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Original Article

Network analysis of the relationship between self-management, self-efficacy, and quality of life among diabetes mellitus patients

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Abstract

Diabetes mellitus (DM) requires constant self-management and self-efficiency, which affects the quality of life among patients. It is important to understand the complex interplay between these factors to improve the results of treatment. The aim of this study was to explore the relationship between self-management, self-efficacy, and quality of life among diabetes mellitus patients. A cross-sectional study of 363 diabetes patients from three public hospitals in Cao Lanh City, Vietnam, was conducted. Self-management, self-efficacy, and quality of life were assessed using the 35-item Diabetes Self-Management Instrument (DSMI), the 6-item Self-Efficacy for Managing Chronic Disease Scale (SECD6), and the 5-item European Quality of Life 5 Dimensions 5 Level Version (EQ-5D-5L), respectively. Network analysis was performed to visually describe the relationship between self-management (which includes five domains of self-integration, self-regulation, interaction with health professionals and other significant people, self-monitoring, and medication adherence), self-efficacy, and quality of life. The network analysis showed that self-monitoring had the highest centrality. Two subscales of self-management, adherence and self-integration, were directly and positively correlated with quality of life, while the interaction was directly and negatively correlated with quality of life. Self-efficacy was positively correlated with self-regulation and self-monitoring, while it was negatively correlated with adherence. A direct positive correlation was also found between self-efficacy and quality of life. In conclusion, these findings highlight the pivotal role of self-management and self-efficacy in enhancing quality of life. Future studies should focus on patient education interventions to enhance adherence and self-efficacy, ultimately improving the quality of life in people with diabetes.

Keywords: Adherence, self-efficacy, self-management, quality of life, Vietnam

Introduction

Diabetes mellitus (DM), also known as diabetes, is a chronic disease that affects the physical, social, and mental well-being of people with the disease [1]. It affects individuals regardless of age, sex, or geographic location and significantly contributes to global morbidity and mortality [2]. People with diabetes can experience distress due to loss of control over their lives, excessive stress in self-care, feelings of loneliness, and fear of complications and death [3]. An estimated 537 million individuals between the ages of 20 and 79 worldwide have diabetes, accounting for 10.5% of the world's population in 2021 [4,5]. This global burden is also reflected in Vietnam,

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where nearly 4 million adults in Vietnam between the ages of 20 and 79 have diabetes, making up 6.1% of the adult population in 2021 [6]. Nearly 62.6% of diabetes cases in Vietnam are undiagnosed. Most notably, of the people identified with diabetes, more than 55% of patients developed complications, of which 34% were cardiovascular complications [7,8]. Therefore, public health measures to prevent and control diabetes are essential in the context of Vietnam [9].

People with diabetes not only suffer from dangerous complications but also reduced health-related quality of life (QoL) [10]. A previous study has found that compared to the general population of the same age, those with diabetes had lower QoL scores [11]. This may be explained by the high need for treatment, especially if they develop complications that increase hospitalization, disease burden, and mortality among people with diabetes [12]. According to a Vietnamese study, people with diabetes problems had a poor average QoL, particularly when it came to their social and mental health [13]. Assessment and monitoring of QoL is increasingly recognized by healthcare professionals as an important element in the care of people with diabetes [14]. For this reason, improving QoL is considered an important goal of many healthcare interventions, including diabetes management interventions.

Prior research showed the connection between people with diabetes's quality of life, self-efficacy, and self-management. Patients who have better self-management such as diet and physical activity or conducting examinations to control blood sugar, will have better disease outcomes, which eventually can improve the QoL for people with diabetes [15]. Patients with higher self-efficacy are more confident in managing medication-related tasks, such as understanding and taking their medications, which ultimately improves their QoL [16]. Specifically, a study conducted in Malaysia identified a connection between the quality of life of older adults with type 2 diabetes mellitus and their level of medication self-efficacy [16]. Another study in Indonesia found a significant relationship between self-management and the QoL in people with diabetes [15]. Furthermore, a study in 2021 found that self-efficacy was a predictor of self-management behavior practice among people with diabetes mellitus in Indonesia [17]. However, these studies examined these factors in pairs, rather than analyzing their interconnection simultaneously. Although simultaneous assessment of these three relationships has been performed in chronic conditions such as children with chronic illness, medical complexity [18] and hypertensive patients [19], simultaneous assessment of these three aspects remains a knowledge gap in diabetic patients.

