Evaluation of Sports Prostheses and Functional Adaptations in Lower Limb Amputees of Rahim Yar Khan, Pakistan

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Received: 09-07-2025 **Revised:** 20-08-2025 **Accepted:** 15-09-2025 **Published:** 09-10-2025

ABSTRACT

Amputation of the lower limb can significantly affect an individual's mobility, social interactions, and both physical and mental well-being. While regular exercise and sports participation are known to positively influence these aspects in healthy individuals, amputees often experience long-term physical impairments and temporary or permanent mobility loss. To engage in sports activities, such individuals commonly rely on assistive technologies such as prosthetic limbs, wheelchairs, or crutches. This study employed a cross-sectional design to observe and evaluate the routine physical activities of lower limb amputees, focusing on their use of sports prostheses and their adaptation over time and varying levels of activity intensity. Data were collected from four focus groups comprising a total of 45 participants. The findings revealed that trauma was the leading cause of amputation (77.8%), followed by congenital conditions (11.1%). A higher incidence of amputation was recorded between 2015 and 2022 (44.4%) compared to 33.3% during 2007–2014. The most common level of amputation was trans-tibial (44.4%), followed by trans-femoral (33.3%) and Syme foot (11.1%). Most participants reported no significant discomfort while using prosthetic limbs; however, a subset did experience issues such as pain or difficulty in movement.

Keywords: *amputation, lower limb, cross sectional study, prostheses*

INTRODUCTION

Amputation of a limb, particularly the lower extremity, can result in long-term physical disability and temporary or permanent loss of mobility (Webster et al., 2012). Beyond physical impairment, limb loss profoundly affects psychological well-being, emotional health, social interaction, and overall quality of life (Gallagher et al., 2021). Numerous studies emphasize the role of physical activity and sports participation in improving these aspects among able-bodied individuals and, more significantly, among

amputees (Hutzler et al., 2019. Lower limb amputees benefit considerably from innovative mobility solutions, especially prosthetic devices tailored for recreational or competitive sports (Nolan, 2008).

The most common causes of amputation include trauma, vascular diseases, congenital deformities, and malignancies (Ziegler-Graham et al., 2008). In the United States, approximately 82% of limb amputations are due to vascular conditions, while trauma accounts for 16%; the remaining cases result from congenital conditions, infections, or cancer-related surgeries (Dillingham et al., 2015).

This study evaluates the sports participation and prosthetic adaptation experiences of athletes with lower limb amputations. Prior research suggests that young athletes with unilateral transtibial amputations often outperform those with bilateral trans femoral amputations in sports (Bragaru et al., 2013). Despite the level of amputation, many individuals continue engaging in leisure and sports activities (Radtka et al., 2016). While sports prosthetics are commonly associated with elite athletes, many users remain unaware of accessible recreational facilities (Jaarsma et al., 2014). Devices like the Smart Leg incorporate actuators and fluid modules to assist movement, enabling stair climbing and incline walking (Windrich et al., 2016).

Participating in sports with prosthetics supports physical rehabilitation and fosters emotional healing. Many amputees report regaining a sense of identity through sports. However, most sports prostheses are visibly mechanical, composed of carbon plates and metal structures, which may not harmonize aesthetically with the human form (De Bressy de Guast et al., 2021). Injury rates among amputee athletes are comparable to non-disabled players, particularly in high-impact sports (Fagher et al., 2016). Physical activity is associated with improved psychological well-being, justifying sports-based rehabilitation in post-discharge care (Tasiemski et al., 2004).

To explore limb loss's effects on social engagement, a structured questionnaire was distributed to 45 individuals with lower limb amputations. Participants under age 35 reported reduced social participation post-amputation, with leisure activities shifting from cycling and team sports to passive tasks (Rybarczyk et al., 2004). In the Netherlands, 60% of lower limb amputees participate in sports, yet data on prosthetic adaptation remain limited.

Modern prosthetic designs prioritize comfort, safety, and functionality (Highsmith et al., 2016). Recent innovations claim performance advantages over natural limbs, though ethical scrutiny is needed (Burkett, 2010). This research underscores the need to legitimize prosthetic inclusion in competitive sports (Gavron & DePauw, 2005).

