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# DEMOGRAPHICS AND CLINICAL CHARACTERISTICS OF MAJOR LIMB AMPUTATION IN PATIENTS REPORTING TO HELPING HAND INSTITUTE OF REHABILITATION SCIENCES, MANSEHRA, PAKISTAN: A RETROSPECTIVE RECORD-BASED CROSS-SECTIONAL STUDY (2022-2024)

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## ABSTRACT

***Background:*** *Major limb amputation (MLA) is a life-changing surgical intervention often performed for trauma, advanced disease, or irreversible limb damage. Understanding the frequency, pattern, and underlying indications is essential for targeted prevention and rehabilitation strategies.*

***Objective:*** *To determine the frequency, pattern, and indications of MLA among patients in the last 2 years, presenting to the Helping Hand Institute of Rehabilitation Sciences (HHIRS), Mansehra, Pakistan.*

***Methods:*** *A retrospective record-based cross-sectional study was conducted at HHIRS, Mansehra, Pakistan for a time period of 2 years, from January 2022 to December 2024. All patients with Major Limb Amputation meeting the inclusion criteria were recruited. Data on demographic variables, amputation level, and etiological factors were extracted from institutional records and analysed using SPSS v.27 to generate frequency distributions and cross-tabulations.*

***Results:*** *A total of 79 patients underwent MLA during the study period were included through convenient sampling. Lower limb amputations accounted for the majority of cases (92.4%), with below-knee amputation being the most frequent level (69.6%), followed by above-knee amputation (22.8%). Males were more commonly affected than females (84.8% vs. 15.2%). The most affected age group was between the 4th and 6th decades of life. Trauma was the predominant cause of MLA (44.3%), followed by diabetes mellitus (25.3%), peripheral vascular disease (5.1%),*

*tumours (5.1%), and other causes including road traffic accidents, gunshot injuries, burns, falls, and earthquake-related injuries.*

***Conclusion:*** *MLA is more prevalent among males, with the lower limb, particularly the below-knee level being most frequently affected. Trauma remains the leading cause, followed by diabetes. Prevention strategies should focus on injury reduction, diabetic foot care, and vascular disease management.*

***Keywords:*** *Diabetes mellitus, epidemiology, major limb amputation, peripheral vascular disease, Pakistan, trauma.*

## INTRODUCTION

Limb amputation is defined as the removal of a limb or part of a limb from the body, either surgically or as a result of trauma (1). It is one of the oldest surgical procedures in medical history, dating back approximately 2,500 years to the era of Hippocrates(2). Historically, amputations have been performed for various reasons, including punishment, therapeutic purposes, and as treatment for severe injury or disease(3). Evidence suggests that the practice of amputation for medical treatment was present in ancient Egypt(4). Amputations are classified as major or minor. Major limb amputation refers to the removal of a limb above or below the elbow, or above or below the knee. Minor amputations involve the removal of digits (fingers or toes) or parts of the hand or foot (5). The level of amputation is determined by the site of removal and is influenced by factors such as the extent of injury or disease, vascular status, and potential for rehabilitation(6). Each amputation level requires specific surgical considerations, particularly in relation to neurovascular structures(7).

Globally, the incidence of limb amputation varies due to differences in trauma prevalence, disease patterns, and healthcare systems. In developed countries, peripheral vascular disease is the leading cause of amputation, whereas in many developing countries, trauma remains predominant (8, 9). The overall prevalence of amputation is difficult to determine in low- and middle-income countries due to the absence of reliable registries(10). In the United States, an estimated 185,000 limb amputations occur annually, with lower extremity amputations being more frequent than upper extremity amputations(11). Approximately 80–90% of lower limb amputations in these settings are related to vascular disease (12). In developing countries, the etiological profile differs, with trauma, infections, and malignancies contributing significantly to amputation rates(13). Studies have reported that trauma is a frequent cause of limb amputation in countries such as Korea, Saudi Arabia, and in regions of sub-Saharan Africa(14). Non-traumatic causes, particularly diabetes mellitus, also contribute substantially. Diabetic patients face a 15–20 times higher risk of limb amputation compared to non-diabetics, with peripheral neuropathy, infection, and ischemia being major contributing factors (15). In Pakistan, the prevalence of diabetes is high(16), and amputation rates due to diabetes are elevated due to delays in referral, lack of awareness regarding foot care, and limited access to specialized care(17). Additionally, conflict-related injuries and natural disasters, such as bomb blasts and earthquakes, have further increased the incidence of traumatic amputations in recent years in the country(18, 19).

