



Impacts of psychological resilience on self-efficacy and quality of life in patients with diabetic foot ulcers: a prospective cross-sectional study

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Background: Patients with diabetic foot ulcer (DFU) usually have a poor quality of life (QoL) and self-efficacy, which is affected by many risk factors. However, the role of psychological resilience in QoL and self-efficacy in DFU patients has remained unclear.

Methods: This prospective cross-sectional study was performed in a single center from January 2018 to February 2020. A total of 98 DFU patients were enrolled in this study. Some demographic and clinical data were prospectively collected from participants. The psychological resilience of participants was assessed by Connor-Davidson resilience scale (CD-RISC). Self-efficacy was also assessed using the diabetes management self-efficacy scale (DMSES) and QoL was assessed by the 36-item short-form (SF-36) health survey. Univariable and multivariable linear regression were used to analyze the risk factors of self-efficacy and QoL. Then, logistic regression was used to analyze the predictors of psychological resilience among the participants.

Results: A CD-RISC score of more than 85 points was defined as high psychological resilience in this study; there were 28 participants diagnosed with high psychological resilience and 70 patients with low psychological resilience. Those with high psychological resilience had significantly higher self-efficacy, general health, vitality, social functioning, role emotional, and mental health than those with low psychological resilience. According to multivariable linear regression, low psychological resilience and older age were identified as risk factors of self-efficacy. On the contrary, low psychological resilience, older age, lower perceived social support and higher level of glycosylated hemoglobin were identified as risk factors of QoL. Finally, males had lower psychological resilience than females and those receiving more social support had higher psychological resilience than participants receiving less social support.

Conclusions: Some risk factors of QoL and self-efficacy were identified in this study and these results may provide some evidence for the improvement of QoL and self-efficacy in DFU patients. Being female and receiving higher social support were shown to have potential for improving psychological resilience in DFU patients.

Keywords: Psychological resilience; self-efficacy; quality of life (QoL); social support; diabetic foot ulcer (DFU)

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Introduction

Diabetes mellitus (DM) has become the most important metabolic disease nowadays and there are over 400 million people with DM globally according to the report of the International Diabetes Federation in 2015 (1). It is expected that the number of diabetic patients will continue to increase over the coming decades (2). The blood sugar disorder of diabetic patients may induce injury of the blood vessels and peripheral nerves. Furthermore, advanced DM can cause some severe complications including diabetic nephropathy, diabetic retinopathy, and diabetic neuropathy (3). Diabetic foot ulcer (DFU) is another important complication of DM, which has attracted much attention from diabetic scholars.

The causes of DFU are both diabetic neuropathy and angiopathy. On the one hand, injury of blood vessels would lead to vascular stenosis, and then insufficient blood supply of the lower extremity. Lower limb ischemia then leads to limb ulcer and even gangrene (4). On the other hand, diabetic nephropathy inhibits patients from feeling pain or any discomfort, leaving feet vulnerable to being unwittingly squeezed and deformed (4). In a previous study, the incidence of DFU in diabetic patients older than 50 years was 8.1% (5), which was slightly higher than the average worldwide incidence (6). Patients with DFU usually have poor prognosis, and there is a diabetic amputation every 20 seconds (7). The annual mortality of DFU patients is as high as 11%, and the mortality of amputation patients has reached 22% (8). In addition, the recurrence of DFU after healing is relatively high at up to over 50% (9).

Poor quality of life (QoL) is also associated with DFU, especially when it recurs or deteriorates. In attempts to improve the QoL of DFU patients, many studies have been performed to analyze the risk factors of poor QoL and provide guidance for the diagnosis, treatment, and nursing of DFU. Alrub *et al.* reported that female gender and obesity were related to poorer QoL in Jordanian DFU patients (10). Al Ayed *et al.* reported that, in addition to gender and obesity, education, occupation, income, and the number of complications were predictors of poor QoL in DFU patients (11). A recent meta-analysis indicated that some other risk factors such as the level of C-reactive protein (CRP), ulcer size, and level of glycated hemoglobin (HbA1c) had significant impacts on the QoL of DFU patients (12). Increasingly, attention has been paid to the role of psychological factors in the QoL of DFU patients. Polikandrioti *et al.* reported that severe anxiety contributed

to poor QoL in DFU patients (1). Psychological resilience refers to how people react psychologically and behaviorally to change in their external environment. It has been reported that improved psychological resilience was related to higher QoL in patients with inflammatory bowel disease, breast cancer, and hypertension (13-15). However, no related study has yet been performed to investigate the impacts of psychological resilience on QoL in DFU patients.