Given that diabetes is a chronic condition with no complete cure, maintaining both physical and emotional well-being is crucial for patients. Understanding the factors associated with QoL is important for comprehensive treatment and developing interventions for people living with diabetes. Therefore, the aim of this study was to examine the visual network of relationships between self-management, self-efficacy, and quality of life among diabetes mellitus patients.

Methods

Study setting

A descriptive cross-sectional study was conducted on 363 patients diagnosed with diabetes mellitus who visited three public hospitals in Cao Lanh City, Vietnam, between October and November 2024. The capital of Dong Thap, Cao Lanh, is situated on the left bank of the Mekong River, 120 kilometers southeast of Ho Chi Minh City [20]. This area was chosen due to its high diabetes burden and limited patient knowledge. A prior study found that 90.87% of diabetes patients in this area did not know their medication names, and 84.35% were unaware of side effects, underscoring the need for further research to improve diabetes management and patient education [21]. The sample size required for this study was calculated using the correlation sample size formula [22] based on the expected correlation coefficient between self-efficacy and QoL (r=0.31), referenced from previous research [23], with a Type I error rate of α=0.001 and a Type II error rate of ß=0.01. The minimum sample size needed should be 310.

The current study recruited patients based on inclusion criteria, which included having a diagnosis of diabetes mellitus, being 18 years of age or older, and possessing the ability to read and write. The exclusion criteria included the incomplete questionnaire and participants who

withdrew their consent to participate in the study. Participants were recruited between October and November 2024. In settings with limited resources and budget constraints, a convenience sampling method was employed. Printed self-administered questionnaires were distributed to outpatients while they waited to receive their medications at the dispensing points of the hospitals until 150 questionnaires were collected at each hospital (a total of 450 questionnaires were distributed across the three hospitals, of which 87 were excluded due to more than half of the questions being left unanswered, leaving 363 questionnaires included in the analysis). The identity confirmation information was not collected in the questionnaire.

Data measurements

Self-management was assessed using the Vietnamese version of the Diabetes Self-Management Instrument (V-DSMI) [24]. This instrument was previously validated on the Vietnamese population, achieving a Cronbach's alpha of 0.92 [24]. This 35-item scale was used to assess self-management practices in the past three months of adults with diabetes in five subscales: self-integration (9 items) examined the incorporation of diabetes management into daily activities such as diet, exercise, and weight control; self-regulation (10 items) involved monitoring physical symptoms related to diabetes; interaction with health professionals and other significant people (9 items) focused on the role of medical support in diabetes care; self-monitoring (4 items) assessed the monitoring of blood glucose to facilitate self-care practices; and medication adherence (3 items) evaluated the consistency of the following prescribed medication schedules and attending clinic appointments. Each item was rated by participants using a 4-point Likert scale, ranging from 1 (never) to 4 (always). The score for each subscale and the overall scale was calculated as the sum of its items. Higher scores reflected better diabetes management practices. In this study, the analysis focuses on subscales rather than the overall self-management scale. By examining individual subscales, this approach enabled the identification of targeted interventions, making it more practical than a broad consideration of self-management.

Self-efficacy was measured using the Self-Efficacy for Managing Chronic Disease 6-item Scale (SECD6) [25]. This scale was designed to assess patients' level of confidence in managing different aspects of chronic disease, including 6 items. Each item was rated on a 10-point Likert scale from 1 (not at all confident) to 10 (totally confident). The Vietnamese version of SECD6 was translated for this study using the Translation, Review, Adjudication, Pretesting, and Documentation (TRAPD) approach [26]. Initially, the questionnaire was translated into Vietnamese by a Vietnamese public health researcher who had completed their doctoral studies in an English-speaking country and an English teacher specializing in medical terminology at a Vietnamese university. Subsequently, the initial translation was reviewed by a group of experts, including two clinical doctors and a language specialist. Some terms that were not yet standardized were discussed and harmonized to reflect the same concepts as the original version during the review process by the research team. The adjudicated version was pretested with 15 diabetic patients at a hospital in Dong Thap, and the results indicated that the questions were clear and understandable; therefore, no changes were made. Each stage of the translation process was meticulously documented (**Underlying Data**). The self-efficacy score was calculated as the average score of its items. Higher scores reflect higher levels of confidence in disease management. QoL was assessed by the Vietnamese version of EQ-5D-5L [27]. This scale was assessed on 5 dimensions such as mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, and 5 levels from 1 (no problems) to 5 (extreme problems). Each dimension was coded with a number from 1 to 5, corresponding to the level of the problem. Then converted to an index score according to the guidelines for Vietnamese people [27]. Higher scores reflect higher levels of QoL.