Study Objectives:

1. To assess functional outcomes of lower limb prostheses (Syme Foot, Transtibial Prosthesis) in competitive settings.
2. To evaluate barriers to sports participation among lower limb amputees.

MATERIALS AND METHODS

Research Design

The researcher used a descriptive research design for this study. The cross-sectional survey method enabled the collection of data at a single point in time, allowing for the examination of current practices, perceptions, and experiences of prosthesis users.

Data were collected through structured questionnaires, focusing on participants' physical activity routines and the impact of prosthetic use over time and varying intensities of sports engagement.

Population and Sample of the Study

The target population consisted of individuals of different age group with amputees, from Rahim Yar Khan and Turkey Hospital, Muzaffargarh. A conveniently selected sample consisting of 45 individuals

participated in the study. Participants were surveyed to assess their physical activity levels, experience with sports prostheses, and general health records post-amputation.

Instrumentation

Data were gathered using a structured self-made questionnaire administered to an accessible population. The sample included both individuals who actively used sports prosthetics and those who had undergone lower limb amputation but were not currently using prosthetic devices. The instrument was designed to capture diverse experiences, including those of individuals with prior sports involvement and those without.

Validity and Reliability

The instrument's validity was ensured through expert review, while reliability of the instrument was assessed through applying cronbach-alpha method to assess the internal consistency of the items.

Data Analysis

Collected data were analysed using SPSS version 21. Descriptive statistics, including frequencies and percentages, were used to summarize the findings and identify key trends within the study population.

Result

Table.1 Mean of function of Lower Limbs (the table in opposite direction)

		Did you play sports before the amputation?	When did you have your lower limb amputated?	What is the reason for the amputation?	What is the degree of amputation?
N	Valid	45	45	45	45
	Missing	0	0	0	0
Mean		1.11	21.89	7.33	3.89
Std. Deviation		.318	.745	.674	1.005
Variance		.101	.556	.455	1.010
Range		1	2	2	3

The study examined the impact of sports prostheses on individuals with lower limb amputations, focusing on their lifestyle, mobility, and physical activity patterns. Data were collected from 45 participants, with 88.9% (n = 40) reporting prior sports engagement before amputation. The majority of amputations (77.8%) resulted from trauma, followed by congenital causes (11.1%). Most participants underwent transtibial amputation (44.4%) or transfemoral amputation (33.3%). Prosthetic use was prevalent, with 55.6% relying on prosthetic legs, while 22.2% used wheelchairs or crutches. Social reasons (77.8%) were the primary motivation for prosthesis adoption. Post-amputation, 33.3% of participants engaged in sports twice monthly, though 33.3% reported no recent sports activity. Key barriers included locomotion difficulties (33.3%) and pain/rashes (22.2%). Descriptive statistics (mean, SD, variance) and visualizations (Figures 1–6, Tables 1–5) underscored trends in amputation timing (44.4% occurred during 2015–2022) and prosthetic utility. Overall, prostheses facilitated athletic reintegration for many, but adaptation challenges persisted for a subset (Table 1-3)

Table 2 Frequency of prosthetic use, sports participation, and reported hindrances (N = 45).

		What is the reason of prostheses?	What kind of prosthetic aid you use while performing any kind of activity?	How often have you played sports the past six months?	Which complain hinder you from participation in sports?
N	Valid	45	45	45	45
	Missing	0	0	0	0
Mean		3.89	11.78	11.78	18.56
Std. Deviation		1.005	1.042	1.042	1.179
Variance		1.010	1.086	1.086	1.389
Range		3	3	3	3

Analysis of Frequency Table 2 indicates that the majority of participants experienced no major difficulties after being fitted with prosthetic devices. For many, prostheses significantly enhanced their ability to resume sports activities following their amputation, enabling them to pursue their athletic interests and, in some cases, even consider careers in sports. However, a subset of individuals reported discomfort or difficulty in adapting to the prosthesis, which led them to discontinue sports participation altogether. A total of eight key variables related to prosthetic use and sports engagement were selected for graphical representation. Descriptive statistical analysis, including mean, standard deviation, median, and variance, was applied to interpret the data collected from the study sample (Figure 1).

