



Health-Related Quality of Life, Anxiety, and Depression After Below-Knee Amputation in Diabetic Foot Patients: A Cross-sectional Study

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Abstract

Background: Diabetic foot disease often leads to below-knee amputation (BKA), with substantial consequences for health-related quality of life (HRQoL). Identifying associated psychological and sociodemographic factors is crucial for optimizing post-operative care.

Objectives: To assess HRQoL, anxiety, and depression among diabetic foot patients following BKA, and explore their associations with sociodemographic factors.

Methods: A cross-sectional study was conducted among 112 amputated patients admitted to Firoozgar Hospital (Tehran) between 2022 and early 2023. Participants completed the short form health survey (SF-36) and the Hospital Anxiety and Depression Scale (HADS). Variables assessed included age, sex, education level, income, and history of surgical site infection (SSI). Statistical analyses involved descriptive and inferential methods.

Results: Higher educational levels were significantly associated with improved SF-36 scores ($P < 0.05$) and lower HADS anxiety/depression levels ($P < 0.05$). Older age showed negative correlations with physical functioning ($R = -0.72$, $P < 0.001$) and general health ($R = -0.03$, $P = 0.790$). While most HRQoL differences between sexes were statistically non-significant, female participants reported slightly lower scores in vitality, general health, and emotional role domains. The presence of SSI tended to lower physical functioning scores, though differences did not reach statistical significance.

Conclusions: Age and education significantly influence post-amputation HRQoL. These findings underscore the need for tailored psychosocial support and rehabilitation strategies targeting vulnerable subgroups.

Keywords: Diabetic Foot, HADS, Quality of Life, SF-36

1. Background

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia, which can lead to various complications affecting multiple organ

systems (1). Among these complications, diabetic foot disease poses a significant challenge due to its potential for severe morbidity and disability (2). In cases where conservative treatments fail, below-knee amputations (BKAs) are often performed to prevent the spread of

infection and improve patient outcomes (3). However, the impact of such surgical interventions on the health-related quality of life (HRQoL) of diabetic foot patients warrants further investigation. The HRQoL is a multidimensional concept that encompasses an individual's physical, psychological, and social well-being as it relates to their health condition (4). Moreover, depression and anxiety that may develop following BKA have been shown to substantially reduce HRQoL in diabetic foot patients (5). Understanding the HRQoL outcomes in diabetic foot patients post-amputation is crucial for healthcare providers to tailor effective interventions and support systems (6).

2. Objectives

This study assesses HRQoL in diabetic foot patients following BKA using the short form health survey (SF-36) and the Hospital Anxiety and Depression Scale (HADS), and examines how demographic factors – age, sex, education, financial status, and surgical site infection (SSI) history – relate to post-operative outcomes.

3. Methods

This descriptive cross-sectional study was conducted at Firoozgar Hospital in Tehran between 2022 and early 2023. A total of 112 eligible diabetic foot patients who had undergone BKA were consecutively included using convenience sampling. Given the limited number of eligible patients at our center and the absence of sufficient prior data for an a priori power calculation, all cases meeting the inclusion criteria were included. Inclusion criteria comprised adults with diabetic foot who had undergone BKA, while patients with cognitive impairments or severe comorbidities preventing participation were excluded.

Each participant completed two validated instruments: The SF-36, which measures various domains of HRQoL, and the HADS, which assesses psychological distress. Both instruments have demonstrated strong psychometric properties. The SF-36 shows good construct validity, content validity, and internal consistency (Cronbach's alpha: 0.70 - 0.99 across subscales), while the HADS demonstrates adequate construct and criterion validity, with Cronbach's alpha values of 0.70 for depression and 0.85 for anxiety subscales in the Iranian population (7, 8). The SF-36 measures eight domains of physical and mental

health, while the HADS specifically evaluates anxiety and depression.

Patients with limited literacy or mobility were interviewed by trained staff, either in person or by phone. Demographic information – including age, sex, education level, financial status, and history of post-operative SSI – was collected from medical records and participant reports. Collected data were analyzed using SPSS software. Descriptive statistics, including means \pm SD, frequencies, and percentages, were used to summarize the data, and inferential analyses, including *t*-tests, ANOVA, chi-square tests, and correlation analyses, were performed to examine associations between variables.

