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Health-related quality of life among lower limb amputees using prostheses in Nepal: a cross-sectional study

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Abstract

Introduction Lower limb amputation significantly impacts individuals' quality of life, with prostheses playing a crucial role in rehabilitation and mobility restoration. In Nepal, where access to advanced medical care is limited, understanding the factors affecting the well-being of prosthesis users is essential for optimizing rehabilitation services. This study investigates the sociodemographic and health-related variables influencing the quality of life among lower-limb amputees using prostheses in Nepal.

Methods A cross-sectional study was conducted at a super-specialized disability care center within a tertiary care hospital. The study included 43 amputees who had received prostheses at least five years prior and were regular users. The sample was drawn from patients at the same hospital. The study collected data on sociodemographic characteristics, health components, and pain experiences. Health-related quality of life (HrQoL) was assessed using the SF-12 tool, with scores above 50 indicating high HrQoL on the Mental Component Summary (MCS) and Physical Component Summary (PCS). Scores below 50 indicated low HrQoL. Factors associated with these variables were analyzed using Chi-square (χ^2) at a 95% confidence interval.

Results Our study assessed the health-related quality of life among lower limb amputees, finding that 76.74% of participants scored high in mental health and 81.40% in physical health. Significant associations were identified between age and marital status with the Mental Component Summary (MCS) and Physical Component Summary (PCS). Additionally, the reason for amputation and the experience of the Phantom pain were linked to the MCS. Factors like treatment for stump pain, perceived effectiveness of stump pain treatment, and residual stump pain were associated with both the PCS and MCS, while actions taken for stump pain and extremity dominance were associated significantly with the PCS. The level of amputation and treatment for phantom pain also showed significant association. All associations were significant ($p > 0.05$) at a 95% confidence interval.

Conclusion These findings indicate that age, marital status, extremity dominance, reason for amputation, stump pain treatment, and pain management are critical factors influencing the quality of life among lower limb amputees. The

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study underscores the need for comprehensive rehabilitation programs incorporating effective pain management, spouse support, and tailored interventions based on individual demographic and clinical characteristics.

Keywords Lower limb amputation, Prosthesis user, Quality of life, Mental health, Physical health, Nepal

Background

Lower limb loss has profound implications for both physical function and psychosocial well-being, significantly affecting quality of life [1]. Rehabilitation typically involves using assistive devices to restore daily activities and improve overall functioning [2]. Prostheses are particularly preferred among these devices because they allow individuals to perform daily tasks more naturally [3].

The civil war in Nepal (1996–2006) resulted in at least 13,000 deaths and hundreds of traumatic amputations [4]. Similarly, the 2015 earthquakes caused over 8,800 deaths and 22,000 injuries [5]. Overall, approximately 100,000 people in Nepal live with amputated limbs due to various causes, including war, road traffic accidents, natural disasters, burns, and illnesses like diabetes. This situation presents a significant public health challenge, impacting the individuals affected and the quality of life for their families and communities. Furthermore, many of these individuals are without prostheses, and anecdotal evidence suggests that even more people are undergoing amputations [6]. Nearly 89% of individuals with physical disabilities in Nepal reside in rural regions, with a significant number living in hilly areas (49%) and mountainous regions (11%) [7]. The rugged terrain and high altitudes make mobility exceedingly difficult, leading to increased dependency on others for activities of daily living for the amputees [8]. Also, Nepal's access to prosthetic services is severely limited, particularly in rural and remote areas. A shortage of trained professionals, inadequate infrastructure, and financial barriers prevent many individuals from receiving necessary services [9]. Limited infrastructure restricts access to healthcare and support services, exacerbating physical and emotional challenges [10]. Without prostheses, amputees struggle with isolation, reduced opportunities for employment, and diminished social participation, significantly impacting their overall well-being and quality of life [11].

The physical challenges amputees face in routine activities like ambulation, climbing stairs, and utilizing public transportation are exacerbated without adequate prosthetics. This restriction severely limits their employment opportunities and social engagement, negatively impacting their overall quality of life [12]. Furthermore, the traumatic experience of amputation can trigger psychological conditions such as depression, anxiety, and phantom limb pain. Limited access to mental health services compounds these challenges, creating a multifaceted set of barriers that impede amputees' reintegration into society and their ability to lead fulfilling lives, thereby diminishing their overall quality of life [13]. Also, Socioeconomic factors play a crucial role in determining HrQoL for Nepali amputees. Many individuals struggle with poverty, limited education, and lack of employment opportunities, which can exacerbate the challenges associated with limb loss [14]. Cultural stigma surrounding disability in Nepal can also lead to social isolation and discrimination, further impacting mental health and overall quality of life [15].

Moreover, the pervasive negative social stigma surrounding disability can lead to social isolation and discrimination, significantly impacting the mental health and social participation of amputees. These factors, in turn, adversely affect amputees' overall quality of life [16]. Using prostheses improves mobility and independence for amputees, making daily living activities easier. Mobility boosts self-confidence, self-esteem, and overall well-being, facilitating social connections and reducing isolation [17]. A study in Nepal among amputees revealed that participants experienced feelings of weakness, reduced mobility, and an inability to endure physical strain post-amputation, such as phantom pain [8]. Phantom pain, a perplexing sensation of pain or discomfort in a missing limb, significantly impacts the quality of life for many individuals who have undergone amputation [18]. While prosthetic limbs offer remarkable functional restoration, they often fail to alleviate this persistent condition [19].

