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Original Research Article

Relearning to Live: Functional Outcomes and Quality of Life Among Diabetic Amputees

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Abstract

Background: Diabetes-related lower limb amputation is a major cause of long-term disability, profoundly affecting functional independence and quality of life. Despite advances in surgical care, post-amputation functional outcomes remain suboptimal, particularly in individuals with multiple comorbidities. Assessment of functional quality of life and its determinants is essential for planning rehabilitation and supportive care services.

Objectives: To assess functional quality of life among individuals with diabetes-related lower limb amputation using the Barthel Index and to determine its association with selected socio-demographic and clinical factors.

Materials and Methods: A hospital-based cross-sectional analytical study was conducted among 193 adults aged ≥40 years with diabetes-related lower limb amputation attending a tertiary care teaching hospital in South India from September to December. Participants were recruited using consecutive sampling. Data on socio-demographic characteristics, diabetes profile, comorbidities, prosthesis use, and need for medical assistance were collected using a structured questionnaire and medical record review. Functional quality of life was assessed using the Barthel Index and categorized into total, severe, moderate, and slight dependence. Statistical analysis was performed using SPSS version 20. Associations were tested using Chi-square/Fisher's exact test, with $p < 0.05$ considered significant.

Results: The majority of participants were male (69.9%) and belonged to the 61–70 years age group (34.2%). Most had long-standing Type 2 diabetes (93.2%), with 49.7% having disease duration of 16–25 years. Hypertension (71.5%) and chronic kidney disease (33.7%) were common comorbidities. Based on the Barthel Index, 69.4% exhibited moderate dependence, 30.1% severe dependence, and 0.5% total dependence, while none had slight dependence. Age ($p = 0.012$), employment status ($p = 0.006$), chronic kidney disease ($p = 0.009$), peripheral occlusive vascular disease ($p = 0.014$), neuropathy ($p = 0.043$), phantom limb pain ($p = 0.006$), duration of diabetes ($p = 0.034$), and frequency of need for medical assistance ($p < 0.001$) showed significant associations with functional quality of life.

Conclusion: A substantial proportion of diabetes-related amputees experience moderate to severe functional dependence. Advancing age, long-standing diabetes, vascular and neurological comorbidities, phantom limb pain, and increased caregiving needs significantly impair functional quality of life. Integrated rehabilitation, prosthetic support, and comprehensive comorbidity management are essential to improve post-amputation functional outcomes.

Keywords: Diabetes mellitus; Lower limb amputation; Quality of life; Barthel Index; Functional dependence; Rehabilitation.

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Introduction

Diabetes mellitus is one of the most pressing global public health concerns, with its prevalence rising rapidly across both developed and developing countries. According to the International Diabetes Federation, the global burden of diabetes continues to escalate, driven by population ageing, urbanization, and lifestyle transitions.[1] Chronic hyperglycaemia predisposes individuals to a range of microvascular and macrovascular complications, among which diabetic foot disease remains one of the most disabling. Peripheral neuropathy, peripheral arterial disease, and impaired wound healing contribute to ulceration and infection, frequently culminating in lower limb amputation when conservative and limb-salvage measures fail.[2]

Diabetes-related lower limb amputation is associated with substantial morbidity, mortality, and long-term disability. It is estimated that every 20–30 seconds, a lower limb is lost somewhere in the world due to diabetes.[3] Beyond the immediate surgical impact, amputation represents a life-altering event that profoundly affects mobility, independence, psychosocial well-being, and economic productivity.[4] Functional impairment following amputation often restricts an individual's ability to perform activities of daily living, thereby diminishing overall quality of life.[5] Consequently, functional outcomes have emerged as critical indicators in post-amputation care, complementing traditional clinical endpoints such as survival and wound healing.

Objective assessment of functional status is essential for planning rehabilitation, prosthetic training, and long-term supportive services. The Barthel Index is one of the most widely used validated tools for measuring independence in activities of daily living, categorizing individuals across varying levels of dependence.[6] Its application in amputee populations provides practical insight into real-world functional capability and rehabilitation needs.

