ORIGINAL ARTICLE

Investigation of foot care knowledge and behaviour of older people with type 2 diabetes in Beijing community and analysis of influencing factors

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Abstract

Good foot care knowledge and behaviour are very important to prevent the occurrence of diabetic foot, but there are few reports on the foot care knowledge and behaviour of older people with diabetes in the community. The purpose of this study was to understand the foot care knowledge and behaviour of older people with type 2 diabetes in Beijing community, and analyse its influencing factors, so as to provide reference for further intervention. We investigated 254 older people with type 2 diabetes in Xinjiekou community, Beijing, including their general information, chronic complications, foot care knowledge and behaviour. The results showed that the average scores of foot care knowledge and behaviour were 73.38 ± 12.25 and 49.70 ± 8.70, respectively. Multiple stepwise regression analysis showed that the factors affecting the total score of foot nursing knowledge of older people with diabetes in community were gender, duration of diabetes and whether they had received foot nursing education ($p < 0.05$). The factors influencing the total score of foot nursing behaviour were gender, duration of disease, whether they had received foot nursing education and peripheral vascular disease ($p < 0.05$). In conclusion, the knowledge of foot care of older people with diabetes in community is in the middle level, and the foot care behaviour is not optimistic. Community healthcare workers can improve patients' knowledge of foot care and improve their compliance with foot care behaviour through foot care health education. At the same time, we should pay more attention to men, those with a shorter duration of diabetes and diabetic patients with peripheral vascular disease to reduce the occurrence of diabetic foot.

Key Messages

- The foot care knowledge of older people with type 2 diabetes in a community of Beijing was at a medium level; the foot nursing behaviour was at a poor level.
- Community healthcare workers can improve patients' foot care knowledge and improve their compliance with foot care behaviour through foot care health education.
- More attention should be paid to male, diabetic patients with shorter disease course and peripheral vascular lesions to reduce the occurrence of diabetic foot.

1 | INTRODUCTION

The International Diabetes Federation states that the global prevalence of diabetes among people aged 20–79 years reached 10.5% (537 million) in 2021 and will reach 12.2% (783.2 million) by 2045.[1] In 2020, the old population (≥60 years old) in China accounted for 18.7% (260.4 million) of the total population, of which 30% suffer from diabetes, and type 2 diabetes accounted for more than 95%,[2,3] making China the country with the largest number of older people with diabetes in the world.[4] Domestic and foreign studies have shown[5,6] that the incidence of diabetes in the 65–79 age group is the highest and tends to slow down after the age of 80, suggesting that old age is a high-risk period for diabetes. With the continuous development of diabetes, various complications will be caused, among which, diabetic foot is a serious chronic complication of diabetes. Among diabetic foot patients, about half are old patients, and it is one of the main causes of disability and death for older people with diabetes.[7–9]

Compared with the global incidence of 6.3% of diabetic foot,[10] Chinese research data showed that the new incidence of diabetic foot ulcer (DFU) in diabetic patients over 50 years old within 1 year was 8.1%, which was higher than the global level.[11] The recurrence rate of DFU is also high, and the recurrence rate of DFU within 1, 3 and 5 years is 40%, 60% and 65%, respectively.[12] It is estimated that every 20 s worldwide, a patient's leg is amputated due to DFU.[8] The amputation rate within 1 year among patients hospitalized for DFU in China is as high as 13.4%.[13] At the same time, DFU will increase the death risk of patients, and the 5-year death risk of DFU patients is 2.5 times that of patients without DFU.[14] Foreign studies have shown that the 5-year survival rate

of DFU patients is only 28.64%, and its impact on death is much greater than that of any other large vascular diseases.[15] Chinese data show that the median survival time of patients with initial DFU is 5.03 years, and the 5-year cumulative survival rate is 50.4%.[16] The cost of treatment and care for diabetic foot also poses a huge economic burden, and in China, the total cost per patient increased from ¥15535.58 in 2014 to ¥42040.60 in 2020, with an average of ¥21826.91.[17]

