in which they engaged in each of the action items. Four reverse items, which described incorrect or "dangerous actions," were also included. For the questions assessing knowledge, there were 3 options: "correct," "wrong," and "unclear" that were assigned 1, 0, and 0 points, respectively. The score for each question was added to determine a total score, which was converted to standard score by formula (standard knowledge score $= \frac{\text{actual total score}}{17} \times 100$), ranging from 0 to 100, with 80 to 100 = high knowledge, 60 to 79 = moderate, and 59 or less = low. A 4-tiered Likert scale was used to assess behavior; the frequency of the action was categorized as "never," "occasionally," "often," or "always," which were assigned scores of 1, 2, 3, or 4, respectively. The scores of all the questions were summed to determine a total score, which was converted to a standard score by formula {standard behavior score $= \frac{\text{actual total score}-17}{68-17} \times 100$}, ranging from 0 to 100, with 80 to 100 = high frequency of foot care behaviors, 60 to 79 = moderate, and 59 or less = low. The higher the score, the more frequent the prevention behavior occurred, or the less frequent the risky behavior took place, which indicated better preventive behavior. In our preliminary study, the item-level content validity index (CVI) obtained by expert evaluation was 0.8 to 1.0, and scale-level CVI was 0.976; test-retest reliability of the behavior questionnaire was 0.808, that the knowledge questionnaire was not calculated due to the variability of knowledge items. Considering the multidimensional nature of foot care behaviors obtained from guideline recommendations and experiences, we regard the Cronbach α for the knowledge and behavior questionnaires, 0.627 and 0.519, respectively, to be acceptable.[29]

Foot Risk Stratification

In order to explore the potential to deliver foot care education based on the risk of foot complications, foot stratification methods were applied according to the IWGDF guidelines and the Guidelines for the Prevention and Treatment of Type 2 Diabetes Mellitus in China.[15,30] Participants were screened by the research nurse (J.L.) for existing peripheral neuropathy, peripheral vascular disease, deformities of the foot, foot ulcers, and previous amputation. Peripheral neuropathy was defined as 2 or more abnormal results obtained from the following 6 tests: (1) ankle reflex tested with a percussion hammer; (2) pinprick sensation tested with a sterile pin without a sharp tip; (3) vibratory sense tested with a 128-Hz tuning fork; (4) protective sensation tested with a Semmes Weinstein #5.07/10-g monofilament; (5) thermal sensation tested with the Tip-Therm GmbH; (6) and presence of clinical symptoms including numbness, stinging, or pain. Peripheral vascular disease was defined as one or more abnormal results including the absence of a pedal pulses, an ankle brachial index less than 0.9, or a toe brachial index less than 0.6, and report of intermittent claudication or rest pain. Toe deformities, including claw toes and hammer toes, metatarsal head protrusion, hallux valgus, and rocker bottom foot abnormality, were indications of foot deformities. Under the supervision of an endocrinology physician (Y.G.) and a foot surgeon (Q.X.), the research nurse conducted all foot examinations. According to the IWGDF Guidelines for Diabetic Foot Risk Classification, risk was defined as: without peripheral neuropathy or peripheral vascular disease = grade 0, indicating a low-risk foot; neuropathy only = grade 1 high-risk; with neuropathy and/or arterial disease or foot deformities = grade 2 high-risk; and, with a history of foot ulcers or amputation = grade 3 high-risk.[15] According to the classification, the suggested interval for subsequent clinic visits ranged from 1 to 4 times a year for grade 0 to 3 high-risk patients, respectively.

Data Analysis

All statistical analyses were conducted using SPSS, Version 22 (Statistical Package for Social Science, Armonk, New York). Continuous data were presented as means ± standard deviations (SD), or median values, while categorical data were expressed as frequencies and proportions. One-way analysis of variance tests were used to compare the differences in the K&B of participants based on foot risk level, and by the type of education received. *P* values less than .05 were considered statistically significant.