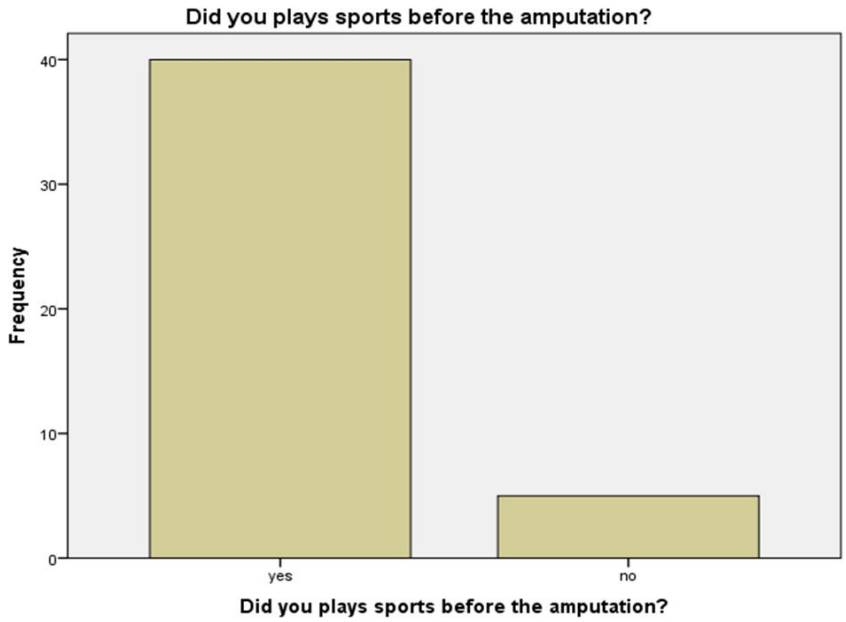

Figure 1 Bar chart showing distribution of amputation cases among participants

Table 3 Pre-amputation sports participation among respondents (N = 45)

Did you play sports before the amputation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	40	88.9	88.9	88.9
	No	5	11.1	11.1	100.0
	Total	45	100.0	100.0	

In this study, data were collected from 45 individuals with lower limb amputations. Among them, 40 participants (88.9%) reported that they actively participated in sports prior to their amputation, while only 5 participants (11.1%) indicated no involvement in sports before their limb loss. These results, as illustrated in the corresponding table and graph, clearly demonstrate that a significant majority of the amputees had a history of sports participation before their amputation. The high frequency of pre-amputation sports activity suggests a strong athletic inclination among the study population, which may influence their motivation to remain physically active post-amputation (Figure 2-3).

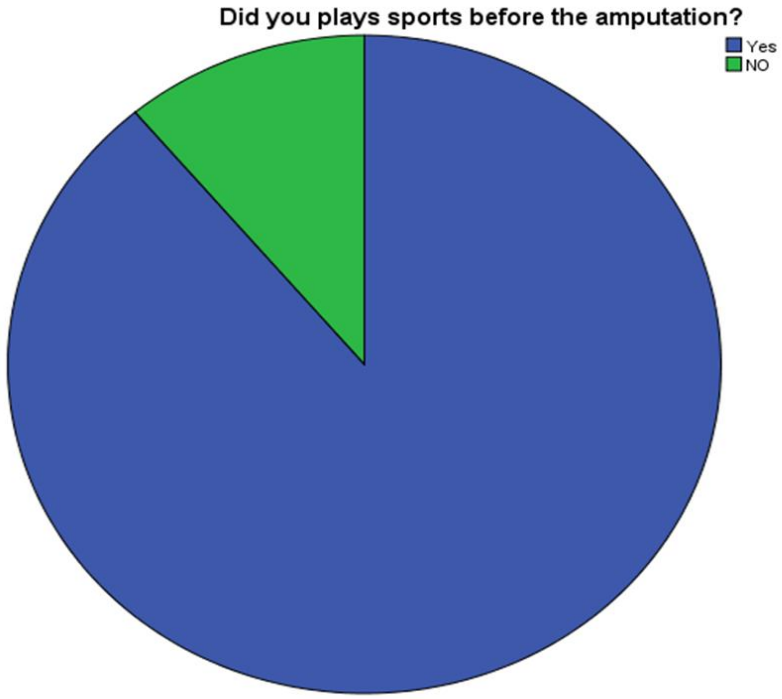

Figure 2: Pie chart of pre-amputation sports participation (yes/no)