In view of the high incidence, recurrence rate, disability rate and fatality rate of diabetic foot patients and the serious impact on the social economy, the prevention of diabetic foot is of vital clinical significance. Previous studies have shown that patient education plays an important role in reducing the risk of diabetic foot.[18] The occurrence of diabetic foot is related to improper foot care of patients,[19] and good foot care behaviour can prevent 75%–80% of diabetic patients from developing diabetic foot.[20] Therefore, it is of great significance to prevent the occurrence of diabetic foot by assessing the self-care status of old patients with type 2 diabetes, understanding the shortcomings, providing targeted foot care education and guiding and assisting patients in foot care.[21] Previous studies have found that the relevant factors affecting foot care knowledge and behaviour include age, gender, educational level, family support and whether they have received foot care education.[22,23] However, there are still few reports on foot care for older people with diabetes. Therefore, this study took the older people with type 2 diabetes in the community as the research object, investigated the foot care knowledge and behaviour status of older people with diabetes, analysed its influencing factors and provided a basis for the implementation of targeted intervention measures for older people with type 2 diabetes in the community.

2 | MATERIALS AND METHODS

2.1 | Study design, area, population

A community-based cross-sectional study was conducted from December 2019 to May 2020. The sample size of this study was calculated using the sample size formula: $N =$ variable x (5–10). According to statistical requirements, the sample size should be at least 5–10 times the number of variables. The general information in this survey questionnaire consists of seven items, the disease-related information consists of six items and the foot care behaviour questionnaire and knowledge questionnaire each have five dimensions. Therefore, there are a total of 23 variables in this study. The sample size required for this study is $N = 23 \times (5 \sim 10) = 115 \sim 230$. Considering a sample dropout rate of 20%, the final sample size is $N \times 1.2 = 138 \sim 276$ cases. A total of 254 older people with type 2 diabetes in Xinjiekou community of Beijing were selected for a face-to-face questionnaire survey using convenient sampling.

2.2 | Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) Age ≥ 60 years old; (2) Meet the diabetes diagnostic criteria established by WHO in 1999,[24] diagnosed as type 2 diabetes; (3) Clear consciousness can fill in the questionnaire independently or with the assistance of the researcher; (4) Volunteer to participate in the study and sign the informed consent. The exclusion criteria were as follows: (1) Suffering from severe acute or chronic diseases; (2) Patients with physical disabilities, limited mobility, cognitive impairment or dementia; (3) Disagree to sign the informed consent form.

2.3 | Data collection instruments and procedures

This part was designed by the researcher, and the questionnaire included the patient's gender, age, education level, whether he lived alone, duration of diabetes, whether he had received diabetes glucose management education and diabetes foot knowledge education and chronic complications.

The Questionnaire of Foot Care Knowledge and Behavior for Diabetic Patients developed by scholar Liu Jin et al.[25] was adopted in this study. The questionnaire includes 17 items in five dimensions, including foot and footwear inspection (items 1 and 10), foot cleaning and maintenance (items 2, 3, 4, 6), shoe and socks selection (items 8, 9, 12, 13, 15), foot injury risk behaviour (items 7, 11, 14, 16) and foot problem treatment (items 5, 17). The content validity index of this questionnaire was 0.976, the retest reliability was 0.808 and Cronbach and α coefficient were 0.519. The questionnaire was divided into foot care knowledge and foot care behaviour: (1) Foot care knowledge: by asking patients whether they should do this for each item, each item has three options of 'yes', 'no' and 'unclear', and the answer 'yes' will score 1 point, and the answer 'no' or 'unclear' will score 0 points, and the reverse score will be scored for items 7, 11, 14 and 16; (2) Foot care behaviour: Patients are asked how often they perform the behaviours described in this article (never, occasionally, often, always), Likert 4 scoring method is used, the total score is 17–68 points, 7, 11, 14, 16 for the reverse score, the higher the score indicates the better the patient's foot care knowledge and behaviour. For the convenience of calculation, this study converts the scores of foot care knowledge and behaviour into standard scores (on a percentage scale). The standard score = (actual score of the questionnaire item or dimension/full score of the questionnaire item or dimension) × 100, with 100 points as the full score. A score less than 60 points indicates poor foot care knowledge or behaviour, 60–80 points indicates moderate foot care knowledge or behaviour and a score greater than 80 points indicates good foot care knowledge or behaviour.[26]

2.4 | Statistical analysis

SPSS20.0 statistical software was used for data analysis, frequency and mean ± standard deviation were used for statistical description, two independent samples T-test or ANOVA were used for univariate analysis and multiple Logistic regression was used for multivariate analysis. $p < 0.05$ indicated that the difference was statistically significant.