In this study, we prospectively enrolled DFU patients in our hospital to determine the role of psychological resilience in their QoL. Besides, self-efficacy represents the confidence of patients to complete certain activities independently and the ability to inject insulin facilitated an increased QoL among DM patients (16). We also analyzed the role of psychological resilience in regulating the self-efficacy of DFU patients, along with the risk factors of psychological resilience. We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/apm-21-967>).

Methods

Study design

This was a prospective cross-sectional study conducted in a single center from January 2018 to February 2020. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Affiliated Hospital of Jiangnan University (No.: 02017014) and informed consent was taken from all the patients.

Study population

The inclusion criteria of this study were as follows: patients who were diagnosed with DFU, older than 18 years, able to complete the questionnaires, and conscious to cooperate with the treatment. The exclusion criteria were as follows: patients who were diagnosed with other life-threatening diseases, had mental diseases, were participating in other clinical trials, and refused to complete the questionnaires.

Data collection

The following data were collected at the time of participant enrolment: gender, age, body mass index (BMI), marital

status, educational status, occupational status, number of children, smoking history, perceived social support, treatment pattern, latest level of HbA1c, classification of foot ulcer, psychological resilience, self-efficacy, and QoL scores.

Measurements

Social support as perceived by participants in this study was assessed by the multidimensional scale of perceived social support (MSPSS) questionnaire. The MSPSS questionnaire had been translated into Chinese and contained 12 items in total. Each item had a score from 1 point, representing 'very strongly disagree', to 7 points, representing 'very strongly agree'. The higher participants scored, the more social support they felt they had access to.

The classification of foot ulcer was based on the Wagner ulcer classification, which was divided into 5 grades including grade 1, superficial diabetic ulcer; grade 2, extended ulcer (to tendon, bone, or joint); grade 3, deep ulcer with abscess or osteomyelitis; grade 4, gangrene in a portion of the forefoot; and grade 5, extensive gangrene of the foot (17).

Psychological resilience of the participants was assessed by Connor-Davidson resilience scale (CD-RISC), which had been translated into Chinese and contained 25 items in total. Each item had a score from 0 point, representing 'never', to 4 points, representing 'always'. The total possible score of CD-RISC was 100 points and a score of more than 85 points defined high psychological resilience.

Self-efficacy was assessed using the diabetes management self-efficacy scale (DMSES). The DMSES had been translated into Chinese and contained a total of 20 items. Each item had a score from 0 points, representing 'cannot be completed at all', to 10 points, representing 'absolutely can be completed'. A higher score indicated higher participant self-efficacy.

The QoL of participants was assessed by the 36-item short-form health survey (SF-36). The SF-36 had been translated into Chinese and it contained 36 items in total covering 8 aspects of QoL. Each item had a different score and proportion. The higher participants scored, the better their QoL was.

Statistical analysis

All statistical analyses in this study were performed using SPSS 20.0 (IBM Corp., Armonk, NY, USA). Categorical

variables were expressed as number and percentage and compared between 2 groups using chi-square test. Continuous variables were expressed as mean and standard deviation. Univariable and multivariable linear regression were used to analyze the risk factors of self-efficacy and QoL and determine the role of psychological resilience in regulating self-efficacy and QoL. Then, univariable and multivariable logistic regression were used to analyze the predictors of psychological resilience. A P value less than 0.05 represented statistical significance.

Results

We enrolled 98 DFU patients in this study as shown in *Table 1*. A total of 68 of these participants were male, the mean age of the cohort was 67.3 ± 13.5 years, and their mean BMI was 24.7 ± 7.9 . Marital status was recorded and 80 participants (81.6%) were married. Regarding educational status, 37 participants (37.8%) had received primary school education, 39 (39.8%) had achieved middle school education, and 22 (22.4%) had completed high school or above education. A total of 31 participants (31.6%) were employed and 67 (68.4%) were retired or unemployed. Most of these participants had at least 1 child and 44 (44.9%) had at least 2 children. A total of 34 participants (34.7%) had a history of smoking. According to MSPSS, the mean score of perceived social support was 68.9 ± 10.4 points. More than half (57.1%) of the participants were undergoing insulin treatment, 20 (20.4%) were taking oral hypoglycemic agents, and 22 (22.4%) were receiving insulin combined with oral hypoglycemic agents. The mean level of HbA1c was $6.6\% \pm 1.2\%$. Based on CD-RISC, the mean score of psychological resilience in enrolled patients was 77.0 ± 18.9 points. The classification of foot ulcer in DFU patients is summarized in *Table 2*. A total of 30 participants (30.6%) were diagnosed as grade 1, 51 (52.0%) were diagnosed as grade 2, 11 (11.2%) were diagnosed as grade 3, 5 (5.1%) were diagnosed as grade 4, and 1 (1.0%) was diagnosed as grade 5.