Functional quality of life following diabetes-related amputation is influenced by a complex interplay of socio-demographic and clinical determinants. Advancing age, unemployment, and lack of social support have been shown to adversely affect rehabilitation outcomes.[7] Clinical factors including duration of diabetes, chronic kidney disease, peripheral vascular disease, neuropathy, and phantom limb pain further compound disability and delay functional recovery.[8] Additionally, access to prosthetic services and the need for ongoing medical assistance play a pivotal role in determining long-term independence.[9]

Despite the growing burden of diabetic amputations, evidence examining functional quality of life and its determinants remains limited, particularly in low- and middle-income settings where rehabilitation resources may be constrained. Most available literature focuses on surgical techniques, ulcer management, or mortality outcomes, with comparatively less emphasis on post-amputation functional dependence.[10] Generating context-specific evidence is therefore essential to guide rehabilitation planning, optimize prosthetic utilization, and improve long-term quality of life. In this context, the present study was undertaken to assess functional quality of life among individuals with diabetes-related lower limb amputation using the Barthel Index and to examine its association with selected socio-demographic and clinical determinants. Understanding these factors is crucial for designing targeted rehabilitation strategies and strengthening comprehensive diabetic foot care services.

Materials & Methods

A hospital-based cross-sectional analytical study was conducted at a tertiary care teaching hospital in South India among individuals with diabetes-related lower limb amputation attending surgical, rehabilitation, and follow-up outpatient services. The study was carried out over a period of 3 months September to December. The study population comprised adults aged 40 years and above who were diagnosed with diabetes mellitus (Type 1 or Type 2) and had undergone unilateral or bilateral lower limb amputation secondary to diabetic complications. Individuals who were clinically stable and provided informed written consent were included in the study. Patients with amputations due to non-diabetic causes such as trauma or malignancy, those who were critically ill, and individuals with severe cognitive or psychiatric illness precluding reliable assessment were excluded.

A total of 193 eligible participants were enrolled using a consecutive sampling technique during the study period. The sample size was calculated using formula $4pq/d^2$ and p was taken from an article from Thomas et.al .[11] Data were collected using a pre-designed and pre-tested structured questionnaire administered through face-to-face interviews, supplemented by review of medical records. Information on socio-demographic variables including age, gender, marital status, employment status, and living arrangement was obtained. Clinical details such as type and duration of diabetes mellitus and comorbidities including hypertension, chronic kidney disease, peripheral occlusive vascular disease, cerebrovascular accident, neuropathy, necrotising fasciitis, and phantom limb pain were recorded. Rehabilitation-related variables such as use of prosthesis and

frequency of need for medical assistance to perform activities of daily living were also documented.

Quality of life in terms of functional independence was assessed using the Barthel Index, a validated tool that measures performance in activities of daily living. Based on the total score, participants were categorized into total dependence (0–20), severe dependence (21–60), moderate dependence (61–90), and slight dependence (91–99). Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 20. Descriptive statistics were expressed as frequencies and percentages. The association between quality of life categories and selected socio-demographic and clinical variables was assessed using the Chi-square test. The study were reviewed by the Institutional Ethics Committee (MMCH&RC/IEC/2025/06/SP/21). Informed consent was taken and documented appropriately.

Results

A total of 193 individuals were included in the analysis. With regard to gender distribution, the study population was predominantly male, comprising 135 participants (69.9%), while females accounted for 58 (30.1%).The age distribution showed that the largest proportion of participants belonged to the 61–70 years age group (34.2%), followed by 71–80 years (29.5%) and 51–60 years (24.4%). Participants aged 40–50 years constituted 8.3%, whereas only 3.6% were in the 81–90 years category, indicating that the study cohort was largely concentrated in the older age brackets. In terms of marital status, most participants were married (67.9%), while 28.5% were widowed. A small proportion were single (2.1%) or divorced (1.6%). Regarding employment status, 38.9% were retired and 36.8% were unemployed, whereas only 24.4% were currently employed, reflecting the older age composition of the cohort. Assessment of living arrangements revealed that an overwhelming majority of participants (96.9%) resided with family members. Only 2.6% lived alone, and a negligible proportion (0.5%) were staying in a care facility.