Without a prosthesis, mobility is significantly limited for amputees, often forcing them to rely on alternatives like sticks and crutches, especially in hilly and mountainous regions. However, many amputees without a prosthesis typically use wheelchairs [20]. In Nepal, access to wheelchairs poses challenges due to limited availability in rural areas, high costs, and inadequate infrastructure [21]. Even when available through charitable foundations or local governments, geographical conditions often make it difficult for individuals to use them effectively for daily activities. The prosthesis can aid in the daily living, aiding in hygiene, household duties, travel, and social events. This improvement in daily functionality significantly enhances amputees' overall quality of life [8]. Long-term users viewed life without a prosthesis as miserable. The prosthesis increased their independence and enhanced their societal position, significantly improving their quality of life [8]. Another study suggests that 48.1% of the amputees used a prosthetic device, and these individuals were found to have a significantly better quality of life [22]. Apart from this, there is a severe lack of essential services for amputees in Nepal, which affects their quality of life. Key shortages include limited access to affordable, quality prosthetics, shortages of trained professionals for fitting and maintenance, and inadequate

rehabilitation services [8]. Low public awareness of available resources further prevents support-seeking, while inaccessibility of healthcare facilities, especially in rural areas, compounds these issues [23].

In Nepal, very few studies have been conducted on lower-limb amputees. To the best of our knowledge, this is the first study to measure the quality of life among prosthesis users with lower limb amputations. Understanding the quality of life of prosthetic users is essential for comprehensively addressing their needs and challenges, improving prosthetic services, guiding healthcare policies, and fostering innovation. In Nepal, where unique socioeconomic and cultural factors come into play, such research is particularly crucial for enhancing the lives of individuals with limb amputations and ensuring their full integration into society. This study will provide valuable data that can drive improvements in healthcare, support systems, and prosthetic technology, ultimately contributing to the well-being and empowerment of prosthetic users in Nepal.

Methods

Study design and setting

A cross-sectional study was conducted among past beneficiaries of the Hospital and Rehabilitation Center for Disabled Children (HRDC). This non-profit, 100-bed hospital identifies, treats, rehabilitates, and socially reintegrates children with physical disabilities. It also provides children and adults with assistive devices, including prostheses and orthoses.

Participants in the study had received prostheses from the Prosthesis and Orthotic Department of HRDC. These prostheses are manufactured by a prosthetist with over 25 years of experience in prosthetic manufacturing. All participants utilized prostheses produced by the same department, crafted under the guidance of a single prosthetist, and employing uniform materials. This standardization ensured consistency and ideal suitability for all participants involved.

Participants

Former patients of HRDC who received a prosthesis at least five years ago and are using the prosthesis regularly were included in the study. Regular prosthetic use was determined based on self-reported frequency of use, with participants indicating that they wore the prosthesis daily for various activities, such as walking, working, and participating in leisure activities. Prosthesis users with comorbidities apart from the amputation, including peripheral vascular disease, diabetes-related complications, chronic pain disorders, and joint issues related to the amputated limb, were excluded from the study. Additionally, participants who were taking medication for mental health conditions as prescribed by a psychiatrist or physician, as well as those with multiple disabilities, were also excluded.

A list of eligible beneficiaries was collected from the electronic medical records to construct a sampling frame of 356 based on the calculated sample size. The final sample size of 43 was determined using the $n = Z^2 \times p \times (1 - p)/d^2$, $p = 2.65$ is the expected proportion of disability [24] in the subject population, (d) is the margin of error set at 5%, and (Z) is the standard normal variate, which is 1.96 for a 95% confidence interval. A total of 43 samples were collected using convenient sampling, with a 100% response rate.

Data collection

One of the authors collected data via face-to-face interviews using a structured questionnaire in the hospital setting. The questionnaire captured sociodemographic characteristics, physical and mental health components, and the presence and frequency of phantom sensations, phantom pain, and stump pain. The KoBo Toolbox was used to manage the questionnaire and minimize data collection errors. The questionnaire was prepared in the KoBo Toolbox and loaded into a smartphone, and data were collected from October 2022 to July 2023.

Measures

Dependent variable

The SF-12 (Short Form Health Survey-12) is a concise health survey used to measure health-related quality of life derived from the longer SF-36 Health Survey [25]. *The SF-12 addresses various health dimensions, including general health, physical functioning, role limitations due to physical health, bodily pain, general mental health, vitality, social functioning, and role limitations due to emotional problems. It includes 12 questions that cover a range of health concepts, providing two main summary scores: the Physical Component Summary (PCS) and the Mental Component Summary (MCS)* [22]. *These scores reflect overall physical and mental health, respectively. Physical Component Summary (PCS) -12 has a test-retest reliability of 0.89, and Mental Component Summary (MCS) has 0.76* [25].

The total PCS and MCS scores were dichotomized; a score above 50 was considered a high health-related Quality of life, and a score below 50 was considered a low health-related Quality of life, as guided by the research done in community and clinic settings [26].

Independent variables

In this study, several independent variables were measured. These include age categorized as less than 40 years old and more than 40 years old; sex (female, male); residence (rural, urban); religion (Hindu, others);

education level (primary, lower secondary, secondary, higher secondary and above); disability card color (red, blue, yellow and white). In Nepal, the disability card system employs a color-coded grading structure to classify disabilities and determine support needs. Grade 1 (red) indicates severe disabilities requiring substantial assistance. Grade 2 (blue) is for moderate disabilities that limit daily activities but allow some independence. Grade 3 (yellow) and the white card signify mild disabilities with minimal impact on everyday tasks [27]; *Extremity Dominance (right, left); marital status (married, unmarried), disabled partner(yes, no); reason for amputation (accident, blood vessel disease, burn, cancer, congenital); side of amputation (both, left, right); level of amputation (below knee, Boyd, knee disarticulation, Symes); The study examined various aspects of pain and phantom sensations experienced by individuals after amputation and prosthesis fitting. The presence of pain before prosthesis was assessed to determine if individuals experienced pain in their residual limb prior to receiving their prosthetic device. The presence of phantom pain after the prosthesis was investigated to see if they continued to feel pain that seemed to originate from the amputated limb, even after the prosthesis was fitted. For those who reported phantom pain, it was noted whether they received treatment for phantom pain. The intensity of phantom sensations was graded as hardly, moderately, or not at all, and the frequency of these sensations was recorded, ranging from a few times a day to never.*