The study protocol received ethical approval from the Institutional Review Board of Firoozgar Hospital ([IR.IJMS.FMD.REC.1400.617](https://doi.org/10.1186/1475-2875-1400-617)). Written informed consent was obtained from all participants.

4. Results

The study included a total of 112 below-knee amputated patients. The mean age of participants was 62.5 ± 11.1 years. The majority were male (78 individuals; 69.6%). Regarding educational attainment, 34 patients (30.4%) held a college degree, while 20 (17.9%) were illiterate. In terms of income, nearly half (49.1%) reported low income, and 6.3% reported high income. Most patients (79.5%) were not admitted due to post-operative SSI; only 20.5% had documented SSI following amputation.

4.1. Associations Between Sociodemographic Factors and Health-Related Quality of Life Outcomes

The HRQoL was assessed using the SF-36 and HADS instruments. Associations were examined with key sociodemographic variables, including age, sex, educational attainment, income level, and SSI status. Increasing age was strongly and negatively correlated with physical functioning ($R = -0.72$, $P < 0.001$), pain ($R = -0.49$, $P < 0.001$), and overall physical health scores ($R = -0.62$, $P < 0.001$), indicating reduced physical capacity in older participants. Mental health domains and psychological distress showed no significant age-related trends. Sex-based differences were nonsignificant across most domains. However, female participants reported lower scores in energy/fatigue (vitality, $P = 0.048$), general health ($P \approx 0.052$), and role emotional ($P =$

Table 1. Associations Between Sociodemographic Variables and Health-Related Quality of Life Domains Based on Short Form Health Survey and Hospital Anxiety and Depression Scale Scores

Domain/Subscale	PF	RP	RE	EF	EW	SF	Pain (P)	GH	Physical Health ^a	Mental Health ^a	HADS-Anxiety	HADS-Depression
Gender												
Female	11.91	0	2.94	13.97	21.52	18.75	28.08	9.26	49.26	57.19	17.85	16.02
Male	11.98	3.52	6.83	17.30	21.89	20.19	28.39	10.57	54.48	66.23	16.66	14.78
P-value	0.964	0.052	0.200	0.048 ^b	0.873	0.593	0.915	0.341	0.287	0.154	0.144	0.096
Age												
R	-0.72	-0.21	-0.14	-0.01	0.08	-0.18	-0.49	-0.03	-0.62	-0.11	-	-
P-value	0.001 ^b	0.024	0.146	0.952	0.401	0.063	0.001 ^b	0.790	0.001 ^b	0.233	0.591	0.225
Education												
College	17.20	5.15	7.84	15.29	17.41	21.69	33.52	10.14	66.02	62.24	-	-
Others	7.25	0	3.33	19.56	25.20	23.75	22.12	10.00	39.37	75.52	-	-
P-value	P < 0.001 ^b	0.100	0.327	0.203	0.007 ^b	0.059	0.023 ^b	0.897	< 0.001 ^b	0.069	↓ P < 0.05	↓ P < 0.05
Income												
Low	11.09	0.45	4.24	15.00	22.47	19.54	25.09	9.45	46.09	61.26	17.14	15.52
Others	13.57	7.14	7.33	17.85	26.28	20.00	31.80	12.14	61.42	68.54	16.71	14.14
P-value	0.509	0.042 ^b	0.560	0.262	0.348	0.984	0.048 ^b	0.463	0.010 ^b	0.731	0.042 ^b	0.511
SSI												
Yes	9.34	1.08	1.44	14.13	20.34	19.02	31.73	10.00	52.17	54.94	17.95	15.73
No	12.64	2.80	6.74	16.85	22.15	19.94	27.41	10.22	53.08	65.69	16.78	15.01
P-value	0.078	0.408	0.126	0.764	0.157	0.490	0.187	0.886	0.870	0.137	0.206	0.396

Abbreviations: SSI, surgical site infection; PF, physical functioning; RP, role physical; RE, role emotional; EF, energy/fatigue; EW, emotional well-being; SF, social functioning; GH, general health; HADS, Hospital Anxiety and Depression Scale.

^a Composite scores derived from multiple subscales.

^b Values indicate statistically significant associations (P < 0.05).

0.200), suggesting reduced perceived vitality and emotional functioning.

