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DETERMINANTS OF DAILY LIVING ACTIVITIES IN AMPUTEES USING PROSTHETIC LIMBS

[1]*Mohammed Abed Mezher and [2]Nizar Abdulateef Jassim

[1]AL Hussain Military Hospital / Ministry of Defense, Baghdad, Iraq.
[2]University of Bagdad / College of Medicine, Baghdad, Iraq.

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***Corresponding Author: Mohammed Abed Mezher**
AL Hussain Military Hospital / Ministry of Defense, Baghdad, Iraq.

ABSTRACT

Background: Amputation and subsequent rehabilitation are complex processes influenced by a range of physical, psychological, social, and environmental factors. Adapting to a prosthesis can be particularly challenging for individuals with higher-level amputations. Comprehensive rehabilitation requires addressing physical concerns such as residual limb health, prosthesis fitting, and medical complications, as well as providing psychological and social support to enhance functionality and quality of life. **Aim:** This study aimed to evaluate daily living activities among prosthesis users using the Barthel Index and to identify key factors influencing their level of independence. **Methods:** A cross-sectional study was conducted at Sadr Al Qanat Center for Prosthetics and Medical Supports between January and May 2024, involving 101 amputees. Patients with neurological, muscular, rheumatologic, or cognitive disorders were excluded. Data were collected via structured interviews, including sociodemographic characteristics, amputation details, and Barthel Index assessments. Statistical analysis was performed using SPSS version 26, with significance set at $p < 0.05$. **Results:** The majority of participants were male (73.3%) with a mean age of 45 years. Trauma was the leading cause of amputation (69.3%), and most had lower limb amputations (86.1%). Full independence in daily activities was observed in 54.5% of participants. Significant factors associated with greater independence included younger age, male gender, higher education, employment, absence of comorbidities, proper prosthesis fitting, and participation in physiotherapy ($p < 0.05$). In contrast, diabetes, cardiovascular disease, back pain, and chronic swelling were linked to higher dependence. **Conclusion:** Effective rehabilitation—including physiotherapy and proper prosthesis fitting—substantially improves independence in daily living among amputees.

KEYWORDS: Daily, Living, Activities, Amputees, Prosthetic, Limbs.

INTRODUCTION

Amputation is a life-altering event that significantly impacts an individual's physical, psychological, social, and environmental well-being. The loss of a limb not only affects body image and mobility but also compromises the ability to carry out daily living activities (ADL), which are essential for personal independence and quality of life.[1] The use of prosthetic limbs has become a crucial part of post-amputation rehabilitation, aiding individuals in regaining function and autonomy. However, the successful reintegration of amputees into everyday life is influenced by a complex interplay of various factors that extend beyond the physical loss of a limb.

Physical factors are among the most direct determinants of ADL performance in amputees. The level and type of amputation significantly influence mobility and functionality. For example, individuals with above-knee or above-elbow amputations typically face more challenges in achieving independence compared to those with lower-level amputations.[2] Additionally, residual limb health, prosthesis fit, and secondary medical complications such as pain, ulcers, or skin breakdown further complicate rehabilitation outcomes. A well-fitted prosthesis that aligns properly with the residual limb can greatly enhance an individual's ability to perform daily tasks, while poor alignment or ill-fitting devices often lead to reduced usage and dependency.[2] Equally important are psychological factors. The emotional toll of limb loss—often manifesting as depression, anxiety,