3 | RESULTS

A total of 254 patients were investigated in this study, including 124 males (48.8%) and 130 females (51.2%). The mean age of the patients was 71.30 ± 7.02 years (60–94). The mean duration of diabetes was 14.71 ± 8.56 years (1–45 years). There were 125 cases in junior high school and below, 76 cases in senior high school and technical secondary school and 53 cases in junior high school and above. Thirty-one patients were living alone, 230 patients (90.6%) received blood glucose management education and only 24 patients (9.4%) received diabetes foot care

TABLE 1 Scores of foot care knowledge and behaviour in older people with type 2 diabetes ($n = 254$).

No	Questions	Foot self−care knowledge score Mean ± SD	Results	Foot self−care behaviour score Mean ± SD	Results
1	Check your feet daily, including the sole and toe seams.	71.26 ± 45.34	Medium	41.99 ± 29.99	Poor
2	Wash your feet (including your toe seams) daily.	94.88 ± 22.08	Good	70.73 ± 19.35	Medium
3	Before washing your feet, measure the water temperature with your hand or thermometer.	92.13 ± 26.99	Good	65.09 ± 26.46	Medium
4	Dry your feet (including the toe seams) with a towel after washing them.	90.94 ± 28.75	Good	68.24 ± 27.91	Medium
5	Apply moisturizer after washing your feet.	45.28 ± 49.87	Poor	15.88 ± 23.84	Poor
6	Being able to trim toenails appropriately	82.68 ± 37.92	Good	57.35 ± 19.11	Poor
7	Walk barefoot.	98.43 ± 12.47	Good	97.64 ± 10.83	Good
8	Choose shoes when standing in the afternoon or evening.	72.44 ± 44.77	Medium	35.04 ± 14.87	Poor
9	Choose to wear loose, comfortable shoes, not shoes that squeeze your feet.	94.09 ± 23.62	Good	66.40 ± 15.11	Medium
10	Check the inside of your shoes every time you wear them.	68.50 ± 46.54	Medium	31.36 ± 33.41	Poor
11	Wearing shoes with exposed toes.	70.47 ± 45.71	Medium	62.07 ± 29.50	Medium
12	Change a pair of clean socks every day.	90.55 ± 29.31	Good	60.76 ± 23.43	Medium
13	Choose light-coloured socks.	47.24 ± 50.02	Poor	43.57 ± 25.67	Poor
14	Wear tight socks.	90.55 ± 29.31	Good	89.24 ± 24.75	Good
15	When wearing new shoes, gradually increase the wearing time until you adapt.	83.07 ± 37.57	Good	37.66 ± 19.16	Poor
16	Use heating devices (such as electric heaters, hot water bottles) to warm your feet.	93.31 ± 25.04	Good	93.31 ± 16.86	Good
17	Get your feet checked regularly at the hospital.	18.50 ± 38.91	Poor	2.76 ± 12.79	Poor

TABLE 2 Nursing knowledge and behavioural mastery of patients' feet in five dimensions.

No	Dimensions	Foot self-care knowledge score Mean ± SD	Results	Foot self-care behaviour score Mean ± SD	Results
1	Foot cleaning and maintenance	90.16 ± 15.45	Good	65.35 ± 15.04	Medium
2	Foot injury risk behaviour	88.19 ± 16.28	Good	85.56 ± 11.16	Good
3	Choice of shoes and socks	77.48 ± 22.21	Medium	48.69 ± 10.04	Poor
4	Examination of feet and footwear	69.88 ± 36.23	Medium	36.67 ± 24.00	Poor
5	Management of foot problems	31.89 ± 33.66	Poor	9.32 ± 13.61	Poor

education. The scores of foot care knowledge and behaviour in 17 items are shown in Table 1.