RESULTS

Demographic and Clinical Characteristics

Table 1 shows the clinical and demographic data for the 200 enrolled patients. The mean age ± SD was 64.7 ± 9.9 years and BMI was 25.0 ± 3.5 kg/m^2. All of the participants had type 2 diabetes mellitus, and the mean ± SD duration of their diagnosis was 10.3 ± 7.7 years (maximum 37, minimum 1, median 10). Diabetic nephropathy, diabetic retinopathy, and a history of foot ulcers were present in 13 (6.5%), 48 (24.0%), and 5 (2.5%) participants, respectively. Overall, 143 (71.5%) of participants never smoked, while 25 (12.5%) quit smoking, and 32 (16%) were current smokers.

Foot Care K&B

The mean ± SD score for foot care knowledge was 63.76 ± 14.85, which indicates moderate knowledge, albeit at the lower end of the range. The mean ± SD score for foot care behavior was 59.78 ± 11.17, indicating low prevention behavior. Table 2 displays the frequency and proportion of correct responses for the knowledge questionnaire, as well as the mean ± SD item score and the proportion of participants with better foot care behaviors per score on the behavior questionnaire.

TABLE 1.
Clinical and Demographic Data (N = 200)

Variables	n (%)
Sex	
Female	106 (53.0)
Male	94 (47.0)
Age, y	
<49	11 (5.5)
50-59	48 (24.0)
60-69	82 (41.0)
70-79	41 (20.5)
80-89	18 (9.0)
Marital status	
Lives with spouse	181 (90.5)
Lives without spouse	19 (9.5)
Lives alone	
No	187 (93.5)
Yes	13 (6.5)
Job status	
Retired	167 (83.5)
Employed	27 (13.5)
Unemployed	6 (3.0)
Monthly income per capita	
<¥3000[a]	32 (16.0)
¥3001-¥4000	61 (30.5)
¥4001-¥5000	43 (21.5)
≥¥5001	64 (32.0)
Residence	
Urban	189 (94.5)
Rural	11 (5.5)
Education level	
Junior middle school or below	62 (31.0)
Senior middle school	54 (27.0)
Junior college	30 (15.0)
Undergraduate education or above	54 (27.0)
Payment for medical expenses	
Medical insurance	161 (80.5)
Free medical care	31 (15.5)
Own expense	6 (3.0)
New rural cooperative medical insurance	2 (1.0)

[a]¥Renminbi (RMB), China currency 1¥ ≈ US $0.14.

Foot Care Education

Of the 200 patients enrolled, 128 (64.0%) received diabetes-related education, although only 73 (36.5%) received diabetic foot-related education. Fifty-three (72.6%) recalled receiving foot education related to shoe selection; 46 (63.0%) foot hygiene and skin care education; 29 (39.7%) education about risky behaviors that could result in injury; and, 28 (38.4%) and 26 (35.6%) foot examination and treatment of foot problems, respectively.

Based on whether patients reported receiving formal education about diabetes and/or diabetic foot, participants were divided into 3 groups: Group A received no diabetes education and no foot care education (n = 72, 36%), Group B received diabetes education without foot care education (n = 55, 27.5%), and Group C received both diabetes education and foot care education (n = 73, 36.5%) (Table 3). We found that participants who received foot care education had significantly higher K&B scores when compared with the other 2 groups ($P < .001$).

Foot Risk Stratification

Based on the IWGDF risk classification system, participants were categorized as low-risk, n = 55 (27.5%), stage 1 high-risk, n = 103 (51.5%), stage 2 high-risk, n = 25 (12.5%), and stage 3 high-risk, n = 4 (2.0%). Thirteen (6.5%) patients were diagnosed with diabetic foot ulcers for which they were unaware. Table 4 shows the K&B scores stratified by the foot risk classification, including participants with diabetic foot ulcers. There were no statistically significant differences in K&B scores (P values = .096 and .658, respectively).