or a diminished sense of self-worth—can hinder motivation and the capacity to engage in rehabilitative activities.[3] Supportive psychological counseling and therapy can help individuals cope with grief and foster a mindset conducive to recovery and adaptation. Moreover, the presence of mental resilience is often a distinguishing feature among amputees who regain high levels of independence. Social support systems also play a vital role in post-amputation recovery. Encouragement from family members, community engagement, and peer support have all been shown to positively influence an amputee's psychological state and capacity to adjust to prosthetic use.[4] Conversely, negative societal attitudes or stigmatization of disability can impede social integration and diminish the individual's willingness to participate in daily activities.[5] The presence or absence of these social factors can significantly affect outcomes in terms of ADL. Environmental and socioeconomic contexts are further layers of complexity. Accessibility to healthcare services, rehabilitation centers, and well-designed public infrastructure are key enablers of independence for prosthesis users. In regions like Iraq, infrastructural challenges can restrict mobility and limit access to essential resources.[6] Socioeconomic status also directly impacts the affordability and quality of prosthetic devices, physiotherapy, and continued medical care. Cultural practices and occupational demands may introduce unique challenges, especially for those attempting to return to traditional roles or physically demanding jobs.[6,7] Given these multidimensional factors, it is essential to comprehensively evaluate the determinants of daily living activities among amputees with prostheses. By using tools such as the Barthel Index, healthcare providers can quantitatively assess the level of independence and identify specific factors that either hinder or promote functional recovery. This understanding is crucial for tailoring rehabilitation strategies and informing health policies that aim to improve the overall quality of life for individuals living with limb loss.

Method

A cross-sectional descriptive study was conducted at the Sadr Al Qanat Center for Prosthetics and Medical Supports over a four-month period, from January 1 to May 1, 2024. This center is recognized for providing comprehensive rehabilitation services and individualized prosthetic solutions for amputees. The study aimed to assess activities of daily living (ADLs) among prosthesis users and identify factors influencing functional independence. The study population included 100 patients with upper or lower limb amputations who were using prosthetic devices. Inclusion criteria encompassed all patients with prostheses—both new and long-term users—attending the center during the study period. Exclusion criteria included individuals with neurological disorders (e.g., stroke, spinal cord injuries), systemic or muscular diseases affecting mobility and balance (e.g., multiple sclerosis, muscular dystrophies), cognitive impairments (e.g., advanced dementia or brain injury), and rheumatologic conditions (e.g., rheumatoid arthritis, lupus). Patients who declined to participate were also excluded. A convenience sampling method was used due to time constraints. Data were collected using a structured interview-based questionnaire divided into three sections: sociodemographic characteristics (age, sex, BMI, employment, education, and smoking status), amputation details (site, level, cause, prosthesis type, and duration of use), and clinical history including rehabilitation and prosthetic-related complications. Functional independence was assessed using the Barthel Index, which evaluates ten essential ADLs such as feeding, bathing, grooming, ambulation, and bladder/bowel control. Data on physical therapy attendance, prosthesis fit, and complications like phantom limb pain, ulcers, and assistive device usage were also recorded. Ethical approval was obtained from the Iraqi Scientific Council for Rheumatology and the Ministry of Health. All participants gave verbal consent. Data were coded and analyzed using SPSS version 26. Descriptive statistics included means ± SD for continuous variables and frequencies for categorical variables. Chi-square or Fisher's exact tests were used to assess associations, with $p < 0.05$ considered statistically significant.

RESULTS

Table 1 demonstrates significant associations between sociodemographic features and levels of independence post-amputation, measured by the Barthel Index. Younger patients (<40 years) and middle-aged patients (40–59) showed higher independence, while older patients (>60) were mostly dependent (p=0.0001). Males were more likely to be fully independent than females (p=0.004). Lower BMI was associated with greater independence (p=0.001). Employers had higher independence than unemployed individuals (p=0.009). Higher education correlated with more independence, with illiterate individuals showing the greatest dependence (p=0.0001). Smoking status showed no significant association with independence levels (p=0.482).

Table 1: Association of Sociodemographic Features with Barthel Index.