Figure 3 Bar chart of lower limb amputation timing (2007–2014, 2015–2022, none

Table 4 Distribution of lower limb amputation timing (N = 45)

When did you have your lower limb amputated?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2007- 2014	15	33.3	33.3	33.3
	2015-2022	20	44.4	44.4	77.8
	NO AMPUTATION	10	22.2	22.2	100.0
	Total	45	100.0	100.0	

According to the results obtained, the rate of amputation has been higher in 2015-2022, i.e. during 2015-2022; about 44% of the people underwent amputation of their lower limbs. After that, the rate of amputation from 2007 to 2014 was 33% and the proportion of those who did not undergo amputation was 22%. In given Graphs (figure) you can clearly see that the frequency of amputation is higher in 2015-2022 (Table 4, Figure 4)

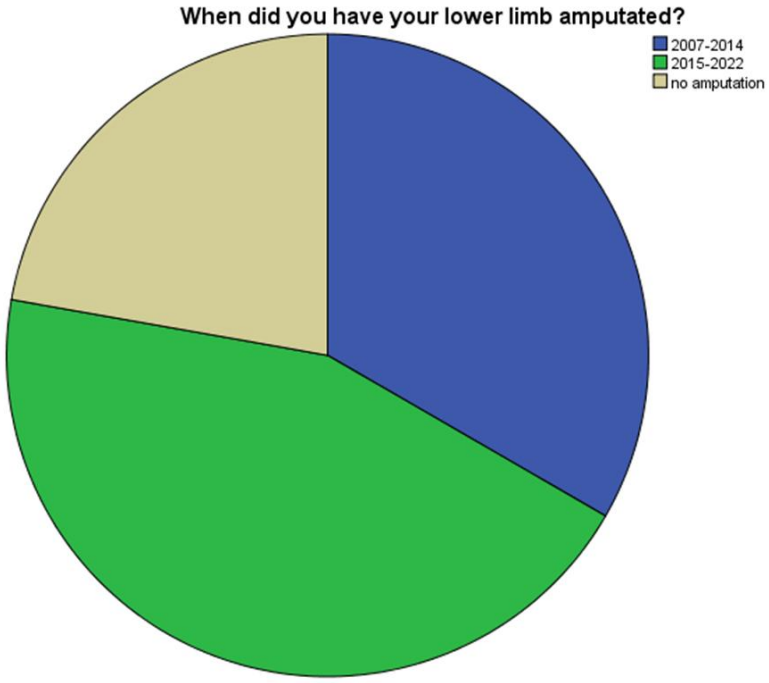

Figure 4 Pie chart of amputation timing distribution.

Table 5 Reason of amputation

What is the reason for the amputation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Trauma	35	77.8	77.8	77.8
	Congenital	5	11.1	11.1	88.9
	no amputation	5	11.1	11.1	100.0
	Total	45	100.0	100.0	

Results from data collected from our survey their indicates is that 77% of people said their amputation was due to trauma. Congenital of 11% and no amputation rate of 11%. According to statistics, we can say that the reason of most of the amputation is trauma. With the help of graphs you can clearly see that most people have amputation due to trauma.