The severity of stump pain was evaluated on a scale that included not at all, hardly, moderately, much, and very much, indicating how intensely individuals experienced pain in their residual limb measured on a Likert scale [28]. *It was recorded whether individuals received treatment for stump pain, and the effectiveness of this treatment was assessed to determine if it successfully reduced the pain. The presence of residual stump pain was noted to understand whether any pain persisted in the residual limb following amputation. Finally, the study looked at actions taken for stump pain, identifying if individuals took specific measures such as medical treatment or other things to manage their pain. These variables were used to provide a detailed understanding of the pain experiences and management strategies of individuals living with a prosthesis after amputation.*

Statistical analysis

The data was collected and extracted from Kobo Toolbox, first organized in MS Excel, then imported into SPSS software version 26 for analysis. Descriptive statistics, including frequencies and percentages, were computed to summarize the variables related to quality of life as measured by the SF-12 questionnaire. Inferential statistics, specifically the chi-square test at a 95% confidence interval, were employed to explore the relationships between these variables and the quality of life among prosthesis users, focusing on the Mental Component Summary (MCS) and Physical Component Summary (PCS) scores of the SF-12.

Ethical consideration

was obtained from the B&B Institutional Review Committee (B&B IRC) with ref no. B&BIRC-22-50, Nepal. After comprehending the information sheet, all participants provided informed consent, which detailed the study's objectives, aims, and potential risks and benefits. Participants were given sufficient time to review the information and were encouraged to seek clarification and ask questions. Throughout the study, utmost respect was given to participants' rights and dignity. They had the freedom to withdraw from the interview without any pressure. Confidentiality was strictly maintained during data collection, analysis, and interpretation.

Results

This study was conducted among 43 participants to assess the impact of prostheses. Table 1 depicts the sociodemographic characteristics of respondents.

The age distribution of participants indicates that 67.44% were under 40 years old, while 32.56% were over 40 years old. The sample was predominantly male, comprising 74.40%, compared to 25.60% female participants. More participants lived in rural areas (60.50%) compared to urban areas (39.50%). The majority of participants identified as Hindu (97.70%). Educational attainment varied, with the largest group completing higher secondary education or beyond (58.1%). According to the government's color grading system, 9.3% of participants had a mild disability, 37.2% had moderate, and 53.5% had severe. Regarding marital status, most participants were married (58.10%), with a significant number of unmarried participants (41.90%) reporting having a disabled partner (18.60%).

As shown in Table 2, Among the reasons for amputation, burns emerged as the primary cause, constituting 39.5% of cases, closely followed by accidents at 34.9%. Regarding the location of amputations, the right leg was more frequently affected, accounting for 60.5% of cases, compared to 30.2% for the left leg and 9.3% for both legs. Below-knee amputations were the most common, representing 76.7% of cases.

Participants reported varying frequencies of phantom sensations following amputation: 18.6% experienced them a few times a day, 20.9% a few times a week, 18.6% a few times a month, and 39.5% never experienced them. Nearly half of the participants (48.8%) reported experiencing phantom pain, yet only a small percentage

Table 1 Sociodemographic characteristics

Variables	Frequency	Percentage
Age		
< 40	29	67.44%
> 40	14	32.56%
Sex		
Female	11	25.60%
Male	32	74.40%
Residence		
Rural	26	60.50%
Urban	17	39.50%
Religion		
Hindu	42	97.70%
others	1	2.30%
Education		
Primary	4	9.30%
Lower Secondary	6	14.00%
Secondary	8	18.60%
Higher Secondary and Above	25	58.1%
Disability Grade		
Mild	4	9.3%
Moderate	16	37.2%
Severe	23	53.5%
Marital Status		
Married	25	58.10%
Unmarried	18	41.9%
Extremity dominance		
Left	12	27.9%
Right	31	72.1%
Disabled partner		
Unmarried	18	41.90%
No	17	39.50%
Yes	8	18.60%

(4.7%) received treatment for it. Stump pain was moderately experienced by 44.2% of participants, with 27.9% receiving treatment. Additionally, 37.2% of participants reported residual stump pain, and the same percentage (37.2%) addressed their stump pain.

Table 3 presents data on the health-related quality of life (HrQoL) among lower limb amputees, specifically focusing on the Mental Component Score (MCS) and Physical Component Score (PCS) derived from the SF-12 Health Survey. The MCS results indicate that 76.74% (33 out of 43 participants) experience a high quality of life, while 23.26% (10 participants) report a low quality of life regarding mental health. Similarly, the PCS results show that 81.40% (35 participants) have a high quality of life regarding their physical health, whereas 18.60% (8 participants) have a low health-related quality of life.

Table 4 shows the p-values with 95% confidence intervals (CI) for the association of general variables with the Mental Component Summary (MCS) and Physical Component Summary (PCS). Age showed a significant relationship with both MCS and PCS, with $p=0.02$ and $p=0.00$, respectively. Marital status was also significantly associated with MCS at $p=0.04$ and PCS at $p=0.00$. Similarly, extremity dominance of the prosthesis user showed a significant association with PCS $p=0.05$. The reason for amputation also showed a significant association with MCS at $p=0.02$.