Major limb amputation has significant social, psychological, and economic implications. In resource-limited settings, the absence of adequate rehabilitation facilities often results in long-term disability, loss of independence, and reduced quality of life for amputees(20, 21). Understanding the frequency, patterns, and indications for amputation is critical for guiding prevention strategies, improving patient outcomes, and informing healthcare policy. Literature shows limited studies done on amputation and its causes. However, despite high rates of amputations in Pakistan, data on MLA in Pakistan is limited, particularly in the northern regions. This study was conducted to determine the frequency, pattern, and indications of major limb amputation among patients reporting to the Helping Hand Institute of Rehabilitation Sciences (HHIRS), Mansehra, Pakistan.

## Material and Methods

This study was a retrospective, record-based cross-sectional study, conducted in accordance with the STROBE guidelines for observational research conducted at Helping Hand Institute of Rehabilitation Sciences (HHIRS), Mansehra, Pakistan, a specialized rehabilitation facility serving patients from Mansehra and surrounding districts. The objective of the study was to assess the frequency, pattern, and indications of major limb amputation among patients reporting to the HHIRS, Mansehra. The study was carried out at Data were collected from the medical records of the registered patients from past two-years, from January 2022 to December 2024. Convenience sampling was used. All patients meeting the inclusion criteria during the study period were included. Inclusion criteria were set to patients of all age groups and genders with major limb amputations registered at HHIRS during January 2022 to December 2024, while patients presenting for stump revision, having incomplete medical records, and with minor limb amputations were excluded from the study. To proceed the study, ethical approval was obtained from the Institutional Research Board (IRB) of the affiliated institute. Following institutional approval, an official request was submitted to the head of HHIRS for access to patient records. Data collection was conducted on-site over fourteen consecutive days, supervised by clinical staff. Registered patient files were reviewed, and relevant information including demographic details, level of amputation, and underlying aetiology was extracted and recorded on a structured proforma developed in consultation with the study supervisor. Data were analysed using SPSS v27. Descriptive statistics were used to summarize frequencies and percentages for categorical variables. Cross-tabulations were performed to explore relationships between demographic factors, amputation levels, and etiological causes.

## Results

| Statistic | Value |
|---|---|
| Mean | 42.4 years |
| Standard Deviation | 9.23 years |
| Median | 50 years |
| Mode | 50 years |
| Minimum | 17 years |
| Maximum | 66 years |

**Table 1 Descriptive Statistics of Age of the participants**

A total of 79 patients met the inclusion criteria for this study. The mean age of the participants was 42.4±9.23 years with median age of 50 years (Table 1)., and Figure 2 showing the distribution of MLA by gender of the participants in HHIRS, Mansehra. The demographic profile presented in table 2 shows us that majority of amputations occurred in the 41-60 years age group (40.5%), followed by those aged 21–40 years (35.4%).

Shown in figure 1, Lower limb amputations were far more common than upper limb amputations. Below-knee amputation (BKA) was the most frequent level (69.6%), followed by above-knee amputation (AKA) (22.8%). Below-elbow amputations accounted for 3.8% of cases, while other levels made up 3.8%. Males accounted for 84.8% of the cases, with females representing 15.2% (see figure 2).