DISCUSSION

In our cross-sectional study of the foot care knowledge and behavior of 200 patients with diabetes receiving care in an endocrinology clinic, the mean ± SD scores for K&B were 63.76 ± 14.85 and 59.78 ± 11.17, respectively, suggesting moderate knowledge and low behaviors. These findings are consistent with those cited in previous studies and reflect lower overall knowledge and behaviors among this diabetic population.[31-35] In addition, we compared our findings to those from other studies conducted in China (Table 5), which demonstrated similarly low findings in both K&B; however, we acknowledge that foot care education and behavior vary widely based on different regions of the country.[25,27,28,36-41] Better-performed behaviors, such as always wearing socks, daily foot hygiene, changing socks daily, drying feet after washing, wearing comfortable shoes, and not walking barefoot, were part of living habits noted in studies from the northern China, in part due to the cooler climate. China has a typical monsoon climate, with 4 distinctive seasons and a significant variation in the day-time and night-time temperatures. The regular occurrence of low temperatures triggers the need for warmth, comfort, and cleanliness, which could at least partially explain the presence of better-performed behavior in certain regions of China compared to others, which might unintentionally result in the lower risk for developing foot ulcers. However, in the country at large, poorly performed foot care behaviors are common such as lack of self-inspecting the feet and checking inside the shoes on a daily basis, obtaining regular foot assessments for early detection of injury, prompt treatment via a health care provider, buying shoes in the afternoon when feet are typically slightly larger, and progressively increasing wearing time of shoes to gradually break them in,[42] all of which are protective behaviors that warrant special education to increase patient awareness of avoiding injury and preventing diabetic foot complications. These findings suggest a continued need to provide education on proper foot care for individuals with diabetes and in particular, neuropathy, and with a special emphasis on older adults.[43]

In another study conducted in our center, we have found that education level, duration of diabetes mellitus, and having received foot care education or not were independent influencing factors for foot care K&B.[44] Meanwhile, whether the patients received foot care education largely depended on availability of resources such as diabetes educators, time, and teaching materials. In this study, 94.5% of participants were from urban areas, 96% had medical insurance, and 42% had an education level above junior college, demographics that are different from other areas of China. Our hospital is one of the top teaching hospitals in Beijing, the capital of China, and the clinic in which the study was conducted is highly experienced in delivering diabetic education and foot ulcer treatment.

TABLE 2.
Result of Foot Care K&B Questionnaires (N = 200)

	Knowledge		Behavior	
Items	Correct Responses, n	Correct, %	Average Item Score, Mean ± SD	Better Behavior[a], %
Wash feet every day	191	95.5	3.75 ± 0.54	95.0
Walk bare foot[b]	187	93.5	3.92 ± 0.31	99.0
Wear comfortable shoes	184	92.0	3.68 ± 0.84	88.5
Wear tight socks[b]	183	91.5	3.65 ± 0.83	90.5
Dry after foot washing	182	91.0	3.55 ± 1.04	83.5
Wear clean socks	161	80.5	3.30 ± 0.77	84.0
Test water temperature before washing foot	159	79.5	2.42 ± 1.14	78.0
Examine foot every day	126	63.0	2.00 ± 1.21	30.0
Examine shoes every time	125	62.5	2.10 ± 1.35	33.0
Regular clinic foot-check	116	58.0	1.09 ± 0.37	2.0
Wear open-toe shoes[b]	115	57.5	3.11 ± 0.84	73.0
Trim toenails properly	111	55.5	2.40 ± 1.45	47.0
Apply cream after washing feet	105	52.5	1.75 ± 1.04	20.5
Use heating equipment[b]	91	45.5	3.65 ± 0.78	90.0
Buy shoes in the afternoon	88	44.0	2.11 ± 1.11	28.0
Wear light socks	84	42.0	2.42 ± 1.14	44.5
Break-in shoes gradually	76	38.0	1.72 ± 1.11	24.5

[a]"Better behavior" is defined as participants selecting correct behavior as "always" or "often," and for the reverse items, selecting "never" or "occasionally."
[b]Reverse items, the number of cases, and score were already reversed in the table.