However, factors such as sex, residence, province, education, religion, partner's disability, possession of a disability card, side of amputation, level of amputation, pain before amputation, experience of phantom sensation, grading of phantom sensation, and duration of phantom sensation were not associated with the physical and mental health components of prosthesis users among lower limb amputees.

Table 5 shows the association between Stump Pain, Phantom-Related Variables, and the Mental Component Summary (MCS) and Physical Component Summary (PCS). Experience of the Phantom pain was significantly associated with MCS at $p=0.04$. Treatment of Stump Pain showed a significant association with MCS at $p=0.03$, and PCS at p-value 0.04, and also both MCS and PCS showed a significant association with Perceived Stump Pain Treatment Effectiveness at $p=0.03$ and $p=0.04$, respectively. Additionally, residual stump pain was significantly associated with MCS at $p=0.04$, PCS at $p=0.00$, and actions taken for the stump showed a significant association with PCS at $p=0.01$. However, Phantom Pain, After Amputation, Treatment of Phantom Pain, and Suffering from Stump Pain were not associated with PCS and MCS.

Additionally, we conducted an analysis of the various factors influencing the level of amputation. Among all the variables examined, only the level of amputation and the treatment of phantom pain showed significant associations at ($p=0.04$),indicating a statistically significant relationship between the level of amputation and the treatment of phantom pain at the 95% confidence level. Other factors assessed in the study did not demonstrate any statistically significant relationships with the level of amputation.

Discussion

Our study aimed to determine the health-related quality of life among lower limb amputees. The results revealed that 76.74% of participants exhibited a high quality of life in mental health components, and 81.40% of amputees reported a high quality of life in physical health components. Conversely, 23.26% reported a low quality of life in mental health components, and 18.60% had a low quality of life in physical health components.

The most common reason for amputation was burns (39.5%), followed by accidents (34.9%), congenital factors (14%), cancer (7%), and blood vessel disease (4.7%). In Nepal, burn injuries are a significant surgical concern,

Table 2 Frequency and intensity of phantom sensation, phantom and stump pain among lower-limb amputees

Variables	Frequency	Percentage
Reason for Amputation		
Accident	15	34.9%
Blood vessel disease	2	4.7%
Burn	17	39.5%
Cancer	3	7%
Congenital	6	14%
Side of amputation		
Both	4	9.3%
Left	13	30.2%
Right	26	60.5%
Level of amputation		
Below knee	33	76.7%
Boyd	1	2.3%
Knee disarticulation	4	9.3%
Symes	5	11.6%
Pain Before Prosthesis		
Yes	30	69.8%
No	13	30.2%
Phantom Pain After Prosthesis		
Yes	21	48.8%
No	22	51.2%
Treatment of Phantom Pain		
Yes	2	4.7%
No	41	95.3%
Phantom Sensation Grading		
Hardly	12	27.9%
Moderately	9	20.9%
Not at all	22	51.2%
Duration of the Phantom Sensation		
A few times a day	4	9.3%
A few times a week	9	20.9%
Never	22	51.2%
A few times a month	8	18.6%
Experienced Phantom sensation		
A few times a day	8	18.6%
A few times a week	9	20.9%
Never	17	39.5%
A few times a month	8	18.6%
Few times a year	1	2.3%
Stump Pain		
Not at all	13	30.2%
Moderately	19	44.2%
Hardly	8	18.6%
Much	2	4.7%
Very much	1	2.3%
Treatment of stump pain		
Yes	12	27.9%
No	31	72.1%
Perceived Stump Pain Treatment Effectiveness		
Yes	12	27.9%
No	31	72.1%
Residual stump pain		
Yes	16	37.2%

Table 2 (continued)

Variables	Frequency	Percentage
No	27	62.8%
Action is taken for stump pain		
Yes	16	37.2%
No	27	62.8%

Table 3 Health-related quality of life among the amputees

	Frequency	Percentage
Mental Component Score		
High HrQol	*33*	*76.74%*
Low HrQol	*10*	*23.26%*
Physical Component Score		
High HrQol	*35*	*81.40%*
Low HrQol	*8*	*18.60%*

often caused by flame burns. Many patients receive no formal treatment at the time of injury, presenting months or even years later with cosmetic or functional issues due to secondary contractures. From 1997 to 2004, burn contracture was the leading cause of lower extremity amputation at the Hospital and Rehabilitation Centre for disabled children(HRDC), Nepal, accounting for 30% of cases as from the study conducted by David A. Spiegel [29].

In rural areas, households commonly use firewood for cooking, and children are often left home alone while parents tend to do chores in the fields or forests. This can lead to accidents, such as children getting too close to cooking stoves, resulting in serious burn injuries. These injuries can lead to severe deformities when reconstructive options are unavailable or when the functional outcomes are deemed inferior to the use of prosthetic devices [29].

Age, marital status, treatment for stump pain, perceived effectiveness of stump pain treatment, and residual stump pain were associated with both PCS and MCS, and actions taken for stump pain and extremity dominance were significantly associated with the PCS among lower limb amputees using prostheses and reason for the amputation was associated with the MCS among the lower limb amputees.

This study found a significant association between "(Age and MCS (p=0.02))", as supported by the study conducted in India [30]and "(Age and PCS (p=0.00))" component of the study, which is also supported by a similar study conducted in Egypt [31] also same have been found in another study conducted by Richa et al. [30]. For amputees using prostheses, the association between age and both PCS and MCS scores can be attributed to the natural physical decline and increasing chronic conditions that accompany aging, leading to poorer physical health and greater difficulty in adapting to prosthetic limbs. Additionally, mental health can be affected by cognitive decline and social factors such as isolation or loss of independence [32], which is common in lower limb amputees. As individuals age, they may experience a decline in physical health due to the onset of chronic illnesses, decreased mobility, and the natural aging process. These physical changes can directly impact their functional abilities and overall health status, leading to a lower PCS score [33].