Data analysis

Descriptive statistics were processed using SPSS 27.0 software (IBM, New York, USA). Correlation between quantitative variables was assessed using the Spearman correlation due to the non-normal distribution of the variables, which was confirmed by the Kolmogorov–Smirnov test, the Shapiro–Wilk test, and the Q-Q plot [28]. Network analysis was performed in R version 4.1.1. (R Foundation for Statistical Computing, Vienna, Austria). Spearman correlation matrix, while Least Absolute Shrinkage and Selection Operator (LASSO) regularization were used to

estimate a partial correlation network [29,30]. A network was selected using the Extended Bayesian Information Criterion (EBIC) [29,30], with γ=0.5, which was performed using the qgraph package to visualize the network [31]. To estimate edge and centrality stability, the bootnet package was applied [32]. Non-parametric bootstrap was used to generate 1000 samples for estimating edge weight stability. A *p*-value less than 0.05 was considered statistically significant.

Results

Descriptive statistics and preliminary analysis

The mean age of the participants was 62.03 years old, with a standard deviation (SD) of 11.87. The majority of them were married (81.6%), had insurance (98.8%), had type 2 diabetes (95.4%), and had hypertension (90.1%). The mean±SD of the adherence, self-efficacy, and quality of life scales were 9.15±1.89, 7.5±1.46, and 0.72±0.24, respectively, as presented in **Table 1.** As expected, moderate to high correlations were observed among the five subscales of self-management (*r*=0.43–0.79), which are presented in **Table 2**. QoL had a low negative association with age (*r*=-0.33) and number of family members (*r*=-0.21) but a low positive association with adherence (*r*=0.24) and self-efficacy (*r*=0.27).

Table 1. Characteristics of diabetes mellitus patients (n=363)

Variables	Frequency (%)	Mean±SD
Demographics		
Age, years		62.03±11.87
Sex		
Women	200 (55.1)	
Men	163 (44.9)	
Living area [20]		
Rural	233 (67.9)	
Urban	110 (32.1)	
Marital status [16]		
Single/divorced/widowed	64 (18.4)	
Married	283 (81.6)	
Education level [3]		
Elementary or below	142 (39.4)	
Middle school	139 (38.6)	
High school or above	79 (21.9)	
Occupational status		
Homemaker	51 (14)	
Retired	112 (30.9)	
Employed	194 (53.4)	
Monthly income, million VND [12]		
<4	141 (40.2)	
4–8	132 (37.6)	
>8	78 (22.2)	
Number of family members [30]		4.83±1.54
Health-related characteristics		
Insurance [34]		
No	4 (1.2)	
Yes	325 (98.8)	
Type of diabetes [14]		
Type 1	16 (4.6)	
Type 2	333 (95.4)	
Current treatment regimen [5]		
Only dietary changes and exercise	32 (8.9)	
Only oral diabetes medication	198 (55.3)	
Oral diabetes medication and Insulin	34 (9.5)	
Insulin only	94 (26.3)	
Diabetes duration, years [13]		
<5	130 (37.1)	
5–10	168 (48)	
>10	52 (14.9)	
Comorbid chronic conditions		
Hypertension	327 (90.1)	
Arthritis	63 (17.4)	

Variables	Frequency (%)	Mean±SD
Gastric and duodenal ulcers	30 (8.3)	
Dyslipidemia	197 (54.3)	
Chronic kidney disease	19 (5.2)	
Number of medications in the current diabetes treatment [29]		1.26±0.87
Diabetes self-management		
Self-integration		27.63±5.39
Self-regulation		24.84±4.8
Interaction		25.23±5.45
Self-monitoring		10.98±2.52
Adherence		9.15±1.89
Total		97.82±16.53
Self-efficacy		7.5±1.46
Quality of life		0.72±0.24

Numbers in square brackets indicate missing values; VND: Vietnamese dong

Table 2. Correlation coefficients between demographics, health-related characteristics self-management, self-efficacy, and quality of life (n=363)

