EUROPEAN JOURNAL OF
MODERN MEDICINE AND PRACTICE
Vol. 6 No. 05 (May - 2026) EJMMP ISSN: 2795-921X

https://inovatus.es/index.php/ejmmp

CLINICAL EVALUATION OF AMPUTATION CAUSES AND REHABILITATION OUTCOMES AMONG IRAQI PATIENTS: A CROSS-SECTIONAL STUDY

Ali Ghalib Hussein
Baghdad Al-Rusafa Health Directorate, Al-Wasiti Educational Hospital

Zaid Fawzi Abdulmohsin Al-Karam
Al-Shaab Teaching Hospital / Baghdad Al-Rusafa Health Directorate

Ahmed Ayad Malallah
Al-Karkh General Hospital/Baghdad Al-Karkh Health Directorate

Abstract: Background: Limb loss in Iraq reflects two realities that often meet in the same clinics: a growing burden of chronic disease (particularly diabetes and peripheral arterial disease) and serious injuries related to road traffic events and explosive remnants of war. Yet, rehabilitation outcomes from private-sector settings in Baghdad are rarely described. **Objective:** To describe the clinical causes and levels of limb amputation and to examine rehabilitation outcomes among Iraqi patients receiving post-amputation care in private hospitals in Baghdad. **Methods:** We performed a cross-sectional study in three private hospitals in Baghdad (January–October 2025). Adults (≥18 years) with a major or minor upper- or lower-limb amputation in the previous 24 months were recruited consecutively from orthopaedic, vascular, and rehabilitation clinics. We combined patient interviews with medical-record review to document demographics, comorbidities, cause and level of amputation, time to rehabilitation, prosthesis access and use, physiotherapy exposure, common complications (residual limb pain, phantom pain, skin problems), and functional outcomes. Mobility was assessed using the Amputee Mobility Predictor with prosthesis (AMPPro) when applicable. We used descriptive statistics and multivariable logistic regression to identify factors associated with a favourable functional outcome (AMPPro ≥26 or independent community ambulation). **Results:** Among 220 participants (mean age 52.8 years; 71.4% men), diabetes-related foot complications (44.1%) and trauma (30.0%) were the leading causes of amputation. Most amputations were lower limb (82.7%), and the commonest major levels were transtibial (34.5%) and transfemoral (21.8%). Patients typically entered structured rehabilitation several weeks after surgery (median 7 weeks; IQR 4–14). The first fitting of a prosthetic leg for 58.7% of eligible lower-limb amputees occurred at an average of 5.5 months (IQR 3 - 9) after obtaining a prosthesis; 46.8% were determined by evaluation to have improved functionality at the final follow-up. The adjusted results indicate that

younger patients, those with transtibial level amputation, early initiation of rehabilitation, use of a prosthesis, and controlled di- abetes were associated with better functional outcome outcomes. **Conclusions:** The findings suggest that the predominant reason for amputations due to diabetes is the result of the amputated limb; therefore, there are also many more amputations associated with diabetes than due to trauma. Additionally, the delay between surgery and rehabilitation and prosthetic fitting varies from patient to patient. Therefore, improvements should be made in diabetic foot prevention programs and creating coordinated pathways for referrals of patients to rehabilitation services and prosthetic services for more timely rehabilitation to improve functional recovery.

Keywords: amputation; Iraq; Baghdad; diabetes mellitus; trauma; rehabilitation; prosthesis; functional outcome; cross-sectional study.

Introduction

Many individuals face a lengthy and challenging recovery period after losing an arm/leg. In these circumstances, they will often experience a significant overnight loss of mobility, and their ability to carry out their daily activities may require some adjustment (e.g., changing their routines at work and at home). In addition, lower-limb amputations often result from a combination of diabetes and peripheral vascular disease, whereas younger individuals are at risk for traumatic amputations resulting from high-energy injuries as a result of their geographic location. The quality of care provided after surgery will also determine whether a person can return to an active, productive lifestyle. Consequently, rehabilitation is not simply going to one "prosthesis appointment"; rather, rehabilitation is made up of multiple appointments that will focus on controlling pain and preventing the formation of contractures, as well as building strength and confidence in the patient; ultimately, if applicable, moving the patient toward prosthesis training and long-term follow-up care. Modern rehabilitation models for amputees incorporate a multidisciplinary team approach and the consistent use of clinical outcome measures to document each patient's progression and adjust treatment as necessary [1].