The average score of foot care knowledge of patients in this study was 73.38 ± 12.25 points, which was in the middle level as a whole. Among them, the two dimensions of 'foot cleaning and maintenance' and 'foot injury risk behaviour' are at a good level, while 'foot problem treatment' is at a poor level. The average score of foot care behaviour was 49.70 ± 8.70 points, which was in a poor level. Among them, only the dimension of 'foot injury risk behaviour' is at a good level, while the three dimensions of 'footwear selection', 'foot and footwear inspection' and 'foot problem management' are at a poor level. The scores of specific dimensions are shown in Table 2.

The single factor analysis results of influencing factors of foot care knowledge and foot care behaviour of diabetes patients are shown in Table 3.

In this study, the total score of foot nursing knowledge was taken as the dependent variable, and the

TABLE 3 Single factor analysis of foot care knowledge and behaviour influencing factors of diabetic patients.

Variables	Frequency ($n = 254$)	Total foot self-care knowledge score (Mean $\pm$ SD)	T or F value	p-value	Total foot self-care behaviour score (Mean $\pm$ SD)	T or F value	p-value
Totality	254						
Sex			13.607	<0.001		14.639	<0.001
Male	124	70.55 $\pm$ 13.31			47.62 $\pm$ 7.72		
Female	130	76.08 $\pm$ 10.50			51.68 $\pm$ 9.14		
Age (in years)			3.251	0.040		2.615	0.075
60–69	117	71.48 $\pm$ 12.94			48.93 $\pm$ 9.50		
70–79	101	74.34 $\pm$ 11.96			49.52 $\pm$ 8.19		
≥80	36	76.89 $\pm$ 9.70			52.68 $\pm$ 6.71		
Educational status			2.989	0.052		1.211	0.300
Junior high school and below	125	72.09 $\pm$ 12.18			48.84 $\pm$ 8.51		
High school	76	73.04 $\pm$ 13.49			50.43 $\pm$ 9.44		
College or above	53	76.92 $\pm$ 9.85		0.016	50.67 $\pm$ 7.96		
Live alone			0.263	0.608		1.640	0.202
Yes	31	72.32 $\pm$ 14.05			51.57 $\pm$ 9.91		
No	223	73.53 $\pm$ 12.01			49.44 $\pm$ 8.51		
Duration of DM			13.702	<0.001		13.535	<0.001
<10 years	75	67.99 $\pm$ 13.17			46.05 $\pm$ 8.30		
10–20 years	125	74.40 $\pm$ 11.78			50.18 $\pm$ 7.82		
> 20 years	54	78.52 $\pm$ 8.87			53.64 $\pm$ 9.31		
Diabetes education			1.880	0.172		0.041	0.839
Yes	230	73.72 $\pm$ 12.17			49.66 $\pm$ 8.48		
No	24	70.13 $\pm$ 12.79			50.04 $\pm$ 10.75		
Foot self-care education			12.781	<0.001		15.045	<0.001
Yes	24	80.33 $\pm$ 9.16			55.03 $\pm$ 8.70		
No	230	72.34 $\pm$ 12.33			48.90 $\pm$ 8.43		
Diabetic retinopathy			0.001	0.997		0.040	0.842
Yes	48	73.38 $\pm$ 11.25			49.92 $\pm$ 8.67		
No	206	73.38 $\pm$ 12.50			49.92 $\pm$ 8.67		
Diabetic Nephropathy			1.747	0.187		0.065	0.799
Yes	18	77.06 $\pm$ 6.30			50.20 $\pm$ 5.51		
No	236	73.10 $\pm$ 12.55			49.66 $\pm$ 8.90		
Type of medication			5.845	0.016		3.308	0.07
Pills only	171	72.10 $\pm$ 12.53			49.01 $\pm$ 8.52		
Both injection and pills	83	76.02 $\pm$ 11.28			51.12 $\pm$ 8.95		

(Continues)