No.	Characteristics	1	2	3	4	5	6	7	8	9	10
1	Age	1									
2	Number of family members	0.25**	1								
3	Number of medications in the current diabetes treatment	0.082	0.22**	1							
4	Self-integration	-0.17**	-0.18**	-0.08	1						
5	Self-regulation	-0.12*	-0.12*	-0.02	0.79**	1					
6	Interaction	-0.02	-0.02	0.02	0.51**	0.50**	1				
7	Self-monitoring	-0.09	-0.07	-0.01	0.63**	0.65**	0.63**	1			
8	Adherence	-0.15**	-0.12*	0.01	0.53**	0.55**	0.43**	0.53**	1		
9	Self-efficacy	-0.15**	-0.07	-0.10	0.21**	0.24**	0.08	0.20**	0.09	1	
10	Quality of life	-0.33**	-0.21**	-0.06	0.18**	0.19**	-0.01	0.11*	0.24**	0.27**	1

*The correlation is statistically significant at the 0.05 level
**The correlation is statistically significant at the 0.01 level

Network visualization

A visualization of the self-management, self-efficacy, and QoL network is presented in **Figure 1**. Based on an estimated 18 non-zero edges out of all possible 21 edges, the network density was estimated to be approximately 85.7%. The two domains of the self-management scale were directly and positively correlated with QoL as indicated by the blue edges drawn between QoL and adherence ($r_{partial}$=0.18; 95%CI=0.08–0.29) and self-integration ($r_{partial}$=0.1; 95%CI=0.01–0.19), whereas the interaction domain of the self-management scale was directly and negatively correlated with QoL ($r_{partial}$=-0.15; 95%CI=-0.25–0.04). Self-efficacy was positively correlated with several domains of self-management, such as self-regulation ($r_{partial}$=0.13; 95%CI=0.04–0.22) and self-monitoring ($r_{partial}$=0.08; 95%CI=-0.01–0.18), and negatively correlated with adherence ($r_{partial}$=-0.04; 95%CI=-0.15–0.07). A direct positive correlation was also found between self-efficacy and QoL ($r_{partial}$=0.17; 95%CI=0.07–0.28).

Centrality stability

The stability of the centrality for expected influence and strength was almost close together and at the highest position, as corroborated by the high, nearly overlapping cyan and purple lines, as presented in **Figure 2**. This indicates that both expected influence and strength maintain strong correlations with their original values across dropping sample sizes. The green line represents closeness centrality, which remains close to 1.0 across all sampled cases, demonstrating its robustness to changes in sample size. In contrast, the red line, which represents betweenness centrality, indicates that betweenness centrality is more sensitive to sampling and loses correlation with the original network characteristics. The shaded areas around each line depict the bootstrapped confidence intervals, providing a visual representation of the variability in these correlations. The stability coefficient (CS) for expected influence (0.75) was equal to the CS-coefficient of strength (0.75), indicating that when 75% of the samples were dropped, the structure of the domain network did not change significantly. The CS-coefficients of closeness and betweenness were 0.36 and 0, respectively. As the CS-coefficient of betweenness was 0 which was less than 0.25, so this study did not focus on interpreting betweenness centrality.