Educational attainment, categorized from illiteracy to college-level education, showed positive associations with physical functioning, role limitations, emotional well-being, and general health (all P < 0.05). Higher education was also linked to lower anxiety and depression scores on the HADS. Income level, categorized as low, moderate, or high, had minimal influence on SF-36 domains. Nonetheless, patients with low income reported significantly higher anxiety scores (HADS-A: P = 0.042) than those with moderate or high income. Finally, SSI status was associated with lower scores in physical functioning and role physical domains, but these differences were not statistically significant. Detailed values are presented in Table 1.

5. Discussion

This study evaluated HRQoL among diabetic foot patients following BKA, using the SF-36 and HADS instruments. It explored the influence of key sociodemographic variables — including age, sex,

educational level, income, and post-operative SSI — on physical and mental health outcomes. Consistent with previous research, this study affirms the substantial negative impact of lower limb amputation on HRQoL in diabetic populations. Prior studies by Ribu et al., Gershater et al., and Jeffcoate et al. documented significantly lower SF-36 scores among amputees, particularly in domains related to physical functioning and general health, with relatively higher scores in mental health components (2, 4, 9). These findings suggest that while physical limitations are pronounced post-amputation, mental health resilience may persist in some subgroups. Our data mirror this pattern, reinforcing the need for targeted physical rehabilitation and adaptive strategies for emotional support.

Age demonstrated a robust inverse association with several SF-36 domains, including physical functioning, role limitations, and general health. Older patients reported markedly diminished physical and role functioning, consistent with established evidence linking advanced age to reduced physical capacity and higher comorbidity burden (10). These trends underline

the need for age-sensitive care plans and individualized rehabilitation programs tailored to older amputees.

Sex-related differences in HRQoL were generally non-significant; however, women showed lower scores in energy/fatigue, general health, and role emotional subscales. While these disparities did not reach strong statistical significance across all measures, they warrant further investigation, particularly given prior evidence suggesting variable psychosocial responses across genders (4, 6, 11).

Educational attainment emerged as a strong predictor of HRQoL. Patients with college-level education scored significantly higher in physical functioning, role limitations, emotional well-being, and social functioning, and reported lower levels of anxiety and depression. These findings align with evidence that education enhances health literacy, coping skills, and access to resources that promote better quality of life (12). Educational interventions, including self-management and psychoeducation, may therefore be essential components in post-amputation care models.

Income level showed minimal association with most SF-36 domains. Nonetheless, patients in the lower income group reported significantly higher anxiety scores. This suggests that socioeconomic hardship may intensify psychological distress, possibly through mechanisms such as financial insecurity, limited access to rehabilitation, and reduced support networks. Addressing economic vulnerabilities through integrated social and psychological services could mitigate these effects.

The SSI was associated with lower scores in physical functioning and role physical domains, reflecting the impact of post-surgical complications on mobility and day-to-day capacity. While the influence of SSI on other HRQoL domains was not statistically significant, its role in delaying healing and increasing disability underscores the importance of proactive infection prevention and timely management (13).

5.1. Limitations and Potential Biases

Convenience sampling may have caused selection bias. Single-center data limits generalizability. Key variables like time since amputation were excluded, and the cross-sectional design prevents causal inference.

Footnotes

Authors' Contribution: Study concept and design: O. E.; Acquisition of data: D. Sh. and Sh. Sh.; Drafting of the manuscript: A. M. A. M.; Critical revision of the manuscript for important intellectual content: M. A.; Statistical analysis: Administrative, technical material support: A. L.; Study supervision: S. F. Sh.

Conflict of Interests Statement: The authors declare no conflict of interest.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication. The data are not publicly available due to the privacy policy of the participants.

Ethical Approval: The present study was approved by the Ethics Committee of Iran University of Medical Sciences ([IR.IUMS.FMD.REC.1400.617](https://doi.org/10.1006/IR.IUMS.FMD.REC.1400.617)).