Additionally, aging often coincides with various psychosocial challenges, including increased social isolation, loss of family and friends, and changes in socioeconomic status, all of which can adversely affect mental health. Older adults are more susceptible to conditions such as depression and anxiety, often exacerbated by the aforementioned factors [34]. This can result in a reduced MCS score, reflecting poorer mental health outcomes. The interplay of these factors emphasizes the need for targeted interventions addressing physical and mental health concerns among older adults to improve their overall quality of life [35].

Physical activity is vital for rehabilitation, improving physical function, prosthesis adaptation, and mental health by reducing anxiety and depression. Regular exercise enhances cardiovascular health, balance, and muscle strength, facilitating independent living. Sleep quality is also important; poor sleep from pain, such as residual or phantom limb pain, can lead to increased inflammation, cognitive decline, and delayed recovery [36, 37]. Thus, addressing sleep issues through pain management and psychological support is essential [38]. Proper nutrition supports recovery by promoting wound healing and strengthening the immune system. Specific nutrients like proteins, vitamins, and probiotics can help reduce inflammation and pain, enhancing adaptation [39, 40]. Integrating nutrition interventions with rehabilitation plans can significantly improve the quality of life for amputees. Future research should prioritize these elements to enhance physical and mental health outcomes in lower limb amputees.

Similarly, "(Marital status and PCS (p=0.00))" and "(Marital status and MCS (p=0.04))" showed significant associations, as supported by the study conducted [31]. Marital status impacts the well-being of amputees using prostheses due to the social, emotional, and practical support provided by spouses, and social support has been reported to have positive outcomes [41].

Table 4 Association between sociodemographic variables along with MCS and PCS

	MCS Score				PCS Score			
Variable	**Low QoL**	**High QoL**	**P-Value**	**Chi-Square Value**	**Low QoL**	**High QoL**	**P-Value**	**Chi-Square Value**
Age			**0.02***	5.65			**0.00***	20.35
Less than 40	8(18.60%)	21(48.84%)			0(0.00%)	29(67.44%)		
More than 40	8(18.60%)	6(13.95%)			8(18.60%)	6(13.95%)		
Sex			0.79	0.06			0.39	0.73
Male	7(16.28%)	25(58.14%)			5(11.63%)	27(62.79%)		
Female	2(4.65%)	9(20.93%)			3(6.98%)	8(18.60%)		
Residence			0.18	0.66			0.08	3.00
Rural	6(13.95%)	20(46.51%)			7(16.28%)	19(44.19%)		
Urban	3(6.98%)	14(32.56%)			1(2.33%)	16(37.21%)		
Province								
1	1(2.33%)	6(13.95%)	2.82	0.72	0(0.00%)	7(16.28%)	0.41	4.98
2	0(0.00%)	1(2.33%)			0(0.00%)	1(2.33%)		
3	3(6.98%)	14(32.56%)			3(6.98%)	14(32.56%)		
5	1(2.33%)	6(13.95%)			2(4.65%)	5(11.63%)		
6	3(6.98%)	4(9.30%)			1(2.33%)	6(13.95%)		
7	1(2.33%)	3(6.98%)			2(4.65%)	2(4.65%)		
Education								
Less than 5 years	1(2.33%)	3(6.98%)	3.13	0.37	1(2.33%)	3(6.98%)	0.59	1.90
Less than 8 years	2(4.65%)	4(9.30%)			2(4.65%)	4(9.30%)		
Less than 10 years	3(6.98%)	5(11.63%)			2(4.65%)	6(13.95%)		
More than 12 years	3(6.98%)	22(51.16%)			3(6.98%)	22(51.16%)		
Religion			0.27	0.60			0.62	0.23
Hindu	9(20.93%)	33(76.74%)			8(18.60%)	34(79.07%)		
Others	0(0.00%)	1(2.33%)			0(0.00%)	1(2.33%)		
Marital Status			**0.04***	4.42			**0.00***	7.07
Unmarried	1(2.33%)	17(39.53%)			0(0.00%)	18(41.86%)		
Married	8(18.60%)	17(39.53%)			8(18.60%)	17(39.53%)		
Partner Disability			0.22	1.63			0.60	0.26
Yes	3(6.98%)	5(11.63%)			2(4.65%)	6(13.95%)		
No	6(13.95%)	29(67.44%)			6(13.95%)	29(67.44%)		
Disability Grade								
Mild	0(0.00%)	4(9.30%)	1.47	0.47	1(2.33%)	3(6.98%)	0.93	0.13
Moderate	3(6.98%)	13(30.23%)			3(6.98%)	13(30.23%)		
Severe	6(13.95%)	17(39.53%)			4(9.30%)	19(44.19%)		
Extremity Dominance			0.67	0.17			**0.05***	3.80
Right	2(4.65%)	10(23.26%)			0(0.00%)	12(27.91%)		
Left	7(16.28%)	24(55.81%)			8(18.60%)	23(53.49%)		
Side Amputation			0.38	0.38			0.51	1.34
Left	2(4.65%)	11(25.58%)			2(4.65%)	11(25.58%)		
Right	6(13.95%)	20(46.51%)			6(13.95%)	20(46.51%)		
Both	1(2.33%)	3(6.98%)			0(0.00%)	4(9.30%)		
Level Amputation			0.95	0.30			0.39	2.97
Boyd	0(0.00%)	1(2.33%)			0(0.00%)	1(2.33%)		
Knee disarticulation	1(2.33%)	3(6.98%)			0(0.00%)	4(9.30%)		
Below knee	7(16.28%)	26(60.47%)			8(18.60%)	25(58.14%)		
Symes	1(2.33%)	4(9.30%)			0(0.00%)	5(11.63%)		
Reason for Amputation			**0.02***	0.19			0.78	6.03
Accident	4(9.30%)	11(25.58%)			5(11.63%)	10(23.26%)		
Blood Vessel Diseases	1(2.33%)	1(2.33%)			1(2.33%)	1(2.33%)		
Burn	4(9.30%)	13(30.23%)			2(4.65%)	15(34.88%)		
Cancer	0(0.00%)	3(6.98%)			0(0.00%)	3(6.98%)		
Congenital	0(0.00%)	6(13.95%)			0(0.00%)	6(13.95%)		