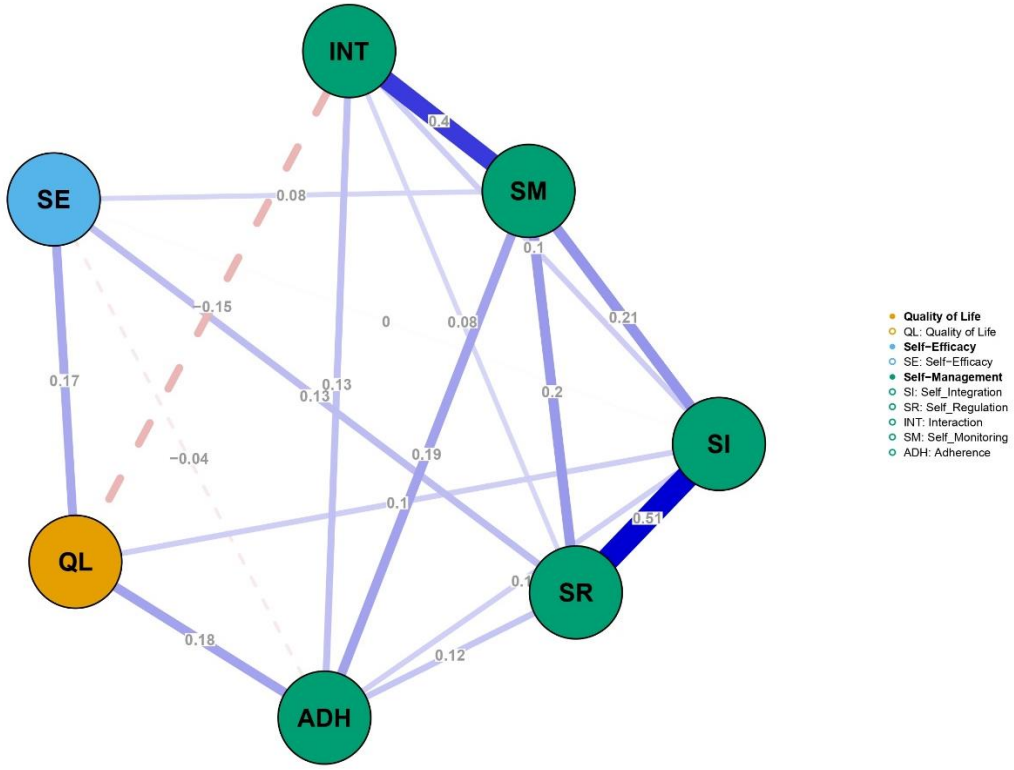

Figure 1. Network visualization of functions of self-management, self-efficacy, and quality of life (QoL). The degree of correlation between two nodes is shown by the edge thickness. Partial correlation coefficients are represented by values on the edges. Positive correlations are indicated by blue borders, and negative correlations are indicated by red edges.

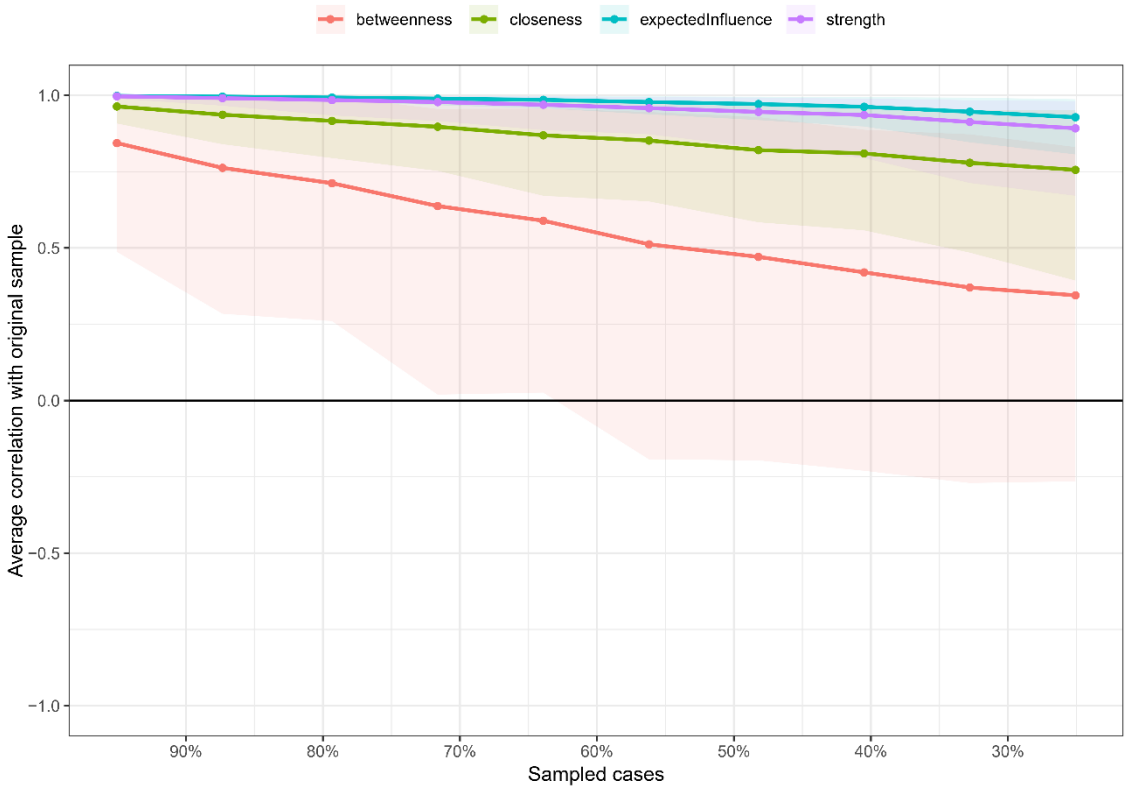

Figure 2. Analysis of edge stability in terms of expected influence, strength, closeness, and betweenness using the network bootstrap procedure.