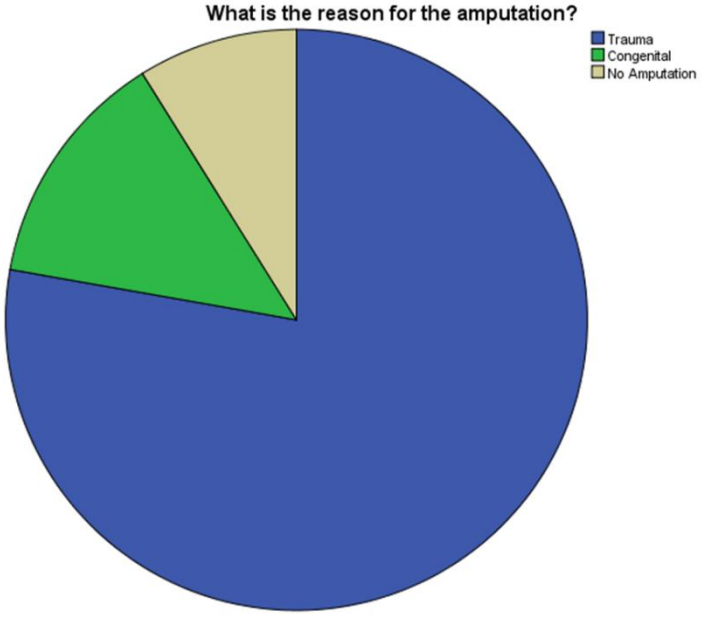

Figure 5 Pie chart of amputation degree (transtibial, transfemoral, Syme's, none)

Based on the survey data, 44.4% of respondents reported having a transtibial amputation, 33.3% had a transfemoral amputation, and 11.1% had a Syme foot amputation. Additionally, 11.1% of participants reported no amputation. These results indicate that transtibial amputation is the most common type among the study population. This distribution is clearly illustrated in Figure 6.

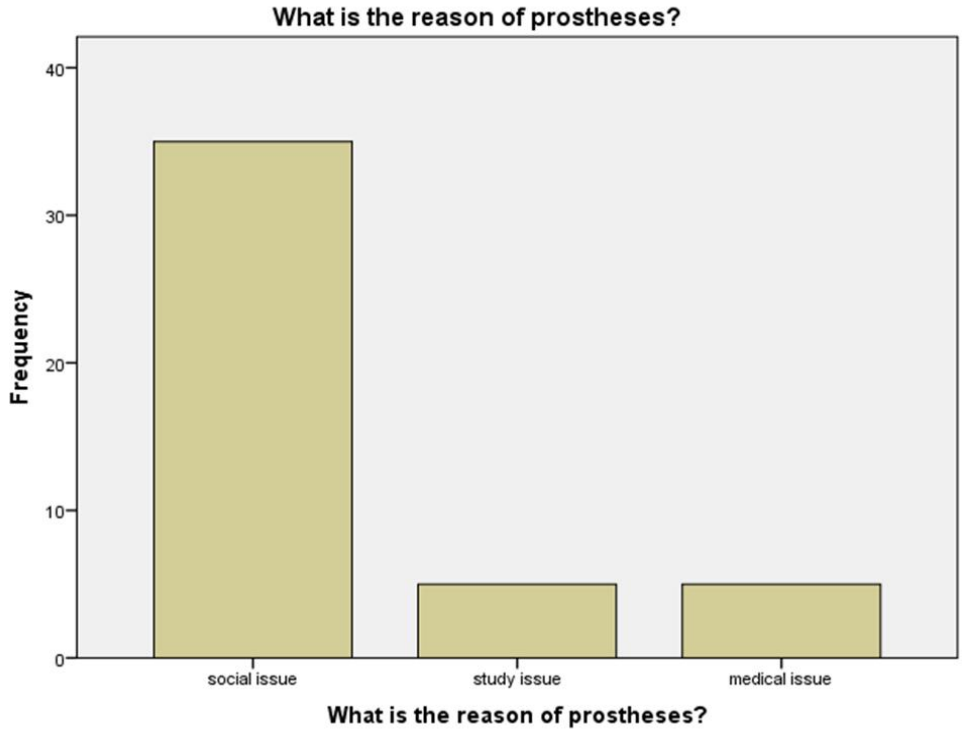

Figure 6 Bar chart of prosthetic aid usage (crutches, wheelchair, prosthetic leg

According to the survey findings, the primary reason for using prostheses among participants was related to social factors. Specifically, 77.8% of respondents reported social issues as the motivating factor for prosthesis use, while 11.1% cited educational needs and another 11.1% mentioned medical reasons. These results clearly indicate that social reintegration and societal expectations play a major role in prosthetic adoption. This distribution is further illustrated in Figure 5. In terms of assistive devices used during physical activities, 55.6% of participants reported using a prosthetic leg, while 22.2% relied on crutches and another 22.2% used wheelchairs. This indicates that the prosthetic leg is the most commonly used aid among lower limb amputees, suggesting a preference for more independent and mobile solutions. The usage distribution is depicted in Figure 6.