While our findings suggest the need for foot care K&B education in this clinic population, we posit the need may be greater in other suburban and rural regions of China, due to the different demographic characteristics of the hospitals, fewer available resources, and patients with less or no medical insurance and lower education levels.

Although the findings were consistent with other study findings related to foot care K&B in other countries, it is difficult to compare our K&B scores directly, due to the differences in the instruments used to measure K&B. The development of our new K&B questionnaires based on IWGDF guidelines was intended to increase its comprehensiveness, and assess foot care knowledge related directly to behavior. In terms of the score-calculating method, we standardized the scores to facilitate a comparison with other studies. However, we recognize that we cannot generalize these findings regarding which foot care behaviors were performed better across China, because most of the studies were conducted near the middle and northern regions of China.[25,27,28,36-41] It is quite possible that the behavioral characteristics of patients in southern China could be different, and more comparable to behaviors reported in India, which lies at a similar latitude.[45] Therefore, the education focus in different regions should recognize the influence of climate; for example, those living in warmer climates would be more likely to walk barefoot due to higher temperatures, placing them at risk for foot injury.

TABLE 3.
Comparison of K&B Score of Different Education Groups (N = 200)

Group	Number of Cases	Knowledge Score, Mean ± SD	Behavior Score, Mean ± SD
A[a]	72	60.21 ± 13.37	55.94 ± 8.74
B[b]	55	60.75 ± 15.27	57.54 ± 10.25
C[c]	73	69.54 ± 14.32[d]	65.27 ± 11.90[d]
F		9.452	16.377
P		<.001	<.001

[a]Group A received no education related to diabetes mellitus.
[b]Group B received diabetic-related education but without foot-specific education.
[c]Group C received foot-specific education.
[d]Least significant difference tests reveal that the K&B score of Group C is higher than the other 2 groups ($P < .001$).

TABLE 4.
K&B Scores Stratified by the Foot Risk Classification (N = 200)

Foot Risk Level	Number of Cases	Knowledge Score, Mean ± SD	Behavior Score, Mean ± SD
Lower risk	55	66.84 ± 13.79	59.32 ± 9.57
Stage 1 high-risk foot	103	61.96 ± 15.71	60.00 ± 11.67
Stages 2-3 high-risk foot	29	66.53 ± 11.67	61.26 ± 13.03
Diabetic foot ulcer	13	58.82 ± 16.46	56.71 ± 9.28
F		2.144	0.537
P		.096	.658

TABLE 5.
Detailed Behavior Results From Different Studies in China

Authors	Year	Region (N: North, S: South)	Always Wear Socks	Wash Foot Daily	Change Socks Daily	Dry Foot After Wash	Wear Comfort Footwear	(Not) Walk Barefoot	Check the Inside of the Shoes	Check Foot Daily	Use Cream After Wash	Massage Foot
Fan et al[25]	2001	Beijing (N)	✓	✓					✓	×	×	×
Li and Xu[27]	2006	Beijing (N)					×	×	×	×		
Shen et al[28]	2008	Beijing (N)					×					
Wang and Wu[39]	2013	Beijing (N)		✓		✓			×	✓		
Li et al[40]	2014	Tianjin (N)							×	×	×	
Feng and Wu[36]	2001	Shanghai (S)	✓		✓		✓		✓	×		×
Wang et al[37]	2006	Sichuan (S)	✓		✓						×	×
Ni et al[41]	2014	Chengdu (S)		✓			✓	✓	×	×		×
Li et al[38]	2010	All China		✓		✓			×	×		
Our study	2015	Beijing		✓		✓	✓	✓		×	×	

Abbreviations: ✓, better-performed behavior; ×, worse/poorly-performed behavior.