Out of the total 193 participants, a substantial majority, 138 individuals (71.5%), were diagnosed with hypertension, while 55 participants (28.5%) did not have hypertension. This finding indicates a high prevalence of hypertension within the study cohort. Given that the population largely comprises individuals with long-standing diabetes mellitus and other vascular comorbidities, the coexistence of hypertension represents an important cardiovascular risk factor.

Its high burden has potential implications for disease progression, risk of macrovascular and microvascular complications, functional limitation, and overall quality of life among the participants. Clinical profiling based on duration of diabetes mellitus demonstrated that nearly half of the participants (49.7%) had diabetes for 16–25 years, followed by 28.5% with 26–35 years duration.

Those with 6–15 years duration constituted 14%, while smaller proportions had diabetes for 36–45 years (6.7%) and 0–5 years (1%).With respect to type of diabetes, the vast majority of participants had Type 2 diabetes mellitus (93.2%), whereas only 6.8% had Type 1 diabetes mellitus. Out of the total 193 participants, 65 individuals (33.7%) were diagnosed with CKD, whereas the majority, 128 participants (66.3%), did not have CKD.

This indicates that approximately one-third of the study population had concomitant chronic kidney disease, reflecting a considerable burden of renal comorbidity within the cohort. The coexistence of CKD is clinically significant, particularly in individuals with long-standing diabetes mellitus, as it may adversely influence functional status, rehabilitation potential, and overall quality of life outcomes. Overall, the table indicates that the study population was predominantly male, elderly, married, and living with family, with a high burden of long-standing Type 2 diabetes mellitus, factors that are important in interpreting functional outcomes and quality of life measures in the cohort.

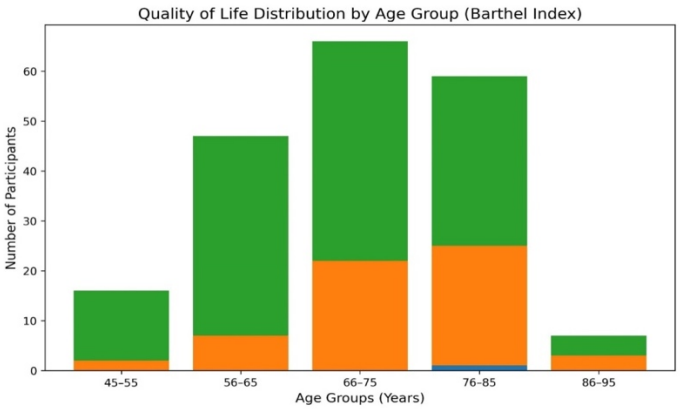

Figure 1: Quality of Life Distribution by age group (Barthel Index)

Figure 1 illustrates the distribution of study participants according to quality of life as measured by the Barthel Index. The majority of participants were categorized under moderate dependence (61–90 score range), accounting for 134 individuals (69.4%), indicating that most subjects retained partial functional independence in activities of daily living. This was followed by severe dependence (21–60 score range) comprising 58 participants (30.1%), reflecting a substantial proportion requiring considerable assistance. Only one participant (0.5%) fell within the total dependence category (0–20 score range), demonstrating profound functional limitation. Notably, no participants were classified under slight dependence (91–99 score range) in the present study cohort. Overall, the figure highlights that while extreme total dependence was rare, a large proportion of participants experienced moderate to severe functional impairment, underscoring the considerable burden of disability within the study population and the need for targeted rehabilitative and supportive care interventions.