Table 4 (continued)

	MCS Score				PCS Score			
Variable	**Low QoL**	**High QoL**	**P-Value**	**Chi-Square Value**	**Low QoL**	**High QoL**	**P-Value**	**Chi-Square Value**
Pain Before Amputation			0.55	0.34			0.72	0.12
Yes	7(16.28%)	23(53.49%)			6(13.95%)	24(55.81%)		
No	2(4.65%)	11(25.58%)			2(4.65%)	11(25.58%)		
Experience Phantom Sensation			0.36	4.32			0.24	5.39
Few Times a Day	1(2.33%)	7(16.28%)			1(2.33%)	7(16.28%)		
Few Times a Week	2(4.65%)	7(16.28%)			2(4.65%)	7(16.28%)		
Never	3(6.98%)	14(32.56%)			2(4.65%)	15(34.88%)		
Few Times a Month	2(4.65%)	6(13.95%)			2(4.65%)	6(13.95%)		
Few Times a Year	1(2.33%)	0(0.00%)			1(2.33%)	0(0.00%)		
Phantom Sensation Grading			0.95	0.08			0.40	1.83
Not at All	4(9.30%)	15(34.88%)			2(4.65%)	17(39.53%)		
Moderately	4(9.30%)	14(32.56%)			4(9.30%)	14(32.56%)		
Hardly	1(2.33%)	5(11.63%)			2(4.65%)	4(9.30%)		
Duration Phantom Sensation			0.14	5.35			0.44	2.68
Few Times a Day	1(2.33%)	3(6.98%)			1(2.33%)	3(6.98%)		
Few Times a Week	1(2.33%)	8(18.60%)			1(2.33%)	8(18.60%)		
Never	3(6.98%)	19(44.19%)			3(6.98%)	19(44.19%)		
Few Times a Month	4(9.30%)	4(9.30%)			3(6.98%)	5(11.63%)		

Research consistently indicates that married individuals report higher levels of life satisfaction and better physical and mental health than those who are single, divorced, or widowed [42]. The emotional and social support a spouse provides can act as a buffer against stressors and enhance coping mechanisms, which is particularly beneficial for mental health. For instance, having a supportive partner can lead to decreased feelings of loneliness and improved psychological resilience [43].

In terms of physical health, married individuals often engage in healthier behaviors and are more motivated to adhere to medical recommendations, likely due to a partner who can encourage and facilitate these behaviors [44]. This dynamic can lead to better management of chronic conditions, improved access to healthcare, and enhanced health outcomes, which are reflected in the higher PCS scores among married individuals.

Married amputees often experience better physical and mental health outcomes because of increased assistance with daily activities, enhanced emotional stability, financial benefits, and motivation for rehabilitation [45]. This support helps them adapt to prosthetic use more effectively, leading to higher PCS and MCS scores and improved quality of life [46].

Our study found a significant association between "(Extremities dominance and PCS (p=0.05))". Taylor et al. found a significant association between amputation and extremity dominance. However, this dominance is less consistent in amputees compared to non-disabled individuals due to biomechanical changes and adaptations following amputation. Specifically, footedness is more likely to change in amputees, and their turning preferences are often influenced by the need for stability and support from the intact limb [47].

Extremity dominance among lower limb amputees using prosthetics may be attributed to its impact on adaptation and physical health. The preference for using the dominant extremities can facilitate quicker mastery of prosthetic control, boosting confidence and functional independence [48]. Similarly, "(Reason for amputation and MCS (p=0.02))" has been shown to have a significant association with the mental health of the prosthesis user among the lower limb amputees, similar findings noted with the study conducted in North Africa [49]. The cause of amputation impacts mental health in lower limb prosthesis users because traumatic amputations often lead to severe psychological distress like PTSD and anxiety. In contrast, chronic illness-related amputations add ongoing emotional burdens and stress, as highlighted by the study [50]. These factors make adaptation and rehabilitation more challenging and affect acceptance and mental health outcomes [41].

"(Experience of the Phantom pain and MCS (p=0.04))" has shown a significant association among the lower limb amputees using prostheses. Similar findings have been found in the research conducted by Limakatso and Parker [51]. Experience of the Phantom pain among lower limb amputees using prosthetics may be linked with improved mental health components, such as reduced psychological distress and enhanced emotional well-being, and with physical components, such as better adaptation to daily activities [52]. Effective pain management and increased confidence in self-care contribute to these positive mental health outcomes, fostering a sense of control and

Table 5 Association between Stump Pain, Phantom-related variables, and MCS and PCS scores