In Iraq, the continued loss of limbs reflects wider trends that impact the health of its citizens and their daily lives. Years of war have resulted in a significant increase in the number of traumatic amputations resulting from blast injuries, gunshot injuries and unexploded ordinance as a result of years of war and conflict. Simultaneously, the rise in non-communicable diseases amongst the ever-expanding urban population has coincided with the rise in the average age of people in these urban areas. Data from the International Committee of the Red Cross (ICRC), which is involved in assisting those who have lost limbs due to conflict, supports this trend by reporting that traumatic amputations are most frequently seen amongst the younger population, whereas non-traumatic amputations are more prevalent amongst older adults. A second major issue is timing; it is widely known that many patients arrive for rehabilitation visits long after they sustain an injury and many times following trauma throughout their recovery process.[2] Delays in coming for rehab will often cause patients to lose fitness/conditioning; develop stiffness in their joints and/or contractures; sustain multiple falls; experience ongoing pain; and develop other long-term complications related to their residual limbs, all of which can limit their ability to participate in activities at home and in the community.

These realities exist in a system of rehabilitation services that has struggled to keep up with demand for rehabilitation services. In Iraq, rehabilitation services have historically been described as limited due to a limited workforce and financial resources; however, there has been a significant expansion of rehabilitative service availability in Iraq since the 2003 invasion.[3] Moreover, there is now clear international guidance as to what the elements of successful prosthetics and orthotics programs should consist of; specifically, to be effective, prosthetics and orthotics services need to be integrated into the overall health system, delivered by a trained and competent team of professionals, supported through appropriate health system governance, adequate financing, reliable information systems and quality assurance.[4] With infrastructure and security pressures preventing patients from receiving continuous care through a series of referred health professionals, patients will likely experience multiple issues associated with receiving adequate, timely care including fragmented referral to providers of care; inconsistent access to key components of care (i.e., limb components); and difficulty getting follow-up care, regardless of the patient's desire to participate in receiving this care or not.[3]

Amputation due to complications of diabetes requires special consideration, given that most of these amputations are usually preventable. On a global scale, amputation as a consequence of diabetes is recognised as an important public health issue; however, the majority of the world population is not aware of the health difficulties and challenges associated with diabetic limb amputation as a result of a lack of research. Furthermore, there are increased mortality rates, and the associated costs of having to live with limb loss are very high, both in terms of economic and personal costs.

Iraq's public health reported that a number of modifiable factors in patients undergoing diabetic foot amputations—glycaemic control, disease duration, hypertension, dyslipidaemia, and body mass index—are significant risk factors for amputation due to diabetes.

In most instances, patients develop neuropathy and subsequent unnoticed injuries that progress to amputation over time as a consequence of developing ischemic, infective and eventually needing to surgically amputate due to delayed presentation.

Diabetic foot programmes with a systematic approach to assessing risk factors, initiating early vascular assessments, controlling infections, applying standardised wound care, and establishing pathways to escalate treatment should all help prevent amputations.

Traumatic amputations, as another variation of amputation, usually result from a sudden traumatic injury with significant energy and often require ongoing rehabilitation as a result of multiple surgeries, ongoing pain and psychological trauma associated with the return to a normal lifestyle and working again. The literature regarding the consequences of a traumatic amputation consistently notes high levels of ongoing pain (including phantom pains), emotional distress and decreased vocational functioning; however, coordinated rehabilitation will normally result in improved long-term outcomes and improved satisfaction.

Injuries sustained in military conflicts can be clearly defined due to the unique explosive mechanisms of injury associated with a limb; the data collected from Iraq-related military operations provide a clear example of the extent of the burden of major limb/vascular injuries sustained in combat. While military data may not completely simulate civilian practices, the data do provide an explanation for the need for a system of rehabilitative services in Iraq that combines the needs for treating patients with multiple injuries as well as patients with chronic conditions causing limb amputation.

Most previous research examining the care of individuals with limb amputations in Iraq has been focused on publicly supported services or programmes supported by humanitarian assistance. Conversely, there is limited published research on the health outcomes of patients treated in private hospitals in Baghdad; this is due in part to disparities in referral practices, access to diagnostic testing, and variations in the sources and financing of prosthetic devices. In some cases, access to consult with a specialist physician or therapist is available sooner through a private hospital. Due to the costs of prosthetic devices and supply chain issues in obtaining them, there can still be a delay in the provision of a prosthetic. Therefore, documenting outcomes to identify bottlenecks and improve the delivery of rehabilitation services is just as important to the research as it is an effective method for doing so. There are many evidence-based rehabilitation models that provide the basis for systematic outcome measurement for the express purpose of achieving this objective.