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age group (years) | 0–20 | 7 | 8.9% |
| | 21–40 | 28 | 35.4% |

| | | | |
|---|---|---|---|
| | 41–60 | 32 | 40.5% |
| | 61–80 | 12 | 15.2% |
| **Gender** | Male | 67 | 84.8% |
| | Female | 12 | 15.2% |
| **Amputation level** | Below elbow | 3 | 3.8% |
| | Above knee | 18 | 22.8% |
| | Below knee | 55 | 69.6% |
| | Others | 3 | 3.8% |

**Table 2 Demographic characteristics of patients undergoing major limb amputation at HHIRS, Mansehra**

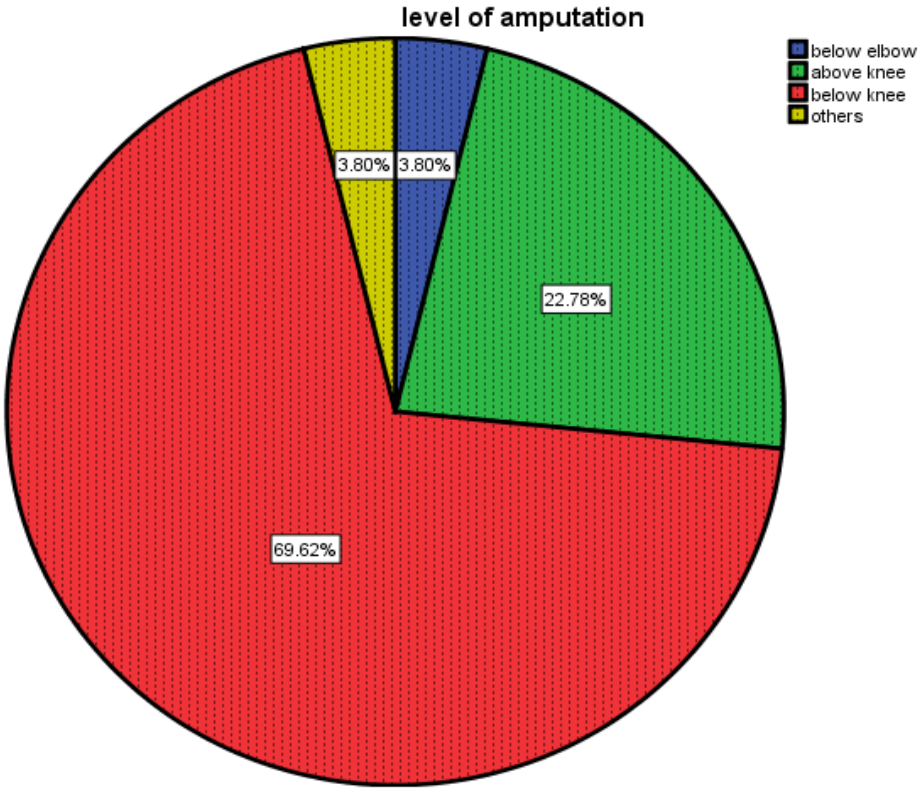


**Figure 1 Proportion of major limb amputations by anatomical level at HHIRS, Mansehra.**

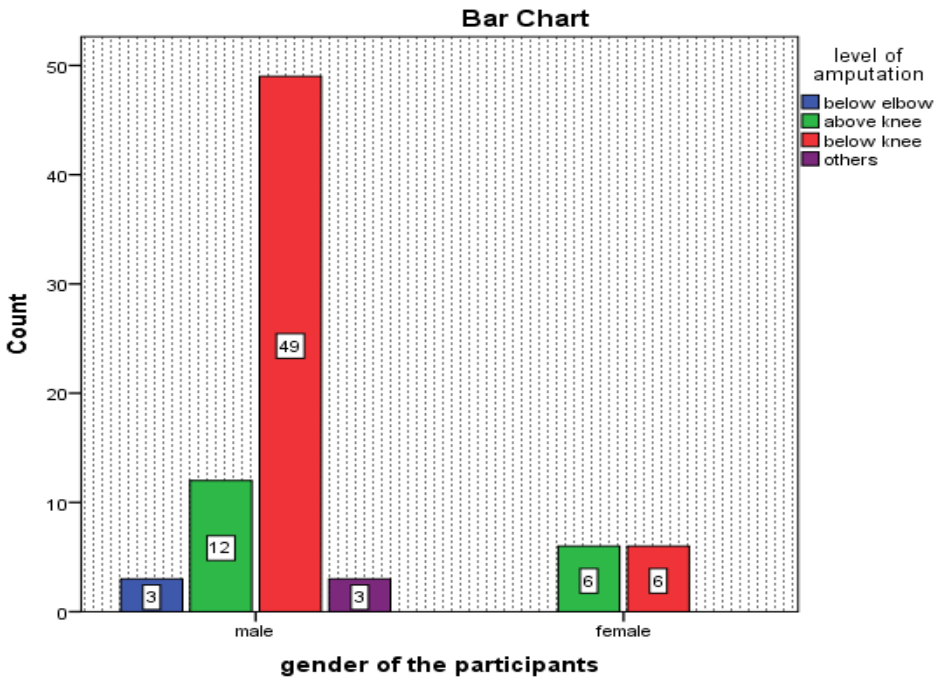


**Figure 2 Gender-wise distribution of amputation levels among patients at HHIRS, Mansehra.**

Trauma was the most common cause of major limb amputation, accounting for 44.3% of cases. Within this group, BKA was the predominant level (n = 23), followed by AKA (n = 7), below-elbow (n = 2), and other levels (n = 3). Diabetes mellitus was the second leading cause (25.3%), with