Our data also revealed that current foot care education was inadequate. In our study, 128 (64.0%) patients recalled having received diabetes education, but only 36.5% had received foot care education, even on the condition that certain examples were provided to help them defining foot care education. One reason for reporting lack of education in our population could be traced back to origin of foot care awareness. In China, routine diabetic education focused initially on blood glucose control and medicine administration, with much less emphasis on foot care. It was the wound care experts that primarily noticed the increasing prevalence of diabetic foot ulcers and raised awareness of diabetic foot prevention and foot care education; the education was gradually adopted in endocrinology clinics where initial implementation of foot care education took place and continues to be the primary deliverer.[46,47] In recent years multidisciplinary care teams comprised of endocrinologists, angiologists, surgeons, wound therapists, physiotherapists, and nurses, co-located in the clinic, are becoming more involved with education of and care for patients with diabetes,[48] providing more opportunities to expand the delivery of foot care education, and to incorporate it into routine diabetic education.

Our findings suggest there were no differences in K&B scores based on whether participants did or did not receive routine diabetes education; however, K&B scores were higher in those that did receive foot care education. Among the low percentage (36.5%) of participants who received foot care education, of those, less than 40% reported to have learned about risky behaviors associated with foot injuries (39.7%), the importance of foot examination (38.4%), and prompt treatment of foot problems (35.6%). Participants who did not receive these aspects of foot education were more likely to have low foot behavior scores. These data also support the need for education that is directed toward improvements in behavior, as several aspects of self-care were poorly performed in our study population.

The IWGDF risk stratification guidelines recommend higher frequency of provider visits/interactions for patients with higher foot risk levels to prevent and/or mitigate complications associated with diabetes.[15] High-risk patients need intensive follow-up and education in order for them to develop better self-management behaviors that are consistent with the guideline. In our study (Table 4), participants across all foot risk levels had consistently low K&B scores; however, no significant differences were found between scores. Lavery and colleagues[49] incorporated patient education into a prevention program based on foot risk stratification; their data demonstrated a reduction in the frequency of hospitalization and amputation. Findings from their study are encouraging, but the exact effect of foot care education on K&B based on stratification remains unclear in our patient population.

Strengths and Limitations

This study focused on the current status of patients receiving care in an endocrinology clinic, a setting where a large portion of patients were at risk for developing foot complications, or already had them, related to diabetes. We had access to a large sample of patients to assess foot care health K&B, measured with our questionnaires developed by our study team. A limitation is the cross-sectional nature of the study that prevents us from establishing a causal relationship between education and low K&B scores. A second limitation is that the study was conducted in one region of China; however, the characteristics of the K&B and education status in different regions need to be studied, and intervention methods need to be adapted to those local communities.

Implications for Practice

With regard to the provision of resources, under the current medical system in China, patients prefer and have access to tertiary care hospitals for medical services, which leads to a deluge of individuals requesting services delivered by these hospitals. Therefore, the high demand placed on health education resources in these settings often exceeds their capacity, which may partially explain the lack of foot care education among our patients. Adding foot care to the role of community-based educators may be one solution to this problem. This has been attempted in Puerto Rico and in other regions of China where there are high rates of diabetes.[50,51] China is gradually implementing a hierarchical medical system and infusing

more resources into the community.[52] One of the main tasks of community medical staff is chronic disease management, including complication prevention, such as the prevention of diabetic foot disease. It is foreseeable that foot care education, as an indispensable part of diabetic foot prevention, could be better implemented in the community under this community model.

CONCLUSION

Moderate to low foot care K&B was found in our study of patients with diabetes mellitus receiving care in an endocrinology clinic in Beijing, China. Specifically, K&B is poor with regard to self-foot examination, prompt treatment of foot problems, and regular foot inspection by professionals. Individuals at highest risk of developing foot complications did not score higher on the K&B questionnaire. Foot-specific education is essential to improve K&B; however, its implementation is inadequate, suggesting the need for improvement in instruction, patient uptake, and application of knowledge. We recommend further study on the effectiveness of the delivery of foot care education based on foot risk stratification, and the implications of foot ulcer prevention in community settings.

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