To accomplish this purpose, a cross-sectional study was conducted; its objectives were to answer two related questions regarding the care of individuals with amputation. The two primary objectives were to identify the characteristics of individuals who receive care after an amputation, as well as the outcomes of care for these individuals. In particular, we will assess the clinical diagnosis and anatomical location of limb amputation for Iraqi adult subjects along with their rehabilitation outcomes, which include function of physical mobility, function of the use of prosthetic devices, incidence of pain and skin complications, and participation as measured by return to work after experiencing an amputation. In addition, we will examine the factors that contribute to achieving the best functional outcomes following amputation. The specific focus of this portion of the analysis will be on factors that can be modified by the health care system, such as the time to initiate rehabilitation and the time post-amputation to provide a prosthetic device, as well as the clinical variables associated with diabetes control and the level of amputation. Identification of these factors will allow for better coordination of care between surgical and rehabilitation teams and will place greater emphasis on developing prevention programmes to prevent avoidable amputations due to diabetes-related complications.

Methodology

Study design and setting: In Baghdad, Iraq, we completed a cross-sectional study of facility-based orthopaedic/vascular surgical care and outpatient rehabilitation services at three private hospitals between 1 January 2025 and 31 October 2025. All three hospitals were selected because they perform amputations or receive post-operative referrals, provide rehabilitation follow-up care to patients who have undergone amputations, and maintain medical records that allow verification of operative details. To ensure confidentiality and compliance with site agreements, the hospitals will be referred to as Hospital A, Hospital B, and Hospital C.

Participants and eligibility criteria: We recruited adult patients (at least 18 years old) with a limb amputation (upper or lower limb, major or minor) who were attending one of the participating hospitals for follow-up care, rehabilitation, prosthetic care, or complication management. To help ensure reasonably accurate recall while still allowing capture of medium-term recovery, we limited study entry to patients whose most recent amputation occurred within the past 24 months. Exclusions from the study were for congenital limb absence, very distal digits or toe tips (which do not typically require formal rehabilitation), severe cognitive impairment or acute psychiatric instability (so they could not provide informed consent), and medically unstable patients at the time they were approached to participate.

Sampling and sample size: Consecutive sampling was employed. On clinic days, members of the research team screened people arriving for their appointments to determine whether they met the eligibility criteria and had not previously been enrolled in the study. A minimum of 200 participants was necessary to both estimate key proportions with an acceptable degree of accuracy and to carry out a multivariable analysis using a limited number of variables or predictors. A total of 220 participants had been recruited by the end of the study.

Data sources and variables: The dataset was created from 2 different but complimentary sources;: (1) statured research assistants conducting structured face-to-face structured interviews in Arabic to assess demographic data (i.e., age, gender, etc.), smoking history and rehabilitation experience (e.g., referral pathways to physiotherapy, number of physiotherapy sessions, training to use a prosthesis, and identified barriers), and (2) standardized chart abstraction to gather clinical data (i.e., date of amputation, side of amputation, level of amputation, reason for amputation, perioperative complications and accumulated comorbid conditions (e.g., diabetes, hypertension, high cholesterol, kidney disease, peripheral artery disease)) The sample for recipients of diabetes was extracted from the most current HbA1c within the past 6 months based on available data. When possible, the most recent height and weight data were used to calculate body mass index. When it was not possible to calculate body mass index, the most recent available sex, height and weight data were used.

Classification of amputation cause and level: By referencing operative notes and specialist documentation, we categorized the primary cause of amputation into one of the following six groups: (1) complications of diabetes resulting in diabetic foot (e.g. ulcer/gangrene/infection); (2) peripheral vascular disease without diabetes; (3) trauma (e.g. road traffic collision/industrial accident/firearm injury/explosives/land mines); (4) tumour; (5) infection not related to diabetes; or (6) other or unknown cause. For patients with more than one diagnosis contributing to their amputation, we classified the primary cause according to a pre-existing hierarchy that prioritises the most immediate reason for surgery (for example, if someone with a diabetic foot ulcer went into septic shock, the amputation would be classified as being diabetes-related). Lower limb amputations were coded according to anatomic site, as follows: partial foot (e.g. transmetatarsal/ray), ankle disarticulation, transtibial (below knee), knee disarticulation, transfemoral (above knee), hip disarticulation/hemipelvectomy. Upper limb amputations were coded according to anatomic site, as follows: partial hand, transradial, elbow disarticulation, transhumoral, shoulder disarticulation/forequarter. Major amputations were defined as occurring above the ankle or wrist (lower limb or upper limb, respectively).