BKA observed in 16 cases and AKA in 4 cases. Peripheral vascular disease (PVD) was responsible for 5.1% of amputations, most of which were at the BKA level. Road traffic accidents (RTA) accounted for 11.4% of amputations, with BKA being the most frequent. Tumors were responsible for 5.1% of amputations, with an equal distribution between AKA and BKA. Earthquake-related injuries accounted for 2.5% of cases, both involving BKA (Please refer to table 3, figure 3).

| Aetiology / Cause | Below Elbow (n) | Above Knee (n) | Below Knee (n) | Others (n) | Total (n) | Percentage (%) |
|---|---|---|---|---|---|---|
| Trauma | 2 | 7 | 23 | 3 | 35 | 44.3% |
| Diabetes mellitus | 0 | 4 | 16 | 0 | 20 | 25.3% |
| Peripheral vascular disease (PVD) | 0 | 1 | 3 | 0 | 4 | 5.1% |
| Road traffic accidents (RTA) | 1 | 2 | 6 | 0 | 9 | 11.4% |
| Tumors | 0 | 2 | 2 | 0 | 4 | 5.1% |
| Earthquake injuries | 0 | 0 | 2 | 0 | 2 | 2.5% |

**Table 3 Distribution of etiological factors and their association with amputation levels among patients at HHIRS, Mansehra**