Sociodemographic Features	61-90 (Slight dependence) No. (%)	91-99 (Minimal dependence) No. (%)	100 (Fully independent) No. (%)	Mean ± SD	P-value
Age (Years)	2 (4.3%)	11 (23.9%)	33 (71.7%)		0.0001
Middle (40-59 y)	9 (29.0%)	1 (3.2%)	21 (67.7%)		
Old (> 60 y)	23 (95.8%)	0 (0.0%)	1 (4.2%)		
Mean ± SD (Age)				61.03 ± 11.598 / 32.83 ± 9.543 / 37.78 ± 9.514	0.0001
Sex: Female	16 (59.3%)	1 (3.7%)	10 (37.0%)		0.004
Sex: Male	18 (24.3%)	11 (14.9%)	45 (60.8%)		
BMI (kg/m²)				23.174 ± 2.24 / 21.183 ± 1.67 / 21.942 ± 1.46	0.001
Unemployed	34 (39.5%)	10 (11.6%)	42 (48.8%)		0.009
Employer	0 (0.0%)	2 (13.3%)	13 (86.7%)		
College grade	0 (0.0%)	2 (15.4%)	11 (84.6%)		0.0001
High grade	7 (17.9%)	7 (17.9%)	25 (64.1%)		
Middle grade	7 (30.4%)	2 (8.7%)	14 (60.9%)		
Primary grades	5 (50.0%)	1 (10.0%)	4 (40.0%)		
Illiterate	15 (93.8%)	0 (0.0%)	1 (6.3%)		
Smoking: No	16 (31.4%)	8 (15.7%)	27 (52.9%)		0.482
Smoking: Yes	18 (36.0%)	4 (8.0%)	28 (56.0%)		

Table 2 shows significant associations between comorbidity factors and Barthel Index scores. Diabetes mellitus, cardiovascular disease, and peripheral vascular disease were strongly linked to higher dependence levels (p-values = 0.0001, 0.0001, and 0.006, respectively). Most diabetic and cardiovascular patients were slightly dependent. Hypertension and respiratory conditions showed no significant association with independence (p-values = 0.440 and 0.655). Patients without these comorbidities were generally more independent. Notably, 74% of non-diabetics and 59.1% of those without cardiovascular disease were fully independent.

Table 2: Association of Comorbidity Factors with Barthel Index.

Comorbidity Factors	61-90 (Slight dependence) No. (%)	91-99 (Minimal dependence) No. (%)	100 (Fully independent) No. (%)	P-value
Hypertension: No	26 (31.4%)	9 (10.8%)	48 (57.8%)	0.440
Hypertension: Yes	5 (35.7%)	3 (21.4%)	6 (42.9%)	
Diabetes mellitus: No	8 (11.0%)	11 (15.1%)	54 (74.0%)	0.0001
Diabetes mellitus: Yes	26 (92.9%)	1 (3.6%)	1 (3.6%)	
Cardiovascular diseases: No	26 (28.0%)	12 (12.9%)	55 (59.1%)	0.0001
Cardiovascular diseases: Yes	8 (100.0%)	0 (0.0%)	0 (0.0%)	
Peripheral artery disease: No	29 (30.2%)	12 (12.5%)	55 (57.3%)	0.006
Peripheral artery disease: Yes	5 (100.0%)	0 (0.0%)	0 (0.0%)	
Respiratory system: No	33 (33.0%)	12 (12.0%)	55 (55.0%)	0.655
Respiratory system: Yes	1 (100%)	0 (0.0%)	0 (0.0%)	

Table 3 highlights significant associations between amputation-related variables and Barthel Index scores. Congenital causes of amputation resulted in 100% full independence, while diabetes-related and peripheral vascular disease causes were linked to high dependence (p=0.0001). Trauma-related amputations showed greater independence (74.3% fully independent). Lower limb amputees were more independent than upper limb amputees (57.5% vs. 35.7%, p=0.0001). Left-sided amputees had higher independence rates compared to right-sided ones, especially in the lower limb group. Transfemoral and transhumeral amputations were associated with greater dependence, while ankle disarticulation and transtibial amputations showed better independence. Overall, both the cause and anatomical level of amputation significantly influenced functional outcomes.

Table 3: Association of Amputation-Related Variables with Barthel Index.