Rehabilitation exposure measures: In order to evaluate the care pathway, we focused on time-sensitive variables that could affect recovery: (a) length of time from surgery until first structured rehabilitation appointment (in weeks), (b) amount of physiotherapy ‘dose’ in 8 weeks before this appointment (none, 1 to 3 sessions – 4 or more sessions) and (c) status of prosthetic limb among participants with major lower limb amputation (not required/not eligible – required but have not received – received but not currently using – received and currently using). For those who received a prosthesis, we recorded how long it took to be fitted with it (in months), how long they normally wear the prosthetic limb each day, and whether they received supervised gait training.

Post-amputation complications: We assessed two common pain syndromes—residual limb pain and phantom limb pain—using patient report (present in the past 7 days: yes/no) and a 0–10 numeric rating scale for average intensity. Residual limb skin problems were recorded as none, redness/irritation, ulceration/breakdown, or infection requiring treatment. Where routine clinical measurements were available, contracture severity was categorized as none/mild (<10°), moderate

(10–20°), or severe (>20°), based on goniometric estimation documented by physiotherapists during standard care.

Functional and participation outcomes: For participants currently using a lower-limb prosthesis, mobility was measured with the Amputee Mobility Predictor with prosthesis (AMPPro), administered by trained physiotherapists using a standardised approach. For participants not using a prosthesis, we described function using the highest mobility level achieved over the prior 2 weeks: non-ambulatory/wheelchair-dependent, household ambulation with aids, or community ambulation. For those employed before amputation, return-to-work status was categorised as returned to the same job, returned with modifications, or not returned. To capture day-to-day participation in a simple way, we also recorded whether the patient could leave home independently, whether personal activities of daily living could be completed without assistance, and the perceived benefit of rehabilitation on a 5-point Likert scale.

Primary outcome: We defined favourable functional status at the time of assessment. For current prosthesis users, a favourable outcome was AMPPro ≥26 (broadly consistent with at least moderate mobility suitable for community ambulation, with variable supports). For participants not using a prosthesis and for those with minor amputations, a favourable outcome was defined as independent community ambulation (with or without a walking aid). As a secondary outcome, we examined prosthesis acquisition among participants with major lower-limb amputation who were judged eligible for fitting by the treating team.

Training, pilot testing, and data quality assurance: Research assistants (physiotherapy graduates) completed a 2-day training programme focused on eligibility screening, informed consent, interviewing, chart abstraction, and privacy procedures. We piloted the questionnaire with 15 amputee patients at a non-participating clinic to improve clarity and flow; pilot responses were excluded from the final dataset. To reduce data-entry errors, 10% of forms were double-entered, and discrepancies were resolved by checking the source documents. Variables that could not be verified in charts were labelled as “self-report only” and were used primarily for descriptive reporting rather than as core predictors in regression analyses.

Ethical considerations: Ethics approval was obtained from the participating hospitals. All participants provided written informed consent. When possible, interviews were conducted in private rooms to protect confidentiality. We de-identified data using unique study codes; the linkage key was stored separately on an encrypted device accessible only to the principal investigator. Patients were informed that participation was voluntary, that refusal would not affect their care, and that they could withdraw at any time. If a patient reported uncontrolled pain or significant psychological distress, the research team informed the treating clinician of the need for further assessment and management.

Statistical analysis: We analyzed data using standard statistical software. Categorical variables are presented as frequencies and percentages, and continuous variables as mean (standard deviation) or median (interquartile range), depending on distribution. We compared participants with favourable versus non-favourable outcomes using chi-square tests for categorical variables and t-tests or Mann–Whitney U tests for continuous variables. To explore factors independently associated with favourable outcome, we built a multivariable logistic regression model using predictors selected a priori for clinical relevance: age, sex, diabetes status (and HbA1c category among those with diabetes), smoking status, cause of amputation (diabetes-related vs trauma vs other), amputation level (transtibial vs transfemoral/other major vs minor/upper limb), time to rehabilitation initiation (≤6 weeks vs >6 weeks), and current prosthesis use (yes/no) among eligible lower-limb amputees.

We assessed collinearity using variance inflation factors and reported adjusted odds ratios (aORs) with 95% confidence intervals (CIs). Regression analyses used complete-case methods; missingness for key variables is reported in the Results.

Results

The study period lasted from the participant's survival to death. During this time period, 238 people were screened; 220 were enrolled based on eligibility criteria determined at the time of participation. The mean age of all persons enrolled in this study was 52.8 years, with a standard deviation of 14.9 years. The largest group of persons were males at 71.4%. The largest percentage of amputated persons reported lower leg amputations (82.7%). Fifty-five people had major limb amputations and made up 66.4% of the enrolled participants. Of the participants enrolled on this study, 52.7% had diabetes. Of the participants who had diabetes, 79.3% had a recent HbA1c value. Table 1 provides the baseline characteristics of participants enrolled in the study. The two largest causes of amputations among the participants were related to diabetes or caused by trauma. The percentage of persons who underwent amputation as a result of peripheral artery disease (PAD) and did not have diabetes was 10.9%. The participants who underwent transtibial (34.5%) and transfemoral (21.8%) amputations among enrolled participants with major transmodel lower extremities comprised 182 of 238 participants enrolled.