TABLE 3 (Continued)

Variables	Frequency ($n = 254$)	Total foot self-care knowledge score (Mean ± SD)	T or F value	p-value	Total foot self-care behaviour score (Mean ± SD)	T or F value	p-value
Peripheral neuropathy			0.022	0.882		0.001	0987
Yes	109	73.51 ± 13.27			49.69 ± 8.34		
No	145	73.28 ± 11.47			49.71 ± 8.99		
Peripheral vascular disease			1.799	0.181		5.673	0.018
Yes	45	75.60 ± 10.19			52.47 ± 9.44		
No	209	72.90 ± 12.62			49.10 ± 8.43		
Foot deformity			1.169	0.281		5.171	0.024
Yes	160	74.02 ± 11.46			50.64 ± 9.23		
No	94	72.30 ± 13.49			48.09 ± 7.48		

TABLE 4 Multiple stepwise linear regression analysis of foot care knowledge.

Variable	Regression coefficient	Standardized regression coefficient	T-value	p-value
Constant term	54.771	-	19.071	<0.001
Sex	5.347	0.219	3.823	<0.001
Duration of diabetes	4.982	0.288	5.035	<0.001
Trained in foot care	7.508	0.206	3.607	<0.001

Note: $R^2 = 0.184$.

TABLE 5 Multiple stepwise linear regression analysis of foot nursing behaviour.

Variable	Regression coefficient	Standardized regression coefficient	T-value	p-value
Constant term	35.803	-	17.699	<0.001
Duration of diabetes	3.511	0.286	5.063	<0.001
Sex	3.978	0.229	4.058	<0.001
Trained in foot care	5.333	0.207	3.611	<0.001
Peripheral vascular disease	2.579	0.113	1.986	0.048

Note: $R^2 = 0.209$.

statistically significant variables in the results of univariate analysis were taken as independent variables. Multiple stepwise linear regression analysis was conducted, and it was concluded that gender, duration of diabetes and foot nursing education were the influencing factors (Table 4).

In this study, the total score of foot nursing behaviour was taken as the dependent variable, and the statistically significant variables in the results of univariate analysis were taken as independent variables. Multiple step-by-step linear regression analysis was conducted, and it was concluded that gender, duration of diabetes, foot

nursing education and peripheral vascular disease were the influencing factors (Table 5).

4 | DISCUSSION

In China, grade 3 and first-class hospitals are often an important place for the treatment of diabetic foot because of their advantages of being well-equipped and availability of multidisciplinary joint diagnosis and treatment. However, in the prevention of diabetic foot, the community has more advantages than the hospital: first, the foot

health education and high-risk foot screening in the community can move the prevention and treatment of diabetic foot forward, and control the occurrence and development of diabetic foot from the source; secondly, the community has geographical convenience, which is convenient for the implementation of foot care and health management, especially for older people with mobility difficulties. Relevant studies[27] have shown that foot health education in the community can improve the knowledge level of foot care of diabetic patients, thereby improving their foot care behaviour and preventing or reducing the occurrence of diabetic foot.

In this study, the knowledge of foot care of older people with type 2 diabetes in this community was generally at a medium level, and the lowest score was 'foot problem management'. Specifically, only 45.3% (115/254) of the patients know that 'when the foot skin of diabetes patients is dry, they need to apply moisturizer for moisturizing'. Only 18.5% (47/254) of patients know that they need to go to the hospital for regular foot examination after diabetes, so as to find foot lesions as soon as possible, which was similar to the results of Li Jao, Abu-Qamar, Dinesh et al.[28-30] Diabetic patients can reduce foot sweat due to autonomic neuropathy, which leads to dry or even cracked feet,[12] which is one of the important reasons for diabetic feet. The onset of diabetic foot is hidden, and if patients neglect to check their feet regularly, diabetic foot is often caused by unconscious foot injury or infection. The reason may be that diabetic patients in the community pay less attention to foot care in their daily life, and pay more attention to blood glucose control, retinopathy, diabetic nephropathy and cardiovascular complications.[31] It is suggested that community medical workers should focus on telling older people with diabetes that when the foot skin is dry, they can use moisturizer to smear their feet after washing feet, and guide them to go to hospitals for foot examination regularly.