Node centrality

The centrality indices for each node are presented in **Figure 3**. Self-monitoring had the highest expected influence and strength centrality, both scoring 1.08, followed by self-regulation with equivalent metrics at 1.05, which indicates that both were strongly correlated with other variables. Self-monitoring (0.03) and self-regulation (0.02) displayed the highest closeness centrality – a measure of distance from other domains – signaling that these two domains were near other network domains. The higher the centrality of a node, the more central it is within the network.

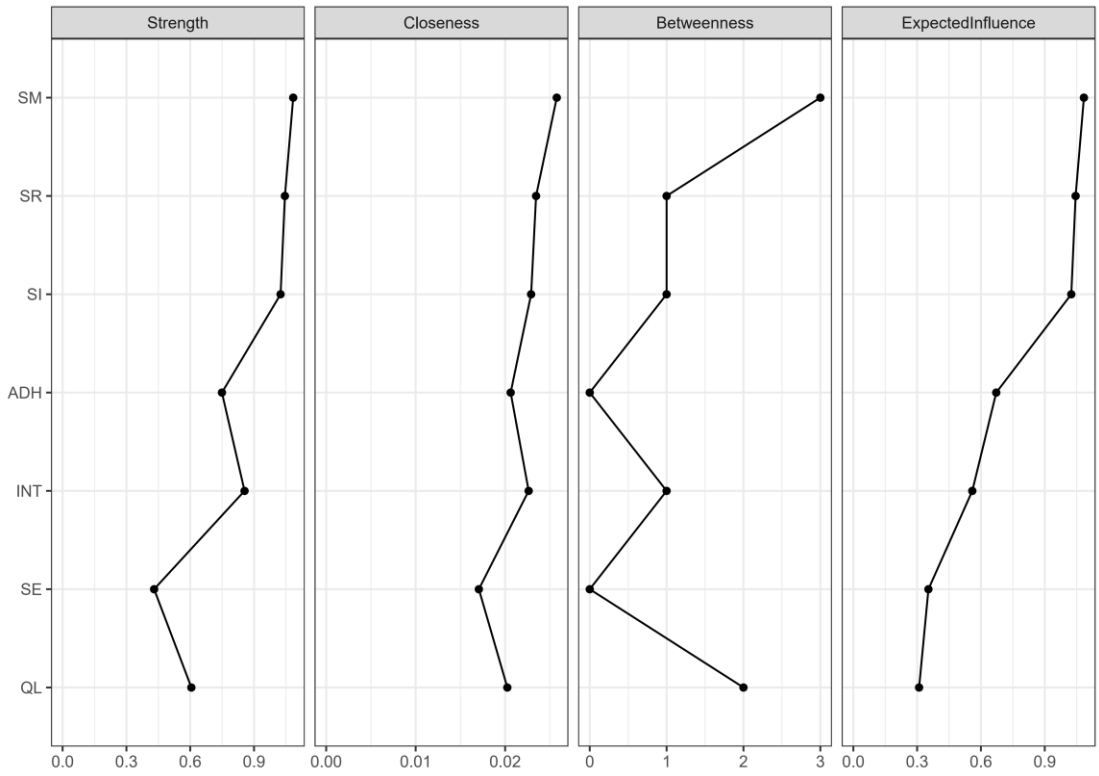

Figure 3. Centrality of domains in the network. ADH: adherence; INT: interaction; QL: quality of life; SE: self-efficacy; SI: self-integration; SM: self-monitoring; SR: self-regulation.

Discussion

Network visualization analysis revealed a direct positive correlation between QoL and specific self-management components, including adherence and self-integration, as well as self-efficacy. These results of our study suggest that participants with better self-management and self-efficacy were more likely to have higher QoL. When examining the network of self-management domains, the two domains of self-integration and self-regulation were the most highly correlated, a result similar to that found in a previous study [33]. In addition, the centrality analysis of the self-management network found that self-monitoring was the most important behavior because it had the highest centrality. This highlights the central role of self-monitoring within the self-management network. Although self-monitoring did not directly influence QoL, its impact may be mediated by other self-management behaviors that indirectly enhance QoL. A study by Murff also found that self-monitoring of blood glucose did not improve QoL [34]. It is suggested that patients might already have had stable blood glucose control, and the infrequent application of self-monitoring of blood glucose daily may not be sufficient to induce changes in behavior or adjustments [34].