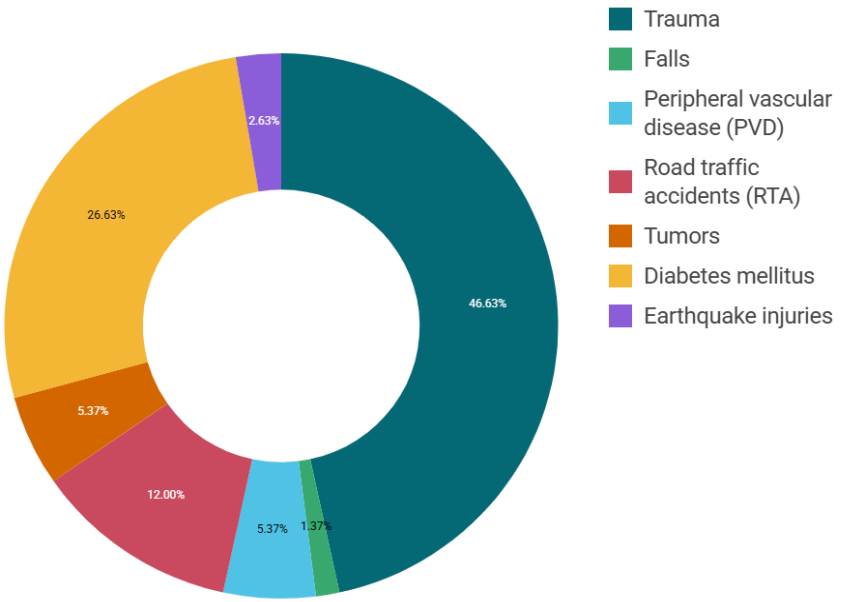


**Figure 3 Pie chart of Distribution of etiological factors and their association with amputation levels among patients at HHIRS, Mansehra**

Among specific injury types, Bomb blast injuries represented 12.7% of trauma-related amputations, predominantly at the BKA level. Gunshot injuries accounted for 2.5% of cases, both at AKA level, while burns and falls each accounted for 1.3% of cases (see table 4, figure 4).

| Aetiology / Cause | Below Elbow (n) | Above Knee (n) | Below Knee (n) | Others (n) | Total (n) | Percentage (%) |
|---|---|---|---|---|---|---|
| Bomb blast injuries | 0 | 1 | 9 | 0 | 10 | 12.7% |
| Gunshot injuries | 0 | 2 | 0 | 0 | 2 | 2.5% |
| Burns | 0 | 0 | 1 | 0 | 1 | 1.3% |
| Falls | 0 | 0 | 1 | 0 | 1 | 1.3% |

**Table 4 Distribution of Anatomical level of amputation by specific types of injuries among patients at HHIRS, Mansehra**

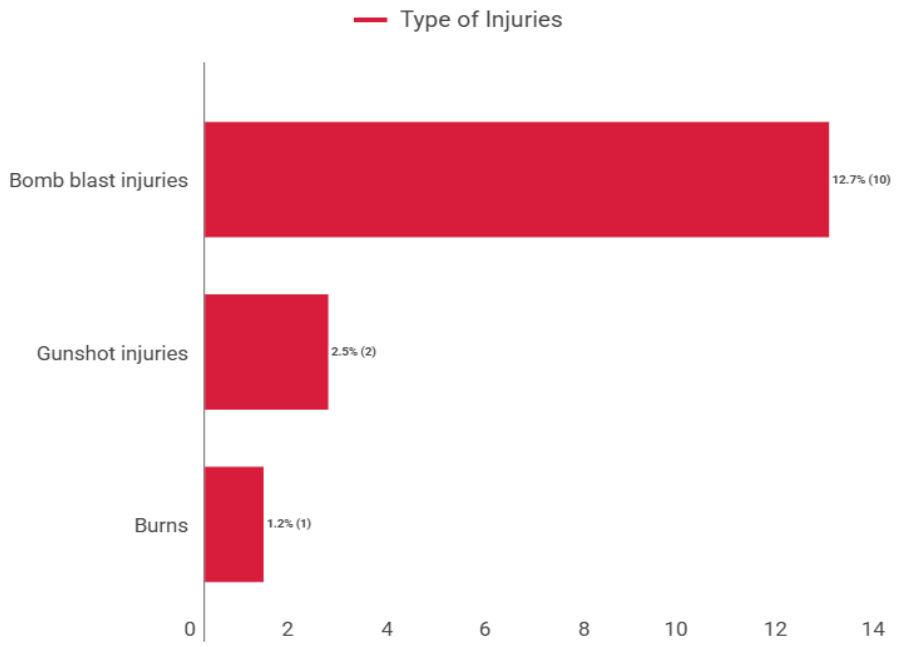


**Figure 4 Distribution of Anatomical level of amputation by specific types of injuries among patients at HHIRS, Mansehra**

## Discussion

This descriptive cross-sectional study assessed the frequency, pattern, and indications of major limb amputation (MLA) among patients at HHIRS, Mansehra, over a two-year period. The findings show that MLA was more common among males than females (84.8% vs. 15.2%), with the majority occurring between the 4th and 6th decades of life. Lower limb amputations predominated, particularly below-knee amputation (BKA), which accounted for nearly 70% of cases.