MCS					PCS			
Variables	**Low QoL**	**High QoL**	**P-Value**	**Chi-Square Value**	**Low QoL**	**High QoL**	**P-Value**	**Chi-Square Value**
Phantom Pain			0.89	0.23			0.29	2.41
Not at All	4(9.30%)	18(41.85%)			3(6.98%)	19(44.19%)		
Moderately	2(4.65%)	7(16.28%)			1(2.33%)	8(18.60%)		
Hardly	3(6.98%)	9(20.93%)			4(9.30%)	8(18.60%)		
Phantom Pain After Amputation			0.65	0.20			0.39	0.73
Yes	5(11.63%)	16(37.21%)			5(11.63%)	16(37.21%)		
No	4(9.30%)	18(41.86%)			3(6.98%)	19(44.19%)		
Treatment for Phantom Pain			0.30	1.07			0.48	0.47
Yes	1(2.33%)	1(2.33%)			0(0.00%)	2(4.65%)		
No	8(18.60%)	33(76.74%)			8(18.60%)	33(76.74%)		
Perceived Phantom Pain Treatment Effectiveness			0.26	1.24			0.93	0.00
Yes	2(4.65%)	3(6.98%)			1(2.33%)	4(9.30%)		
No	7(16.28%)	31(72.09%)			7(16.28%)_	31(72.09%)		
Experience of the Phantom pain			**0.04***	3.77			0.50	4.68
Few Times a Day	0(0.00%)	6(13.95%)			0(0.00%)	6(13.95%)		
Few Times a Month	3(6.98%)	4(9.30%)			1(2.33%)	6(13.95%)		
Few Times a Week	1(2.33%)	5(11.63%)			0(0.00%)	6(13.95%)		
Few Times a Year	1(2.33%)	5(11.63%)			2(4.65%)	4(9.30%)		
Never	4(9.30%)	14(32.56%)			5(11.63%)	13(30.23%)		
Suffering from Stump Pain			0.43	1.66			0.40	1.82
Not at All	2(4.65%)	11(25.58%)			4(9.30%)	9(20.93%)		
Moderately	4(9.30%)	18(41.86%)			3(6.98%)	19(44.19%)		
Hardly	3(6.98%)	5(11.63%)			1(2.33%)	7(16.28%)		
Treatment for Stump Pain			**0.03***	4.32			**0.04***	0.83
Yes	5(11.63%)	7(16.28%)			2(4.65%)	10(23.26%)		
No	4(9.30%)	27(62.79%)			6(13.95%)	25(58.14%)		
Perceived Stump Pain Treatment Effectiveness			**0.03***	4.32			**0.04***	0.83
Yes	5(11.63%)	7(16.28%)			2(4.65%)	10(23.26%)		
No	4(9.30%)	27(62.79%)			6(13.95%)	25(58.14%)		
Residual Stump Pain			**0.04***	4.22			**0.00***	0.98
Yes	6(13.95%)	10(23.26%)			3(6.98%)	13(30.23%)		
No	3(6.98%)	24(55.81%)			5(11.63%)	22(51.16%)		
Action taken for the stump pain			0.45	6.62			**0.01***	0.54
Yes	5(11.63%)	31(72.09%)			6(13.95%)	30(69.77%)		
No	4(9.30%)	3(6.98%)			2(4.65%)	5(11.63%)		

overall improved physical quality of life for individuals adjusting to prosthetic use [53].

"(Stump pain treatment and PCS (p=0.04))" and "(Perceived stump pain treatment effectiveness and PCS (p=0.04))" were significantly associated with PCS of the patients studied, which show the relationship between the stump pain treatment and overall physical quality of life, as highlighted by the study [54]. The significant associations between stump pain treatment and perceived treatment effectiveness on physical well-being can be attributed to several factors. Effective pain management alleviates pain, enabling better mobility and rehabilitation participation and enhancing physical health [55]. Additionally, when patients believe their pain treatment is effective, they are more likely to engage in physical activities and adhere to rehabilitation programs, promoting better physical well-being [56]. Effective pain management also reduces anxiety and depression associated with chronic pain, leading to improved overall well-being [57]. Furthermore, reducing pain lowers physiological stress, improves sleep, and enhances immune function, contributing to better physical health [58].

Similarly, "(Stump pain treatment and MCS (p=0.03))" and "(Perceived stump pain treatment effectiveness and MCS (p=0.03))" have been significantly associated with MCS of the lower limb amputees; similar findings are

supported by the research [19]. It can be attributed to several factors. Chronic stump pain impacts daily activities, causing psychological stress and depression, which negatively affect mental health. Improved pain management also boosts the quality of life, enabling greater engagement in social and recreational activities, which improves MCS scores [59]. Perceived treatment effectiveness fosters a sense of control, boosting self-esteem and reducing feelings of helplessness [60]. Additionally, interactions with healthcare providers offer emotional support, further benefiting mental health. As physical and mental health are closely linked, effective pain treatment enhances both, leading to better MCS outcomes for lower limb amputees [30].

The study also found a significant association between "(Residual stump pain and PCS (p=0.00))" and "(Residual stump pain and MCS (p=0.04))"; similar findings have been reported in the study [19]. The significant association between residual stump pain and both PCS and MCS can be attributed to the detrimental impact of chronic pain on physical health and functioning. Residual stump pain, common among individuals with limb loss, often leads to severe limitations in mobility, daily activities, and overall physical well-being and mental well-being of the amputees [61]. Chronic pain can restrict physical functioning, increase bodily discomfort, and hinder the ability to perform daily roles, all of which are components measured by the PCS [62]. This association underscores the critical need for effective pain management strategies to enhance stress management, physical and mental health functioning, and overall quality of life for individuals with limb loss [63].