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References

1. Armstrong DG, Boulton AJM, Bus SA. Diabetic Foot Ulcers and Their Recurrence. *N Engl J Med*. 2017;**376**(24):2367-75. [PubMed ID: [28614678](https://pubmed.ncbi.nlm.nih.gov/28614678/)]. <https://doi.org/10.1056/NEJMr1615439>.
2. Jeffcoate WJ, Vileikyte L, Boyko EJ, Armstrong DG, Boulton AJM. Current Challenges and Opportunities in the Prevention and Management of Diabetic Foot Ulcers. *Diabetes Care*. 2018;**41**(4):645-52. [PubMed ID: [29559450](https://pubmed.ncbi.nlm.nih.gov/29559450/)]. <https://doi.org/10.2337/dci7-1836>.
3. Mills JS, Conte MS, Armstrong DG, Pomposelli FB, Schanzler A, Sidawy AN, et al. The Society for Vascular Surgery Lower Extremity Threatened Limb Classification System: risk stratification based on wound, ischemia, and foot infection (WIFI). *J Vasc Surg*. 2014;**59**(1):220-34 e1-2. [PubMed ID: [24126108](https://pubmed.ncbi.nlm.nih.gov/24126108/)]. <https://doi.org/10.1016/j.jvs.2013.08.003>.
4. Ribu L, Hanestad BR, Moum T, Birkeland K, Rustoen T. Health-related quality of life among patients with diabetes and foot ulcers: association with demographic and clinical characteristics. *J Diabetes Complications*. 2007;**21**(4):227-36. [PubMed ID: [17616352](https://pubmed.ncbi.nlm.nih.gov/17616352/)]. <https://doi.org/10.1016/j.jdiacomp.2007.02.001>.
5. Kizilkurt OK. Quality of life after lower extremity amputation due to diabetic foot ulcer: the role of prosthesis-related factors, body image, self-esteem, and coping styles. *Dusunen Adam: J Psychiatry Neurol Sci*. 2020;**33**(2). <https://doi.org/10.14744/dajpns.2020.00070>.
6. Ragnarson Tennvall G, Apelqvist J. Health-related quality of life in patients with diabetes mellitus and foot ulcers. *J Diabetes Complications*. 2000;**14**(5):235-41. [PubMed ID: [11113684](https://pubmed.ncbi.nlm.nih.gov/11113684/)]. [https://doi.org/10.1016/S1056-8727\(00\)00133-1](https://doi.org/10.1016/S1056-8727(00)00133-1).
7. Rezaei S, Khaksari Z. Validity and Reliability of the Short Form Health Survey Questionnaire (SF-36) for Use in Iranian Patients With

- Traumatic Brain Injury (TBI). *Iran J Neurosurg.* 2019;79-91. <https://doi.org/10.32598/irjns.5.2.79>.
8. Kaviani H, Seyfourian H, Sharifi V, Ebrahimkhani N. [Reliability and validity of Anxiety and Depression Hospital Scales (HADS): Iranian patients with anxiety and depression disorders]. *Tehran Univ Med J.* 2009;67(5):379-85. FA.
 9. Gershater MA, Londahl M, Nyberg P, Larsson J, Thorne J, Eneroth M, et al. Complexity of factors related to outcome of neuropathic and neuroischaemic/ischaemic diabetic foot ulcers: a cohort study. *Diabetologia.* 2009;52(3):398-407. [PubMed ID: 19037626]. <https://doi.org/10.1007/s00125-008-1226-2>.
 10. Colon-Emeric CS, Whitson HE, Pavon J, Hoenig H. Functional decline in older adults. *Am Fam Physician.* 2013;88(6):388-94. [PubMed ID: 24134046]. [PubMed Central ID: PMC3955056].
 11. Fortington LV, Dijkstra PU, Bosmans JC, Post WJ, Geertzen JH. Change in health-related quality of life in the first 18 months after lower limb amputation: a prospective, longitudinal study. *J Rehabil Med.* 2013;45(6):587-94. [PubMed ID: 23624575]. <https://doi.org/10.2340/16501977-1146>.
 12. Ribu L, Birkeland K, Hanestad BR, Moum T, Rustoen T. A longitudinal study of patients with diabetes and foot ulcers and their health-related quality of life: wound healing and quality-of-life changes. *J Diabetes Complications.* 2008;22(6):400-7. [PubMed ID: 18413188]. <https://doi.org/10.1016/j.jdiacomp.2007.06.006>.
 13. Pemayun TG, Naibaho RM, Novitasari D, Amin N, Minuljo TT. Risk factors for lower extremity amputation in patients with diabetic foot ulcers: a hospital-based case-control study. *Diabet Foot Ankle.* 2015;6:29629. [PubMed ID: 26651032]. [PubMed Central ID: PMC4673055]. <https://doi.org/10.3402/dfa.v6.29629>.