A CD-RISC score of more than 85 points was defined as high psychological resilience. There were 28 participants with high psychological resilience and 70 with low psychological resilience in this study (*Table 1*). More participants with high psychological resilience were employed compared to those with low psychological resilience (50% vs. 24.3%, $P=0.013$). Besides, patients with high psychological resilience received much more social support than those with low psychological resilience

Table 1 Characteristics of enrolled DFU patients

Characteristics	Overall	Low resilience	High resilience	P value
Number	98	70	28	
Gender				0.782
Male	68 (69.4%)	48 (68.6%)	20 (71.4%)	
Female	30 (30.6%)	22 (31.4%)	8 (28.6%)	
Age, year	67.3±13.5	65.8±12.8	70.7±11.0	0.081
BMI	24.7±7.9	24.9±8.4	24.0±7.0	0.619
Marital status				0.216
Married	80 (81.6%)	55 (78.6%)	25 (89.3%)	
Single/divorce	18 (18.4%)	15 (21.4%)	3 (10.7%)	
Educational status (school level)				0.923
Primary	37 (37.8%)	27 (38.6%)	10 (35.7%)	
Middle	39 (39.8%)	28 (40.0%)	11 (39.3%)	
High or above	22 (22.4%)	15 (21.4%)	7 (25.0%)	
Occupational status				0.013
Employed	31 (31.6%)	17 (24.3%)	14 (50.0%)	
Unemployed	67 (68.4%)	53 (75.7%)	14 (50.0%)	
Number of children				0.079
0	5 (5.1%)	5 (7.1%)	0 (0%)	
1	49 (50.0%)	38 (54.3%)	11 (39.3%)	
≥2	44 (44.9%)	27 (38.6%)	17 (60.7%)	
Smoking history	34 (34.7%)	23 (32.9%)	11 (39.3%)	0.546
Perceived social support score	68.9±10.4	66.3±10.7	75.3±8.9	<0.001
Treatment pattern				0.464
Insulin	56 (57.1%)	38 (54.3%)	18 (64.3%)	
Oral	20 (20.4%)	14 (20.0%)	6 (21.4%)	
Insulin plus oral	22 (22.4%)	18 (25.7%)	4 (14.3%)	
Level of HbA1c, %	6.6±1.2	6.5±1.2	6.8±1.2	0.205
Psychological resilience score	77.0±18.9	71.3±16.5	91.2±17.8	<0.001

DFU, diabetic foot ulcer; BMI, body mass index; HbA1c, glycated hemoglobin.

(75.3±8.9 vs. 66.3±10.7, $P<0.001$). More participants with high psychological resilience were diagnosed with grade 1 foot ulcer; however, no significant difference was found (Table 2). There was no significant difference in other variables between 2 groups.

The self-efficacy and QoL of DFU participants are summarized via DMSES and SF-36 scores in Table 3.

Participants with high psychological resilience had significantly higher levels of self-efficacy, general health, vitality, social functioning, role emotional, and mental health than participants with low psychological resilience (self-efficacy 67.0±7.9 vs. 61.6±7.3, $P=0.003$; general health 60.0±9.3 vs. 54.1±8.4, $P=0.005$; vitality 63.9±11.2 vs. 53.1±11.3, $P<0.001$; social functioning 65.1±6.8 vs.

Table 2 Classification of foot ulcer in DFU patients

Grade	Overall, n (%)	Low resilience, n (%)	High resilience, n (%)	P value
Grade 1: superficial diabetic ulcer	30 (30.6)	17 (24.3)	13 (46.4)	0.285
Grade 2: ulcer extension	51 (52.0)	40 (57.1)	11 (39.3)	
Grade 3: deep ulcer with abscess or osteomyelitis	11 (11.2)	8 (11.4)	3 (10.7)	
Grade 4: gangrene to portion of forefoot	5 (5.1)	4 (5.7)	1 (3.6)	
Grade 5: extensive gangrene of foot	1 (1.0)	1 (1.4)	0 (0)	

DFU, diabetic foot ulcer.