Amputation-Related Variables	61-90 (Slight dependence) No. (%)	91-99 (Minimal dependence) No. (%)	100 (Fully independent) No. (%)	P-value
Cause: Congenital	0 (0.0%)	0 (0.0%)	2 (100.0%)	0.0001
Cause: Diabetes mellitus complication	23 (92.0%)	1 (4.0%)	1 (4.0%)	
Cause: Peripheral vascular disease	3 (100.0%)	0 (0.0%)	0 (0.0%)	
Cause: Trauma	8 (11.4%)	10 (14.3%)	52 (74.3%)	
Cause: Tumor	0 (0.0%)	1 (100.0%)	0 (0.0%)	
Amputation: Upper limb	2 (14.3%)	7 (50.0%)	5 (35.7%)	0.0001
Amputation: Lower limb	32 (36.8%)	5 (5.7%)	50 (57.5%)	
Side: Left lower limb	16 (29.6%)	1 (1.9%)	37 (68.5%)	0.0001
Side: Left upper limb	0 (0.0%)	3 (50.0%)	3 (50.0%)	
Side: Right lower limb	16 (48.5%)	4 (12.1%)	13 (39.4%)	
Side: Right upper limb	2 (25.0%)	4 (50.0%)	2 (25.0%)	
Level: Ankle disarticulation	1 (11.1%)	0 (0.0%)	8 (88.9%)	0.0001
Level: Knee disarticulation	0 (0.0%)	0 (0.0%)	2 (100.0%)	
Level: Partial foot	0 (0.0%)	0 (0.0%)	2 (100.0%)	
Level: Transfemoral	15 (51.7%)	4 (13.8%)	10 (34.5%)	
Level: Transhumeral	2 (28.6%)	5 (71.4%)	0 (0.0%)	
Level: Transradial	0 (0.0%)	2 (50.0%)	2 (50.0%)	
Level: Transtibial	16 (35.6%)	1 (2.2%)	28 (62.2%)	
Level: Wrist disarticulation	0 (0.0%)	0 (0.0%)	3 (100.0%)	

Table 4 reveals a strong correlation between K-levels and Barthel Index scores, indicating mobility-related independence. K1 and K2 patients were mostly slightly dependent (100% and 87.0%, respectively). K3 patients had mixed outcomes, with 60.0% slightly dependent and 13.3% fully independent. K4 patients demonstrated the highest independence, with 90.9% scoring fully independent. This trend shows increasing independence with higher K-levels. The association is statistically significant (p=0.0001).

Table 4: Association of K Levels and Barthel Index.

K Level	61-90 (Slight dependence) No. (%)	91-99 (Minimal dependence) No. (%)	100 (Fully independent) No. (%)	P-value
K1	5 (100.0%)	0 (0.0%)	0 (0.0%)	0.0001
K2	20 (87.0%)	3 (13.0%)	0 (0.0%)	
K3	9 (60.0%)	4 (26.7%)	2 (13.3%)	
K4	0 (0.0%)	4 (9.1%)	40 (90.9%)	

Table 5 highlights the relationship between Barthel Index scores and various daily living activities. Feeding, dressing, toilet use, transfers, mobility, and stair climbing all showed statistically significant associations with levels of independence (p=0.0001). Most patients were fully independent in feeding (56.7%), dressing (67.1%), and toilet use (62.5%). Transfers and mobility had high independence rates with 24.7% and 80.9% scoring full marks, respectively. Stairs revealed strong dependence, with all patients scoring 0 requiring full assistance. Grooming was the only activity with no significant association (p=0.134). Overall, daily activity performance strongly correlated with functional independence.

Table 5: Association of Barthel Index Scores Across Daily Living Activities.

Barthel Index Parameters	61-90 (Slight dependence) No. (%)	91-99 (Minimal dependence) No. (%)	100 (Fully independent) No. (%)	P-value
Feeding (10 points)	33 (34.0%)	9 (9.3%)	55 (56.7%)	0.0001
Feeding (5 points)	1 (25.0%)	3 (75.0%)	0 (0.0%)	
Grooming (0 points)	2 (100.0%)	0 (0.0%)	0 (0.0%)	0.134
Grooming (5 points)	32 (32.3%)	12 (12.1%)	55 (55.6%)	
Dressing (10 points)	21 (25.6%)	6 (7.3%)	55 (67.1%)	0.0001
Dressing (5 points)	13 (68.4%)	6 (31.6%)	0 (0.0%)	
Toilet use (10 points)	21 (23.9%)	12 (13.6%)	55 (62.5%)	0.0001