Table 1: Association Between Quality of Life and Other Variables

	Quality of life (Barthel index)			**Chi Square/ Fischers Exact**	**P Value**
	1- Total Dependence	**2-Severe Dependence**	**3-Moderate Dependence**		
Demographic variables					
Gender					
Male	1	45	89	2.834*	0.242
Female	0	13	45		
Age					
45-55	0	2	14	17.575*	0.012
56-65	0	7	40		
66-75	0	22	44		
76-85	1	24	34		
86-95	0	3	4		
Marital Status					
Married	0	35	95	11.128*	0.131
Single	0	1	3		
Widow	1	22	32		
Divorced	0	0	3		
Employment Status					
Employed	0	6	41	11.877*	0.006
Retired	0	29	46		
Unemployed	1	23	47		
Living Arrangement					
Alone	0	0	5	7.601*	0.544
In Care Facility	0	0	1		
With Family	1	58	128		
Comorbidities					
Hypertension					
Yes	1	39	98	1.157*	0.633
No	0	19	36		
Necrotising Fascitis					
Yes	0	11	20	1.083*	0.601
No	1	47	114		
CKD				8.025*	0.009
Yes	0	28	37		
No	1	30	97		
CVA				3.386*	0.237
Yes	0	8	9		
No	1	50	125		
POVD				8.119*	0.014
Yes	1	16	19		
No	0	42	115		
Neuropathy					
Yes	0	3	24	6.301*	0.043

No	1	55	110		
Phantomlimb Pain				14.375*	0.006
Yes	1	50	85		
No	0	7	47		
Use of prosthesis				3.535*	0.114
Yes	0	23	36		
No	1	35	98		
Duration of diabetes mellitus				22.587*	0.034
0-5	0	0	2		
6-15	0	1	26		
16-25	0	33	63		
26-35	1	22	32		
36-45	0	2	11		
Frequency of need for medical assistance to manage daily Activities				47.662*	<0.001

Table 1 depicts the association between quality of life, as assessed by the Barthel Index, and selected demographic and clinical variables. With respect to demographic characteristics, age demonstrated a statistically significant association with quality of life ($\chi^2 = 17.575$, $p = 0.012$), with increasing age corresponding to higher levels of severe and total dependence, particularly among individuals aged 76–85 years. Employment status was also significantly associated ($\chi^2 = 11.877$, $p = 0.006$); unemployed and retired participants exhibited greater functional dependence compared to those who were employed. However, gender ($p = 0.242$), marital status ($p = 0.131$), and living arrangement ($p = 0.544$) did not show statistically significant relationships with quality of life.

Among comorbid conditions, chronic kidney disease demonstrated a significant association with poorer functional status ($\chi^2 = 8.025$, $p = 0.009$), with affected individuals showing higher proportions of severe dependence. Peripheral occlusive vascular disease was similarly associated with worse quality of life outcomes ($\chi^2 = 8.119$, $p = 0.014$). Neuropathy also showed a significant relationship ($\chi^2 = 6.301$, $p = 0.043$), indicating increased dependence among those affected. In addition, phantom limb pain emerged as an important determinant of reduced quality of life ($\chi^2 = 14.375$, $p = 0.006$). In contrast, hypertension ($p = 0.633$), necrotising fasciitis ($p = 0.601$), and cerebrovascular accident ($p = 0.237$) were not significantly associated with Barthel Index categories.

With regard to disease profile and rehabilitation variables, duration of diabetes mellitus demonstrated a statistically significant association with quality of life ($\chi^2 = 22.587$, $p = 0.034$), with longer disease duration corresponding to greater functional dependence. Although individuals using prostheses showed a relatively better distribution in moderate dependence, the association did not reach statistical significance ($p = 0.114$). Notably, the frequency of need for medical assistance to perform daily activities showed a highly significant association with quality of life ($\chi^2 = 47.662$, $p < 0.001$), indicating that individuals requiring more frequent assistance had markedly higher levels of severe and total dependence. Overall, the findings indicate that advancing age, adverse employment status, longer duration of diabetes, selected vascular and neurological comorbidities, phantom limb pain, and increased need for medical assistance are key determinants of poorer functional quality of life among the study participants, whereas gender, marital factors, living arrangement, and certain comorbidities did not demonstrate significant associations.