Table 3 Self-efficacy and QoL of enrolled DFU patients

Variables	Overall	Low resilience	High resilience	P value
Self-efficacy	63.2±7.9	61.6±7.3	67.0±7.9	0.003
Physical functioning	39.1±8.8	38.6±8.1	40.3±10.5	0.399
Role physical	24.0±6.0	23.7±6.0	24.9±6.1	0.375
Bodily pain	62.5±10.6	61.9±10.2	64.0±11.8	0.412
General health	55.8±9.0	54.1±8.4	60.0±9.3	0.005
Vitality	55.9±12.0	53.1±11.3	63.9±11.2	<0.001
Social functioning	59.2±7.0	56.8±5.5	65.1±6.8	<0.001
Role emotional	36.6±8.4	34.5±7.6	41.5±8.3	<0.001
Mental health	54.7±9.6	51.9±8.3	61.9±9.1	<0.001

DFU, diabetic foot ulcer; QoL, quality of life.

Table 4 Univariable and multivariable linear regression analysis of risk factors of self-efficacy in DFU participants

Variables	Univariable		Multivariable	
	β (95% CI)	P value	β (95% CI)	P value
High psychological resilience	5.264 (1.897 to 8.632)	0.003	4.340 (0.610 to 8.070)	0.023
Older age	-0.288 (-0.548 to -0.028)	0.030	-0.081 (-0.160 to -0.002)	0.044
High education versus other	0.086 (0.004 to 0.169)	0.041	0.078 (-0.085 to 0.241)	0.345
Employed versus unemployed	0.164 (0.018 to 0.368)	0.036	0.217 (-0.033 to 0.467)	0.088
Higher level of	-1.846 (-3.180 to -0.511)	0.007	-1.462 (-2.764 to 0.160)	0.068

CI, confidence interval; HbA1c, glycated hemoglobin.

56.8±5.5, $P<0.001$; role emotional 41.5±8.3 *vs.* 34.5±7.6, $P<0.001$; mental health 61.9±9.1 *vs.* 51.9±8.3, $P<0.001$).

Risk factors of self-efficacy were analyzed using univariable and multivariable linear regression, as shown in *Table 4*. Low psychological resilience, older age, low education, unemployment, and higher level of HbA1c were identified as potential risk factors according to univariable

linear regression. After adjusting by multivariable linear regression, low psychological resilience and older age were identified as risk factors of self-efficacy.

Then, risk factors of QoL in DFU participants were analyzed (*Table 5*). Low psychological resilience, older age, lower perceived social support, and higher level of HbA1c were identified as risk factors of QoL according to

Table 5 Univariable and multivariable linear regression analysis of risk factors of QoL in DFU participants

Variables	Univariable		Multivariable	
	β (95% CI)	P value	β (95% CI)	P value
High psychological resilience	5.943 (2.105 to 9.780)	0.003	5.647 (1.197 to 10.096)	0.013
Older age	-0.191 (-0.412 to -0.015)	0.018	-0.295 (-0.554 to -0.036)	0.026
Married versus single/divorce	6.465 (1.091 to 11.840)	0.019	3.664 (-0.299 to 7.628)	0.070
Employed versus unemployed	2.887 (0.414 to 5.359)	0.023	3.358 (-0.474 to 7.189)	0.085
Higher perceived social support	4.652 (0.860 to 8.443)	0.017	4.663 (0.426 to 8.900)	0.031
Higher level of glycosylated hemoglobin	-0.102 (-0.246 to -0.018)	0.040	-0.266 (-0.521 to -0.011)	0.041

DFU, diabetic foot ulcer; QoL, quality of life; CI, confidence interval.