The study also revealed a significant association "(Actions taken for stump pain and PCS (p=0.01))". This suggests that individuals who actively manage their stump pain tend to experience lower levels of pain. Additionally, the study's findings indicate that autonomy—similar to the proactive actions taken to address stump pain—plays a crucial role in enhancing the use of prosthetic devices [47]. When lower-limb amputees feel a sense of control over their rehabilitation and daily activities, they are more likely to engage effectively with their prostheses [47]. This heightened engagement ultimately leads to improved physical functioning, enabling amputees to regain mobility and independence. Inversely, one study shows that individuals with poorer physical health and greater pain are more likely to seek frequent or aggressive interventions to manage their stump pain [41]. Our study shows a significant association between the level of amputation and the phantom pain treatment at (p=0.04). The association between the level of amputation and phantom pain treatment is related to how different amputation levels affect nerve damage, pain mechanisms, and psychological responses. Higher-level amputations may lead to more complex pain sensations due to extensive nerve involvement, influencing the type and intensity of phantom pain experienced [64]. Additionally, individuals may cope differently with limb loss based on the amputation level, impacting their treatment response. Consequently, this variation necessitates tailored treatment approaches to effectively manage phantom pain based on the specific circumstances of each patient [51].

Addressing both physical and psychosocial aspects is essential to enhance the quality of life for lower limb amputees. Key interventions should include prioritizing burn injury prevention, especially in rural settings, comprehensive pain management, and improved access to prosthetic rehabilitation. Psychosocial factors, such as marital status, significantly influence an amputee's well-being, highlighting the need for counseling services, support groups, and family education programs to enhance emotional support. Tailored mental health interventions, based on the amputee's age, should focus on issues like cognitive decline, social isolation, and loss of independence. Rehabilitation programs must also consider extremity dominance to facilitate better prosthetic adaptation and functional independence. Expanding community support networks and providing culturally sensitive education on stump care will empower amputees to take charge of their recovery. By creating a multidisciplinary care pathway that integrates medical, social, and psychological support, we can develop a holistic approach to rehabilitation and significantly improve the overall well-being of lower limb amputees.

Strengths and limitations of the study

The study on health-related quality of life among lower limb amputees using prostheses in Nepal has several strengths. Firstly, it fills a crucial gap in the existing literature by focusing on a population and geographical region that has not been extensively studied, thus providing valuable insights into the specific challenges lower limb amputees face in Nepal. Secondly, the study's use of a standardized tool, the SF-12 Health Survey, allows for reliable and consistent measurement of health-related quality of life, making the results more robust and comparable to other studies. Additionally, including participants who had received prostheses from a single, experienced provider ensures consistency in the quality and type of prosthetic care, which helps to isolate the effects of prosthetic use on quality of life.

This study has several limitations that should be acknowledged. The sample size of 43 participants is relatively small, which may limit the statistical power and generalizability of the findings, increasing the likelihood of Type II errors where significant associations may go undetected. Additionally, convenience sampling may introduce bias, as

participants were selected based on availability rather than random selection, potentially leading to a sample that does not accurately represent the broader population of lower limb amputees. This limitation may affect the applicability of the findings across different demographics, such as age, gender, and reasons for amputation.

Furthermore, the cross-sectional design restricts causal inferences, making determining the directionality of relationships between sociodemographic variables and health-related quality-of-life outcomes difficult. Self-reported measures may also be subject to biases, impacting the reliability of the results. Future research should aim to include larger, more diverse samples and consider randomized sampling methods. Despite these limitations, this study provides valuable insights into the factors influencing health-related quality of life among lower limb amputees in Nepal, underscoring the need for comprehensive rehabilitation strategies.

Study implications

The findings of this study underscore critical implications for enhancing health-related quality of life (HRQoL) among lower limb amputees. Significant associations between factors such as age, marital status, stump pain management, and the perceived effectiveness of pain treatments highlight the need for tailored rehabilitation programs that address the unique challenges faced by amputees. Effective pain management strategies can improve mobility and engagement with prosthetic devices, leading to better physical and mental health outcomes. Additionally, increasing social support through counseling and community engagement can positively influence emotional stability, particularly for older amputees or those coping with traumatic amputations.

Furthermore, the study emphasizes the importance of proactive pain management and empowering amputees in their rehabilitation journey. Educating patients on self-management techniques can foster autonomy and control, which is essential for adapting to prosthetic use. The correlation between the perceived effectiveness of pain treatment and HRQoL highlights the need for continuous patient-provider communication to ensure individuals feel supported in their treatment choices. In summary, the evidence from this study points to the necessity for a comprehensive, individualized approach to rehabilitation that addresses both the physical and emotional aspects of living with limb loss, ultimately enhancing the overall quality of life for lower limb amputees.

Conclusions

These findings indicate that age, marital status, extremity dominance, reason for amputation, stump pain treatment, and pain management are critical factors influencing the quality of life among lower limb amputees. The study underscores the need for comprehensive rehabilitation programs incorporating effective pain management, spouse support, and tailored interventions based on individual demographic and clinical characteristics. By addressing these factors, rehabilitation efforts can enhance mobility, independence, and social integration for lower limb amputees in Nepal, ultimately promoting a more fulfilling life despite the physical challenges they face while using prostheses.

Abbreviations

HrQoL	Health-related Quality of Life
SF-12	Short Form Health Survey-12
MCS	Mental Component Summary
PCS	Physical Component Summary
χ^2	Chi-square
B&B IRC	B&B Institutional Review Committee
HRDC	Hospital and Rehabilitation Center for Disabled Children

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

BB, RB, and NB contributed to the study's idea and conception, questionnaire development, analysis, writing of the original draft, and finalisation of the manuscript. AB was involved in the study's idea and conception. NB also handled data collection. PKY and YPG contributed to the initial review, manuscript writing, editing, and revising. BB and RB provided supervision. All authors have read and approved the final manuscript.

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Data availability

Primary data for this study was collected and is available upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the B&B Institutional Review Committee (B&B IRC) under reference number B&BIRC-22-50 in Nepal. Informed consent was secured from each participant following the Declaration of Helsinki, a set of ethical principles for medical research involving human subjects developed by the World Medical Association (WMA) in 1964.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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