Characteristic	**n (%) or mean ± SD**
Participants	220
Age (years)	52.8 ± 14.9
Male sex	157 (71.4)
Lower-limb amputation	182 (82.7)
Major amputation (proximal to ankle/wrist)	146 (66.4)
Diabetes mellitus (documented)	116 (52.7)
Hypertension (documented)	102 (46.4)
Dyslipidaemia (documented)	78 (35.5)
Current smoker	64 (29.1)
Employed before amputation	143 (65.0)

In many cases, patients experience delays between their surgeries and their rehabilitation. The average patient sees a physiotherapist between four and fourteen weeks post-op; the average for any given patient is seven weeks, and fewer than half see their physiotherapist within six weeks of their surgery. Recent experiences with physiotherapists have also varied significantly. Of the patients who saw their physiotherapists, about one-quarter (22.3%) reported no visits in the past eight weeks, while 38.6% reported four or more visits. Among patients who had lower-limb amputation, about one-half attempted to be fitted for a prosthetic, and of those fitted, 82.4% were using the prosthetic at assessment. Patients who received prosthetics experienced delays of 3 to 9 months before being fitted; the median time from surgery to successful fitting was 5.5 months.

Table 2. summarizes causes, levels, and rehabilitation access indicators.

Domain	Category	n (%)
Primary cause of amputation	Diabetes-related foot complications	97 (44.1)
	Trauma	66 (30.0)
	Peripheral arterial disease (non-diabetic)	24 (10.9)
	Tumour	9 (4.1)
	Infection (non-diabetic)	12 (5.5)
	Other/unknown	12 (5.5)
Lower-limb level (n=182)	Partial foot	41 (22.5)
	Ankle disarticulation	7 (3.8)
	Transtibial	63 (34.6)
	Knee disarticulation	9 (4.9)
	Transfemoral	40 (22.0)
	Hip/hemipelvectomy	22 (12.1)
Time to rehabilitation	≤6 weeks	92 (41.8)
	>6 weeks	128 (58.2)
	Median (IQR), weeks	7 (4–14)
Prosthesis status (eligible major lower-limb, n=126)	Obtained and currently using	61 (48.4)
	Obtained but not using	13 (10.3)
	Indicated but not obtained	52 (41.3)
	Median (IQR) time to first fitting, months (among obtained)	5.5 (3–9)

As of the assessment date, 46.8% of measured individuals were determined to have good functional ability. Among the 61 individuals using a prosthetic who completed the AMPPro assessment, the median score was 27 (interquartile range = 23–31), indicating that many individuals were able to perform tasks associated with community ambulation, but there was also substantial variability among individuals. Observations of symptoms that could negatively impact rehabilitation included: 46.4% of individuals had indicated they experienced residual limb pain within the past week; 42.7% had indicated they experienced phantom limb pain; almost 1/3 (32.3%) of individuals indicated or had documentation regarding the presence of skin problems related to the residual limb; and 8.2% had indicated they had some form of ulcer/hole on the surface of their residual limb. Working after an amputation remains a challenge. Among individuals employed prior to amputation (n=143), 43.4% of individuals were working in some capacity after amputation.

Table 3. summarizes key outcomes and adjusted associations with favourable function.

Outcome / Predictor	**Value**
Favourable functional outcome	103/220 (46.8%)
AMPPro score among current prosthesis users (n=61), median (IQR)	27 (23–31)
Residual limb pain (past 7 days)	102 (46.4%)
Phantom limb pain (past 7 days)	94 (42.7%)
Any residual limb skin problem	71 (32.3%)
Ulceration/breakdown	18 (8.2%)
Returned to work (any capacity) among pre-amputation employed (n=143)	62 (43.4%)
Adjusted associations with favourable outcome (multivariable logistic regression)	
Age (per 10-year increase)	aOR 0.72 (95% CI 0.58–0.88)
Rehabilitation initiation ≤6 weeks	aOR 1.89 (95% CI 1.05–3.40)
Current prosthesis use (eligible lower-limb)	aOR 2.76 (95% CI 1.34–5.69)
Transtibial level (vs transfemoral/other major)	aOR 2.11 (95% CI 1.03–4.34)
Uncontrolled diabetes (HbA1c ≥8%, among diabetics with value)	aOR 0.54 (95% CI 0.30–0.98)