Toilet use (5 points)	13 (100.0%)	0 (0.0%)	0 (0.0%)	
Transfers (10 points)	10 (100.0%)	0 (0.0%)	0 (0.0%)	0.0001
Transfers (15 points)	22 (24.7%)	12 (13.5%)	55 (61.8%)	
Transfers (5 points)	2 (100.0%)	0 (0.0%)	0 (0.0%)	
Mobility (10 points)	29 (93.5%)	2 (6.5%)	0 (0.0%)	0.0001
Mobility (15 points)	3 (4.4%)	10 (14.7%)	55 (80.9%)	
Mobility (5 points)	2 (100.0%)	0 (0.0%)	0 (0.0%)	
Stairs (0 points)	18 (100.0%)	0 (0.0%)	0 (0.0%)	0.0001
Stairs (10 points)	2 (3.0%)	9 (13.6%)	55 (83.3%)	
Stairs (5 points)	14 (82.4%)	3 (17.6%)	0 (0.0%)	

Table 6 demonstrates key factors influencing independence among amputees, as measured by the Barthel Index. Post-prosthetic physiotherapy and well-fitting prostheses significantly improved independence ($p = 0.0001$). In contrast, complications like back pain, ulcers, chronic swelling, muscle weakness, and phantom sensations were associated with higher dependence ($p < 0.05$). Patients without assistive devices showed greater independence (64.0%), while all device users (cane, crutch, wheelchair) were fully dependent ($p = 0.0001$). Pre-prosthetic physiotherapy had no significant effect ($p = 0.144$).

Table 14: Association of Various Factors with Barthel Index Scores.

Barthel Index Parameters	61-90 (Slight dependence) No. (%)	91-99 (Minimal dependence) No. (%)	100 (Fully independent) No. (%)	P-value
Pre-prosthetic physiotherapy: No	2 (66.7%)	1 (33.3%)	0 (0.0%)	0.144
Pre-prosthetic physiotherapy: Yes	32 (32.7%)	11 (11.2%)	55 (56.1%)	
Post-prosthetic physiotherapy: No	27 (69.2%)	5 (12.8%)	7 (17.9%)	0.0001
Post-prosthetic physiotherapy: Yes	7 (11.3%)	7 (11.3%)	48 (77.4%)	
Prosthesis fitting: No	11 (73.3%)	4 (26.7%)	0 (0.0%)	0.0001
Prosthesis fitting: Yes	23 (26.7%)	8 (9.3%)	55 (64.0%)	
Back pain: No	33 (33.7%)	10 (10.2%)	55 (56.1%)	0.009
Back pain: Yes	1 (33.3%)	2 (66.7%)	0 (0.0%)	
Postural alignment: No	29 (30.2%)	12 (12.5%)	55 (57.3%)	0.006
Postural alignment: Yes	5 (100.0%)	0 (0.0%)	0 (0.0%)	
Ulcer: No	31 (31.6%)	12 (12.2%)	55 (56.1%)	0.048
Ulcer: Yes	3 (100.0%)	0 (0.0%)	0 (0.0%)	
Chronic swelling: No	30 (30.9%)	12 (12.4%)	55 (56.7%)	0.017
Chronic swelling: Yes	4 (100.0%)	0 (0.0%)	0 (0.0%)	
Excessive sweating: No	32 (34.8%)	12 (13.0%)	48 (52.2%)	0.280
Excessive sweating: Yes	2 (22.2%)	0 (0.0%)	7 (77.8%)	
Muscle weakness: No	30 (30.9%)	12 (12.4%)	55 (56.7%)	0.017
Muscle weakness: Yes	4 (100.0%)	0 (0.0%)	0 (0.0%)	
Contracture: No	31 (32.0%)	11 (11.3%)	55 (56.7%)	0.083
Contracture: Yes	3 (75.0%)	1 (25.0%)	0 (0.0%)	
Phantom sensation: No	34 (34.0%)	11 (11.0%)	55 (55.0%)	0.024
Phantom sensation: Yes	0 (0.0%)	1 (100.0%)	0 (0.0%)	
Residual limb pain: No	30 (30.9%)	12 (12.4%)	55 (56.7%)	0.017
Residual limb pain: Yes	4 (100.0%)	0 (0.0%)	0 (0.0%)	
Skin infection: No	33 (33.3%)	12 (12.1%)	54 (54.5%)	0.814
Skin infection: Yes	1 (50.0%)	0 (0.0%)	1 (50.0%)	
Assistive device: Cane	11 (100.0%)	0 (0.0%)	0 (0.0%)	0.0001
Assistive device: Crutches	2 (100.0%)	0 (0.0%)	0 (0.0%)	
Assistive device: No	19 (22.1%)	12 (14.0%)	55 (64.0%)	
Assistive device: Wheelchair	2 (100.0%)	0 (0.0%)	0 (0.0%)	