Medication adherence was positively correlated with QoL in older adults with DM. The results of the present study are consistent with a previous study, which found medication adherence to be associated with improved QoL in older adults with DM [35]. One possible explanation is that the full benefit of most medications can only be achieved if patients adhere closely to their prescribed regimen [36]. When there is greater patient adherence, debilitating

symptoms are reduced, clinical outcomes are improved in the short term, and disease control is increased in the long term, thus leading to better QoL. Conversely, an uncontrolled disease process can undermine patient well-being [36]. Clinicians should create plans to help patients take their medications as prescribed, offer continuing assistance, and evaluate compliance at every appointment.

The findings of this study showed that in diabetes patients, self-efficacy and QoL were significantly weakly and positively correlated. This is consistent with previous studies, which concluded that diabetic patients with good self-efficacy had better QoL [16,37,38]. A person's belief in a particular activity in a given situation is known as self-efficacy, and it can be mediated by four factors: verbal persuasion, performance accomplishments, physiological/emotional arousal, and vicarious experience [39]. Glycemic control will be impacted by self-efficacy in managing diabetes, which may assist in lowering complications and eventually enhancing the patient's QoL [40]. Patients with diabetes who perceive high self-efficacy are more motivated to participate in a diabetes diet because they feel confident that they can complete the dietary requirements [23]. Within the network model, adherence and self-efficacy emerged as the most influential factors affecting QoL. This suggests that these two factors play the most important role in activating and directly influencing QoL. Therefore, to improve a patient's QoL, adherence and self-efficacy are the most effective aspects to focus in future intervention studies.

Interaction with medical professionals and other important individuals is frequently thought to improve patients' QoL. A previous study found that patients who felt more comfortable asking questions had higher QoL [41]. One possible explanation is that good communication between patients and providers may increase the level of social support in patients and subsequently improve mental health and QoL. However, contrary to expectations, our study found an inverse relationship between interaction and QoL. This paradox may be explained because patients with severe disease or poor prognosis have lower QoL and may have more interactions with healthcare professionals and feel comfortable expressing their concerns to healthcare professionals, as their health conditions require frequent care and monitoring. Future qualitative research should be designed to explore the reasons for such a reversal in the relationship so that appropriate intervention strategies can be developed.

This study has several limitations. First, our findings were based on a self-administered questionnaire, which was susceptible to some self-report bias and recall bias. As a result, participants may have overestimated or underestimated their self-management behaviors, potentially influencing the accuracy of the reported outcomes. Second, because the design of this study is cross-sectional, it is difficult to clearly establish causality; that is, it is not possible to determine the direction of edges in the network of self-management, self-efficacy, and quality of life. Future research should use longitudinal or interventional study designs, such as behavioral interventions targeting self-efficacy and adherence, to confirm the causality emerging from this study. Third, the network analysis did not incorporate demographic and health-related factors, limiting the ability to detect the effects of these factors. Finally, since participants were recruited from a single city in Vietnam, the findings may not be generalizable to other regions or populations with different healthcare systems and socio-economic conditions.

Conclusion

The study demonstrated that self-management, including adherence and self-efficacy, had a direct and positive relationship with QoL. Although self-monitoring had the highest centrality in the self-management network, it did not have a direct impact on QoL. However, self-monitoring indirectly supports QoL by influencing other self-management behaviors, such as adherence and self-regulation. Our findings suggest the need for structured medication management plans specifically designed to enhance patient adherence, personalized counseling to boost confidence in self-management, and the integration of digital tools for effective self-monitoring at each clinical visit.

Ethics approval

The study was reviewed by the Institutional Review Board of Dong Thap Traditional Medicine Hospital, Vietnam, and adhered to the ethical principles outlined in the Declaration of Helsinki.

Informed consent was obtained from all participants prior to the start of data collection, with strict confidentiality maintained for all information collected throughout the study.

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

The additional data supporting the findings of this study are openly available on Figshare at https://doi.org/10.6084/m9.figshare.28396814.v1.

Declaration of artificial intelligence use

We hereby confirm that no artificial intelligence (AI) tools or methodologies were utilized at any stage of this study, including during data collection, analysis, visualization, or manuscript preparation. All work presented in this study was conducted manually by the authors without the assistance of AI-based tools or systems.

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