Discussion

Baghdad's private hospitals show some gains, & patients get specialized pieces of medical equipment, so they can move more easily after getting prosthetics; however, diabetes is still a major reason why people are having their limbs amputated, which is contributing to an ongoing flow of amputations coming into Baghdad's hospitals. In addition, the transition from being an amputee through surgery into rehabilitation is not going well and is very slow. In our sample, less than half of the patients were evaluated & were doing okay when we evaluated them for function. There are also a large number of patients experiencing pain as well as problems with their skin. These types of events happening in hospitals are similar to how patients get treated in other post-conflict countries, where access to rehabilitation and prostheses is often inconsistent or delayed.[2,3]

Causes of amputation: diabetes remains the dominant cause of amputations at this time, and therefore, there continues to be a great deal of trauma around the day. Diabetes type-two foot health problems were the most common reason for patients having their legs amputated in this study, and appear consistent with the global trend that the leading causes of lower-extremity limb loss are diabetes and vascular disease.[5] Research in countries around Iraq indicates that the same pattern exists in regard to patients having their legs amputated for diabetes.[9] In addition, the findings of this study identify several other modifiable risk factors amongst diabetic foot disease amputees that

lead to amputations, such as poorly regulated diabetes, high/very high blood pressure, high/very high cholesterol, and high body mass index.[6] Further analysis of our data suggests that diabetics with poor metabolic control (A1c ≥8.0%) tend to have poorer functional outcomes post-amputation. As well as being financially/socioeconomically related to diabetes, there is also a clinical significance given that poor metabolic control directly affects the healing process, increases the incidence of infections, & contributes to recurring skin breakdowns; thus, interrupting therapy & limiting the time a patient can tolerate their prosthesis; as well as eroding the patient's confidence to be able to walk.

In addition to diabetes as the dominant cause of amputations, trauma accounted for about 30% of the amputations, illustrating that Baghdad has both a high incidence of diabetes and trauma occurring at the same time. Trauma is a contributing factor in amputation cases among younger individuals who are exposed to environments influenced by war and trauma[7]. Data from the ICRC in Iraq indicate that there is a high number of traumatic amputations, and the time to get to rehabilitation services has been cited as an issue[2]. Our data indicate that private hospitals do not automatically address these delays either. When prosthetic clinics are accessible, patients still have to obtain their own components to build a prosthesis (generally through private insurance) and contend with transportation issues and variable referral practices. Previous research in Iraq on rehabilitation services has documented that both the labour force and financial resources are limited in all areas of operational capacity[3].

Amputation Level and Functional Recovery. The level of amputation impacts function; distal amputations provide a longer arm (lever) from which to walk, are typically less taxing (energetically) for walking, providing greater opportunity for successful gait training and mobilising in community settings. As per the results of our logistic regression modelling, transtibial amputees have been associated with higher rates of successful functional outcomes than those with proximal major amputations; this is consistent with previous reports that have documented lower physical function and quality of life in individuals with proximal amputations[10]. From the perspective of the clinical services system, shared decision-making between the surgeon and rehabilitation personnel is critical in determining limb length. When a limb can be preserved without compromising infection control or tissue viability, this substantially increases the patient's functional potential.

Timing of Rehabilitation – The timing of the initiation of rehabilitation was associated with whether functional outcomes were improved when rehabilitation started within six (6) weeks of the amputation. Evidence-based methods supporting immediate post-operative management, progressive strengthening and balance training, and structured preparation for prosthetic training support this statement. The practical implications here are obvious: if patients do not participate in mobility and/or strengthening early on, the compounding will be cumulative. Some of these consequences would include: loss of strength/conditioning, development of contractures, fear of moving due to pain and/or loss of ability to perform basic activities, or increased difficulty in obtaining/progressing through the prosthetic training process.

Additionally, the timing of rehabilitation services is not only a patient-focused issue but also depends on several other factors, such as the timing of discharge planning, referral patterns, appointment availability and accessibility, and the costs associated with rehabilitation. Hospitals can change pathways within these areas to reduce preventable delays (waiting) in services.

Acquisition and Use of Prostheses. Access to prosthetic devices was one of the strongest positive predictors of function in the sample. In general, when prostheses are properly fitted, are used with formal gait training, and the proper skill and resources are provided to retrain the patient in their use of the device, it allows the patient to increase functional mobility, provide others with the ability to be less dependent on others for assistance (i.e., caregiver assistance), and provide the opportunity for the patient to work outside of the home/community. WHO guidelines emphasise that prosthetic services should be delivered through a framework of professionals and a combination of resources, technology, and rehabilitation services, with follow-up care/integration with rehabilitation.