Table 6 Univariable and multivariable logistic regression analysis of predictors of psychological resilience in enrolled DFU patients

Variables	Univariable		Multivariable	
	OR (95% CI)	P value	OR (95% CI)	P value
Male vs. female	0.321 (0.128–0.805)	0.015	0.332 (0.129–0.855)	0.022
Married vs. single/divorce	2.542 (1.107–5.838)	0.028	2.388 (0.986–5.248)	0.060
High education vs. other	1.874 (1.042–3.426)	0.042	1.656 (0.906–3.021)	0.101
Higher perceived social support	1.112 (1.050–1.177)	<0.001	1.155 (1.064–1.253)	0.001

DFU, diabetic foot ulcer; OR, odds ratio; CI, confidence interval.

multivariable linear regression.

Predictors of psychological resilience were analyzed using univariable and multivariable logistic regression (Table 6). The results showed that males had lower psychological resilience than females and participants receiving more social support had higher psychological resilience than those receiving less social support.

Discussion

There were different grades of foot ulcer among the participants in our study, most of whom had grade 1 or grade 2 foot ulcers. Generally, most DFU participants were diagnosed with a grade of less than 4 according to a previous study (1,18). However, conditions graded as such will still incur a significant decrease in the QoL of patients. Based on our results, the mean score of general health in all participants was 55.8±9.0 out of 100 points, which was similar to previous reports (19,20). Moreover, most participants in our study had low self-efficacy with a mean score of 63.2±7.9 out of 200 points. Previous studies

have also determined that self-efficacy may be significantly decreased in diabetic patients (16,21). The ascertainment of risk factors of QoL and self-efficacy, therefore, has become an important topic to date.

In their study, Polikandrioti *et al.* found that living in a capital city and having high levels of anxiety was significantly harmful for patients' general health (1). Another study also found that female gender, overweight, peripheral vascular disease, and stress in life may be related to lower QoL in DFU patients (10). A study from Saudi Arabia found that many factors may affect the QoL of DFU patients, including age, educational status, occupational status, income, and complications (11). In the present study, low psychological resilience, older age, lower perceived social support, and higher level of HbA1c were identified as risk factors of QoL. The level of HbA1c reflected the adherence characteristics of DFU patients; adherence characteristics were verified in previous study as important factors of QoL in diabetic patients (22). Polikandrioti *et al.* also found that the decrease of social support was significantly related to the increase of depression in DFU

patients and the presence of depression would further affect the QoL of patients (18). Most importantly, low psychological resilience was identified as an important risk factor of QoL in DFU participants in our study, which is similar to how it has been shown to influence patients with other diseases (13,14).

Our study identified low psychological resilience and older age as risk factors of self-efficacy. Only a few studies have previously mentioned the risk factors of self-efficacy and a randomized controlled clinical trial confirmed that resilience training can improve the self-efficacy in diabetic patients (21). Some more well-designed studies are needed to further verify these findings.

Considering the important role of psychological resilience in QoL and self-efficacy in DFU patients, we also analyzed the predictors of psychological resilience in this study. Female gender and higher social support would strengthen psychological resilience of DFU patients according to our results. It is not difficult to understand the important role of social support in psychological resilience. Machisa *et al.* also concluded that increased social support was related to increased psychological resilience in survivors of intimate partner violence and patients with posttraumatic stress disorder (23,24). However, the role of gender in regulating psychological resilience is not so clear. It may be explained by different socioeconomic status or physiological hormone levels of patients.

Some limitations existed in this study. Firstly, this prospective cross-sectional study enrolled only 98 DFU patients from a single center. The number of enrolled patients was relatively small and there may have been some resulting bias in the results. Secondly, some previous studies have also collected the adherence characteristics of DFU patients. These characteristics may be related to psychological resilience and affect the self-efficacy and QoL of patients. However, we did not collect these characteristics in this study, which may be improved in a future study. Thirdly, perceived social support, psychological resilience, self-efficacy, and QoL were assessed by several scales. In effect, some participants may not have filled out these scales truthfully, leading to the instability of the results.

Our study enrolled 98 DFU patients from a single center and found that most patients were classified as having either grade 1 or grade 2 of foot ulcer. According to linear regression analysis, low psychological resilience and older age were identified as risk factors of self-efficacy while low

psychological resilience, older age, lower perceived social support, and higher level of HbA1c were identified as risk factors of QoL. These results may provide some evidence for the improvement of QoL and self-efficacy in DFU patients. Besides, female patients and receiving higher social support may help to improve psychological resilience in DFU patients.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <http://dx.doi.org/10.21037/apm-21-967>

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/apm-21-967>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Affiliated Hospital of Jiangnan University (No.: 02017014) and informed consent was taken from all the patients.

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