The male predominance observed in this study is consistent with reports from Iran, Nigeria, and other developing countries, where rates range from 55.9% to over 65%(22, 23). This trend is often attributed to higher male involvement in occupations and activities with greater risk of trauma. Trauma emerged as the leading cause of MLA (44.3%), followed by diabetes mellitus (25.3%). These findings differ from many studies in developed countries, where peripheral vascular disease and diabetes are the primary causes. However, they are consistent with data from Iran, Turkey, and west Africa, where trauma remains a major contributor(24-27). The high trauma rates in our study may reflect local risk factors such as road traffic accidents, occupational hazards, and conflict-related injuries, including bomb blasts and gunshots. Diabetes, the second most frequent cause in our cohort, aligns with regional and international literature emphasizing its role in non-traumatic amputations. Poor glycemic control, late presentation, and limited access to specialized diabetic foot care services contribute to the high amputation burden in Pakistan(28). Peripheral vascular disease accounted for 5.1% of amputations, which is lower than figures from developed countries, again reflecting the dominance of trauma in our setting(29).

Tumor-related amputations (5.1%) in our study were less frequent compared to the 14.2% and 32% reported in some African countries (30, 31). The lower proportion may be due to earlier detection and alternative limb-salvage interventions in our population. Earthquake-related injuries were rare (2.5%), consistent with previous disaster-related amputation studies that report rates below 1% in large-scale events. Age distribution patterns in our study showed the highest incidence in the 41-60 years age group, which contrasts with some previous reports where younger adults (17–49 years) predominate(32, 33).

This difference may reflect variations in local trauma epidemiology, healthcare access, and chronic disease prevalence. The predominance of BKA over AKA observed in our study mirrors trends in both developing and developed settings, likely due to the functional advantages of knee preservation, including improved gait efficiency, balance, and prosthetic use. The higher rate of lower limb amputations overall is consistent with global patterns, reflecting the greater vulnerability of the lower extremities to both vascular compromise and trauma(32, 34).

These findings have important public health implications. Reducing trauma-related amputations will require improved road safety measures, occupational hazard mitigation, and conflict injury prevention. Addressing diabetes-related amputations demands early detection programs, public education on foot care, and accessible multidisciplinary management. Longitudinal studies should be conducted to track the incidence and causes of major limb amputations, enabling better resource allocation.

## Conclusion

Major limb amputation in this study was more frequent among males, with the majority of cases occurring between the 4th and 6th decades of life. Lower limb amputations predominated, particularly at the below-knee level. Trauma was the leading cause, followed by diabetes mellitus and peripheral vascular disease. These findings highlight the need for targeted preventive strategies, including improved trauma prevention measures, road safety initiatives, and comprehensive diabetic foot care programs. Expanding access to rehabilitation and prosthetic services is essential to improve functional outcomes and quality of life for amputees in this region.

## Policy Level Recommendations

1. Regional trauma prevention programs, including road safety campaigns and workplace hazard awareness should be established for awareness.
2. Personalized Diabetic foot care clinics in primary and secondary healthcare facilities should be established to allow early detection and management of high-risk feet.
3. Improve public awareness about limb health and early medical consultation in cases of injury, infection, or vascular compromise.
4. Prosthetic and rehabilitation services in public sector facilities should be established to improve post-amputation functional outcomes.

## Limitations of the study:

This study was conducted in a single rehabilitation centre, which may limit the generalizability of the findings to other regions. The retrospective design depended on the completeness and accuracy of existing medical records, which may introduce information bias. Additionally, the study period was limited to two years, and seasonal or annual variations in amputation causes could not be assessed.

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