Given the constraints that Iraq faces (human and physical) with resources and workforce, it is probable that there will also be a significant impact of the shit of the quality of the prosthetic device and the subsequent fitting of the prosthesis to the patient on the quality of care provided to patients. When looking at this and the sample, the overwhelming majority of eligible patients did not receive a prosthetic device (in the sample), and even for the 30+ patients who did receive a prosthetic device, the fitting occurred several months after the patient's surgical index. To reduce this friction, private hospitals would benefit from developing reliable referral relationships with prosthetic manufacturers/providers, utilising case management to track each patient, and incurring the necessary costs to begin the prosthetic consultation process early (based on when the patient's residual limb will be ready for fitting).

Pain and Residual Limb Health. Individuals experienced skin issues and discomfort, which likely contributed to differences in patient experiences. Nearly half of patients recognised at least some form of residual limb discomfort, as well as a greater than 40% chance of experiencing phantom pain (both of which are common following traumatic or nontraumatic amputation). Both residual limb discomfort and phantom limb discomfort can cause problems sleeping, suffering from poor mood, inconsistently tolerating a prosthesis, and not participating in rehabilitation therapy. One-third of participants experienced skin problems; some had developed clinically significant ulcers or skin breakdown. Skin problems do not constitute a "minor complication;" they can halt prosthetic usage altogether, necessitate multiple trips to the prosthetist's office, and deter walking. To adequately address residual limb care as part of rehabilitation, practitioners should incorporate regular limb monitoring, thorough education on daily skin inspection and socket hygiene, and immediate access to prosthetic adjustments when discomfort is experienced, rather than waiting until skin breakdown is evident.

Returning to work and re-engaging in the workforce remain challenging for this dataset of individuals; fewer than 50% of those previously employed continue to work in that capacity. However, it is important to understand that re-entering the workforce is not solely about gait speed or balance; numerous other aspects, such as lack of associated transportation availability, lack of workplace flexibility, lack of job availability, pain management, and support from family members, all play an integral role in one's ability to return to work following an amputation. Quality data from the region show that social support and community reintegration are often fundamental to how individuals live with limb loss over time. In addition, there is much more to meeting the needs of people experiencing limb loss than only meeting their basic physical recovery needs.[11] While clinical care is primarily delivered through the private hospital system, private hospitals can play a significant role in strengthening the pathway to services by providing patients with referrals to vocational counselling (when available), documenting functional limitations to enable workplace accommodations, and linking patients to community resources [12][13][14][15].

Implications for Preventing and Planning Services. The large number of amputations resulting from diabetes makes one message clear: preventing amputations and recovering from them must be seen

as part of the same continuum. Private hospitals in Baghdad can help strengthen diabetic foot services through routine screening to assess risk, patient education, rapid access to care for infected ulcers, timely evaluation of the vascular system, and comprehensive reviews of complicated cases.[5,6] At a systemic level, increasing the degree to which private hospitals are in line with the WHO standards would create clear referral pathways, develop financing systems that will reduce out-of-pocket costs associated with acquiring prostheses and obtaining physiotherapy, develop the workforce that provides services related to the care of patients with limb loss, and develop basic outcome assessment systems.[4] Despite their lack of control over national policy, private hospitals may revise their local patient pathways and use outcome data collected as part of routine practice to develop systems to improve quality.

Limitations

Several factors limit the interpretation of these findings. The design of this study is cross-sectional and does not allow causal conclusions to be drawn from the findings. For example, a patient is more likely to successfully obtain and use a prosthesis if he/she has recovered from surgery; conversely, a patient who develops a complication after surgery may cease to use the prosthesis. The study was limited to three private hospitals in Baghdad, and, therefore, the results may not apply to other governorates or to the public health care system. There are numerous variables that must be self-reported, and some participants with diabetes mellitus did not have HbA1c data available for inclusion in the study. Only current prostheses users received the AMPPro; future studies should include measures of function for individuals who do not use prostheses. Despite these limitations, the insights gathered from this study are valuable and provide a foundation for improvement, especially in the areas of earlier initiation of rehabilitation and timeliness in receiving appropriately fitted prostheses.

Conclusion

In the private hospitals of Baghdad, diabetes-related foot disease accounted for the largest share of amputations; trauma accounted for a substantial number as well. Most patients entered rehabilitation late, waited months to obtain a prosthesis, and achieved less than half of the designated functional status at the time of assessment. Earlier initiation of rehabilitation and current use of prosthesis had a positive correlation with functional status, while previous episodes of uncontrolled diabetes were correlated with negative outcomes. To improve outcomes for patients with limb loss, it is imperative to develop pathways for prevention upstream (robust diabetic foot pathways to decrease avoidable amputations) and to develop efforts for downstream coordination of surgical services, rehabilitation services, and prosthetic services to ensure that all patients follow an orderly, integrated pathway after limb loss.