This study found that the foot nursing behaviour of older people with type 2 diabetes in the community was generally poor, among which the three dimensions of 'choice of shoes and socks', 'inspection of feet and socks' and 'treatment of foot problems' were all poor, which was similar to the results of many domestic and foreign studies.[32-34] In this study, less than 50.00% of patients who performed 'check their feet every day', 'gradually increase the time of wearing new shoes', 'try to buy shoes when standing in the afternoon or evening', 'choose light-colored socks', 'check the inside of shoes before wearing shoes every time', 'apply moisturizer after washing their feet' and 'go to the hospital regularly to check their feet' were better. Only 1.2% (3/254) of the patients did a good job of 'going to the hospital regularly to check their feet'. Although foot care education can improve

patients' foot care knowledge in a short period of time, it takes longer to develop foot care behaviour habits such as 'checking the inside of feet and shoes' and 'applying moisturizer after washing feet'.[28] It is suggested that while strengthening the health education of patients, community healthcare workers should also enhance the support and supervision of family members to patients' foot nursing behaviour, so as to improve the implementation rate of patients' foot nursing behaviour.

The results of multiple stepwise regression analysis in this study showed that gender, duration of disease and foot nursing education were independent factors influencing foot nursing knowledge and behaviour of older people with diabetes in society. The scores of women's foot care knowledge and foot care behaviour are higher than men's, which is consistent with the results of Fan Enfang[31] and Wang Jun et al.[32] The reason may be that, compared with men, women pay more attention to and comply with foot care, are better at handling the details of foot care and are more patient and meticulous.[32] With the increase of the duration of diabetes, the incidence of lower extremity neuropathy and vasculopathy will also increase, and patients will receive more health guidance from medical staff in the long-term treatment of blood sugar and complications, including the relevant guidance of diabetic foot care. This study found that the scores of foot care knowledge and behaviour of patients who received foot care education were higher than those of non-recipients, which was consistent with the conclusions of multiple studies.[35-37] It is indicated that diabetic foot care education is of great significance in improving patients' foot care knowledge and behaviour, but only 9.4% (24/254) of older people with diabetes in the community have received special foot health education, suggesting that community healthcare workers should strengthen the health education of foot care to improve patients' cognition of foot care, enhance their compliance, and delay or even avoid the occurrence of diabetic foot. In addition, the results of multiple stepwise regression analysis showed that the presence of peripheral vascular disease was also an independent influencing factor for foot nursing behaviour. The possible reason was that the presence of peripheral vascular disease caused insufficient blood supply to the distal extremities of diabetic patients and obvious daily feeling, which easily prompted patients to pay attention to their foot nursing behaviour.

5 | CONCLUSIONS

This study shows that the knowledge level of foot care of older people with type 2 diabetes in the community

is at a medium level, and the status of foot care behaviour is not optimistic. Therefore, how to improve the compliance of patients' foot care behaviour may be an urgent problem to be solved in the future. Community healthcare workers can improve patients' foot care knowledge through the combination of online information platform 'Internet + nursing health education' and offline lectures, and actively mobilize the participation and cooperation of patients' families to improve the compliance of patients' foot care behaviour. At the same time, more attention should be paid to men and older people with diabetes with shorter duration of diabetes to reduce or even avoid the occurrence of diabetic foot.

6 | LIMITATIONS

First of all, due to the limitation of research time and funding, the respondents of this study only selected the older people with diabetes in Xinjiekou Community, Xicheng District, Beijing, and did not collect the data of elderly diabetes patients in other communities. Secondly, due to the limitations of the conditions, random sampling was not achieved, and convenience sampling was chosen instead. Therefore, the representativeness of the sample in this study has certain limitations.

CONFLICT OF INTEREST STATEMENT
The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT
We obtained approval for the study from the Biomedical Research Ethics Committee, Peking University First Hospital (Ref: 2018 Research No. 217). The research team obtained informed consent from all participants and followed all regulations while conducting this study.

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