Discussion

The present study assessed functional quality of life among individuals with diabetes-related lower limb amputation using the Barthel Index and explored its association with selected socio-demographic and clinical determinants. The findings revealed a substantial burden of functional dependence, with the majority of participants experiencing moderate to severe limitations in activities of daily living. This pattern reflects the enduring disability associated with diabetes-related limb loss, even after surgical stabilization and wound healing. Similar functional dependence distributions have been documented in rehabilitation cohorts of lower limb amputees, where partial independence is achieved but assistance remains necessary for mobility and self-care.[12]

Advancing age emerged as a significant determinant of poorer functional quality of life in the present study. Participants in older age groups demonstrated higher levels of severe dependence. Age-related sarcopenia, reduced cardiopulmonary reserve, impaired balance, and slower rehabilitation adaptation contribute to diminished prosthetic mobility and functional recovery. Previous studies have consistently identified age as a strong predictor of post-amputation disability and reduced reintegration into independent living.[13]

Employment status also demonstrated a significant association with functional outcomes. Retired and unemployed individuals showed higher dependence levels compared to employed participants. Employment often reflects better premorbid functional capacity, financial stability, and social engagement, which facilitate access to rehabilitation and prosthetic services. Conversely, functional impairment following amputation may itself precipitate job loss, reinforcing the cyclical relationship between disability and socioeconomic vulnerability.[14]

Among clinical determinants, chronic kidney disease was significantly associated with poorer functional status. CKD commonly coexists with long-standing diabetes and contributes to anemia, muscle wasting, fatigue, and reduced endurance, thereby limiting rehabilitation participation. Studies have shown that diabetic amputees with renal impairment experience delayed functional recovery and higher disability scores.[15] Peripheral occlusive vascular disease also demonstrated a significant association with dependence in the present study. Vascular insufficiency compromises stump healing, increases contralateral limb risk, and restricts prosthetic training outcomes, thereby worsening quality of life.[16]

Neuropathy emerged as another significant determinant of functional impairment. Sensory loss and proprioceptive deficits impair balance and gait coordination, increasing fall risk and limiting prosthetic ambulation. Neuropathic pain further compounds disability. Evidence suggests that diabetic neuropathy is strongly associated with reduced mobility and poorer rehabilitation outcomes following amputation.[17] Phantom limb pain was also significantly associated with functional dependence in this study. Persistent phantom sensations and pain syndromes can restrict prosthetic use, impair sleep, and contribute to psychological distress, thereby diminishing overall functional independence.[18] Duration of diabetes mellitus demonstrated a significant relationship with functional quality of life, with longer disease duration associated with greater dependence. Chronic hyperglycaemia leads to cumulative vascular and neurological damage, increasing the likelihood of multisystem complications that hinder post-amputation recovery. Prior longitudinal studies have similarly reported worse functional trajectories among individuals with long-standing diabetes.[19] The frequency of need for medical assistance in performing daily activities showed the strongest association with functional quality of life. Individuals requiring frequent assistance exhibited markedly higher severe and total dependence. This finding is expected, as caregiving dependence directly reflects impaired functional autonomy. Comparable observations have been reported in functional assessment studies where caregiver reliance strongly correlated with lower Barthel and Functional Independence Measure scores.[20] In contrast, gender, marital status, living arrangement, hypertension, necrotising fasciitis, and cerebrovascular accident did not demonstrate statistically significant associations with functional quality of life in the present study. While these factors may influence psychosocial well-being, their direct effect on activities of daily living may be less pronounced than vascular, renal, and neurological complications. Similar non-significant associations have been reported in selected amputee QoL analyses.[21]

The findings of this study have important clinical and public health implications. The high burden of moderate to severe dependence underscores the need for integrated diabetic foot care programs that extend beyond surgical management to include structured rehabilitation, prosthetic services, pain management, and aggressive control of comorbidities. Early identification of high-risk individuals, particularly the elderly and those with renal or vascular disease may facilitate targeted interventions aimed at improving functional independence and overall quality of life.

Budget: Self

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