References

[1] R. S. Gailey, N. Kirk-Sanchez, S. Clemens, A. Symsack, and I. Gaunaurd, “Evidence-based amputee rehabilitation: A systematic approach to the restoration of function in people with lower limb loss,” *Current Physical Medicine and Rehabilitation Reports*, vol. 10, pp. 1–15, 2022, doi:10.1007/s40141-021-00335-2.

[2] C. A. Barth, A. Wladis, C. Blake, P. Bhandarkar, S. Aebischer Perone, and C. O'Sullivan, "Retrospective observational study of characteristics of persons with amputations accessing ICRC rehabilitation centres in five conflict and postconflict countries," *BMJ Open*, vol. 11, no. 12, p. e049533, 2021, doi:10.1136/bmjopen-2021-049533.

[3] J. Faber and P. Saggurthi, "Physical rehabilitation services in Iraq," *The Lancet*, vol. 381, no. 9870, pp. 881–883, 2013, doi:10.1016/S0140-6736(13)60323-2.

[4] World Health Organization, *WHO Standards for Prosthetics and Orthotics*. Geneva, Switzerland: WHO, 2017.

[5] M. Bharara, J. L. Mills, K. Suresh, H. L. Rilo, and D. G. Armstrong, "Diabetes and landmine-related amputations: A call to arms to save limbs," *International Wound Journal*, vol. 6, no. 1, pp. 2–3, 2009, doi:10.1111/j.1742-481X.2009.00587.x.

[6] N. S. M. Hassan, "Risk factors for diabetic foot amputation in sample of Iraqi patients," *National Journal of Clinical Orthopaedics*, vol. 3, no. 3, pp. 36–39, 2019, doi:10.33545/orthor.2019.v3.i3a.159.

[7] Z. B. Perkins, H. D. De'Ath, G. Sharp, and N. R. M. Tai, "Factors affecting outcome after traumatic limb amputation," *British Journal of Surgery*, vol. 99, Suppl. 1, pp. 75–86, 2012, doi:10.1002/bjs.7766.

[8] J. M. White, A. Stannard, G. E. Burkhardt, B. J. Eastridge, L. H. Blackbourne, and T. E. Rasmussen, "The epidemiology of vascular injury in the wars in Iraq and Afghanistan," *Annals of Surgery*, vol. 253, no. 6, pp. 1184–1189, 2011, doi:10.1097/SLA.0b013e3182148ae5.

[9] R. Al Agha, H. Muneer, A. AlQaseer, T. Ismaeel, and O. Badr, "Major lower limb amputation: Causes, characteristics and complications," *Bahrain Medical Bulletin*, vol. 39, no. 3, pp. 159–161, 2017.

[10] M. Alfatafta, H. Alfatafta, A. Alshawabka, H. Atallah, and A. McGarry, "Quality of life among lower limb prosthetic users in Jordan: A cross-sectional study using the Arabic SF-36," *Frontiers in Rehabilitation Sciences*, vol. 6, p. 1665006, 2025, doi:10.3389/fresc.2025.1665006.

[11] N. Abouammoh, W. Aldebeyan, and R. Abuzaid, "Experiences and needs of patients with lower limb amputation in Saudi Arabia: A qualitative study," *Eastern Mediterranean Health Journal*, vol. 27, no. 4, pp. 407–413, 2021, doi:10.26719/emhj.20.124.

[12] S. G. Pinzur, "Functional outcome following traumatic lower-extremity amputation," *Journal of the American Academy of Orthopaedic Surgeons*, vol. 7, no. 6, pp. 358–365, 1999.

[13] J. E. Meikle, M. Devlin, and S. Garfinkel, "Psychological distress and quality of life in persons with limb loss: A systematic review," *Clinical Rehabilitation*, vol. 16, no. 7, pp. 773–782, 2002, doi:10.1191/0269215502cr555oa.

[14] M. Esquenazi, "Amputation rehabilitation and prosthetic restoration. From surgery to community reintegration," *Disability and Rehabilitation*, vol. 26, no. 14–15, pp. 831–836, 2004, doi:10.1080/09638280410001708850.

[15] D. G. Smith, J. W. Michael, and J. H. Bowker, Eds., *Atlas of Amputations and Limb Deficiencies: Surgical, Prosthetic, and Rehabilitation Principles*, 4th ed. Rosemont, IL, USA: American Academy of Orthopaedic Surgeons, 2016.