When participants were asked about their frequency of sports participation over the past six months, 33.3% reported engaging in sports twice a month, 22.2% reported daily participation, 11.1% played once a week, and 33.3% had not participated in any sports activities. These findings show that while a significant proportion of amputees remain physically active, a large portion are still inactive. The most common frequency of participation was twice monthly.

DISCUSSION

Previous studies have shown inconsistent associations between the level of limb amputation and sports participation. While some research suggests no significant differences in activity levels across amputation types (e.g., transfemoral vs. transtibial) (Bragaru et al., 2013), others report higher engagement among above-knee amputees (Kegel et al., 2018). This contradicts assumptions that greater energy demands in proximal amputations limit physical activity (Hendershot et al., 2011). In our study, most participants (88.9%) were active in sports pre-amputation, and trauma was the leading cause of limb loss (77.8%),

aligning with global trends (Dillingham et al., 2015). Transtibial amputations (44.4%) were most common, yet prosthetic use enabled continued sports participation, underscoring the role of adaptive technology (Windrich et al., 2016). Social factors significantly influenced prosthesis adoption, with 77.8% citing social reintegration as a primary motivator, consistent with findings on stigma and identity reconstruction (Sparkes & Brighton, 2017). While prosthetic legs (55.6%) were preferred over wheelchairs or crutches, some users reported discomfort (22.2%), echoing challenges in prosthetic fit and skin health (Highsmith et al., 2016). Notably, sports participation alleviated phantom limb pain for some, a benefit highlighted in prior rehabilitation studies (Gallagher et al., 2021).

Barriers such as limited time and technical support were reported, yet personal motivation and awareness of health benefits facilitated adaptation. This aligns with evidence that pre-amputation activity predicts post-amputation engagement (Radtka et al., 2016) and underscores the need for tailored rehabilitation programs (Jaarsma et al., 2014). Behavioral adaptations, like shifting to individual sports, reflect strategies observed in other disabled populations (Hutzler et al., 2019). Critically, neither amputation level nor cause significantly predicted sports participation, supporting the prioritization of psychosocial support over biomechanical limitations (Gavron & DePauw, 2005). The findings advocate for holistic interventions combining prosthetic innovation, psychological counseling, and community-based sports programs (Tasiemski et al., 2004).

CONCLUSION

This study concluded that trauma remains the leading cause of lower limb amputation, accounting for 77.8% of cases, followed by congenital causes at 11.1%. The data revealed a notable increase in amputation rates during 2015–2022 (44.4%) compared to 2007–2014 (33.3%). Among the types of amputations, transtibial (below-knee) was most prevalent (44.4%), followed by transfemoral (33.3%) and Syme foot amputations (11.1%). The majority of participants reported positive experiences with prosthetic legs, citing improved mobility and comfort, while only a few mentioned issues such as discomfort or skin irritation. Most individuals used prosthetic legs rather than crutches or wheelchairs, highlighting a preference for more functional mobility solutions. Sports and physical activity were widely recognized as beneficial, enhancing fitness, increasing social engagement, reducing phantom limb pain, and relieving psychological stress. However, non-athletes cited barriers such as inadequate facilities, limited mobility, poor health, and a lack of motivation or companionship. Notably, even among proficient prosthetic users, many preferred engaging in activities that did not require prosthetic use. These findings emphasize the importance of individualized counseling and adaptive support systems tailored to each amputee's environment and physical capacity. Going forward, there is a pressing need for awareness campaigns, personalized rehabilitation programs, and improved access to sports facilities and adaptive equipment. Future initiatives should prioritize mobility training, address psychological and physical barriers, and integrate prosthetic-specific surveys to better evaluate functional challenges. Rehabilitation professionals must play an active role in guiding amputees toward regaining independence, with tailored recommendations based on personal capabilities, motivations, and lived experiences.

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