DISCUSSION

This study underscores the profound impact of limb amputation on individuals' quality of life and daily functioning, emphasizing the urgent need for targeted interventions to mitigate preventable causes such as trauma and diabetes. The high prevalence of amputations linked to these factors highlights the necessity for enhanced public health strategies and resource allocation to support this vulnerable population effectively. Investing in improved prosthetic care and comprehensive

rehabilitation services remains pivotal in optimizing outcomes and restoring independence.[8] Age significantly influenced independence levels, with younger patients (<40 years) demonstrating higher functional outcomes. This finding is consistent with prior research indicating better rehabilitation potential and fewer comorbidities in younger individuals.[9] Gender differences were also notable, with males exhibiting greater independence than females, potentially due to differences in physical capacity and societal expectations. These disparities mirror the findings of Zielonka et al., who reported similar trends in post-rehabilitation outcomes.[10] BMI also emerged as a relevant factor, with fully independent individuals having a lower mean BMI. Although higher BMI is traditionally viewed as a risk factor, Radityo et al. suggested it may offer protective benefits against functional decline in older adults, highlighting the nuanced relationship between body composition and mobility.[11] Socioeconomic indicators such as employment and education significantly impacted independence. Employed and college-educated individuals demonstrated higher levels of ADL autonomy, reinforcing the importance of occupational engagement and health literacy in rehabilitation success.[12-15] Medical comorbidities, particularly diabetes and cardiovascular diseases, were strongly associated with reduced independence. This finding is supported by Corrao et al. and Bryła et al., who emphasized the disabling effect of chronic diseases on functional capacity.[16-18] Additionally, congenital amputees showed greater independence, likely due to lifelong adaptation, whereas those with diabetes-related amputations showed marked dependency, as echoed by Augustina et al. and Dasanayaka et al.[19,20] Lower limb amputees, especially those with left-sided amputations, generally exhibited better independence, in agreement with Sonoda et al. and Rachmat et al.[21,22] Furthermore, patients with higher K-levels showed improved ADL performance, aligning with findings from Liu et al. and Serpa-Andrade et al., who linked mobility potential to functional recovery.[23,24] Activities like feeding, dressing, and mobility showed significant associations with overall independence, reinforcing observations by Ogura, Kong, and Tomita.[25-27] Finally, proper prosthetic fitting and physiotherapy substantially improved outcomes, while complications like back pain, ulcers, and swelling diminished functional independence, consistent with prior research.[28-32] These findings highlight the need for individualized, multidisciplinary rehabilitation plans and long-term follow-up for amputees.

CONCLUSION

Younger age and male gender were associated with higher independence levels.

Independence decreased significantly in patients with diabetes, cardiovascular, and peripheral vascular diseases. Traumatic lower limb amputations showed better outcomes than diabetic or upper limb amputations. Physiotherapy, proper prosthetic fitting, and absence of complications or assistive device use greatly enhanced independence.

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