

Observational Clinical Studies

Determinants of Quality of Life in Patients After Lower Limb Trauma: A Cross-Sectional Study

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Abstract: Lower limb injuries encompass a wide range of trauma resulting from various mechanisms. Their impact on patients' quality of life differs according to several determinants, including demographic characteristics and the type of treatment applied. To examine the extent of the relationship between patients' quality of life and selected variables (age, sex, education, type of treatment). Methods and sample: A quantitative cross-sectional study was conducted between June 2025 and September 2025 using the standardized WHOQOL-BREF questionnaire. Adult patients after lower limb trauma (n = 309), assessed in the early post-traumatic period, specifically between 1 and 3 months after injury. Results: Statistically significant differences in quality of life were found between males and females ($\chi^2 = 19.08$; $df = 3$; $p < 0.001$). Higher age showed a weak negative correlation with quality-of-life scores ($R = -0.36$; $p < 0.001$). The lowest quality of life was reported among individuals with primary education (median = 3.0), whereas patients with secondary and tertiary education achieved higher median scores (both median = 4.0). No statistically significant differences were identified between conservatively and surgically treated patients regarding their perceived quality of life ($p = 0.519$). Conclusions: Assessing and evaluating patients' quality of life is crucial in nursing practice. Understanding the factors that influence quality of life is essential for nurses and represents an integral component of holistic patient assessment, as well as the planning and implementation of nursing interventions aimed at improving the quality of life of patients after lower limb trauma.

Keywords: Quality of life, lower limb injuries, determinants of quality of life, Rehabilitation after injury, WHOQOL BREF questionnaire, Health-related quality of life (HRQoL)

1. Introduction

Lower limb injuries represent one of the most common types of trauma, characterized by considerable heterogeneity and arising from various mechanisms of injury [1]. The athletic population is also considered a risk group. The specific sports environment, in combination with characteristic sport- and game-related movement patterns, may lead to excessive loading of the lower limbs and the subsequent development of angular deviations in the knee and ankle joints of athletes [2], thereby increasing the risk of traumatic injuries to both soft and rigid tissues of the lower extremities. Optimal dynamic stability plays a crucial role in the prevention of lower-limb injuries in athletes [3]. If injuries are not adequately treated, they may result in long-term functional impairments [4].

Fractures of the lower extremities constitute a significant global health burden and pose substantial social and economic challenges. Projections indicating a rise in incidence over the coming decades highlight the importance of early implementation of preventive strategies [5].

Epidemiological studies consistently report that the most common lower limb injuries include sprains and strains of ligamentous and musculoskeletal structures; ankle and tibial fractures; and knee injuries, including ligamentous and meniscal lesions, as well as fractures of the patella, femur, and proximal femur [6, 7]. Each musculoskeletal pathology is associated with pain and anxiety. Sympathetic autonomic manifestations may also occur, including palpitations, sweating, dyspnea, and other symptoms [8]. Pain, particularly somatic pain, is a significant factor contributing to a reduced quality of life, as it affects the overall health status, emotional well-being, and physical fitness of patients [9]. Lower limb injuries are associated with marked limitations in daily functioning and reduced quality of life, persisting even several months into rehabilitation [10]. According to the World Health Organization (WHO), quality of life is defined as an individual's perception of their health status across several dimensions, including physical, psychological, economic, social, and environmental aspects. Kuciaková et al. [11] state that quality of life is perceived as an indicator of an individual's overall health status. It is defined as a comprehensive state of both mental and physical well-being, encompassing adequate social and personal functioning, a positive perception of one's own health, high life satisfaction, and overall well-being [12]. According to Murgoci et al. [13], the concept of quality of life refers to the overall well-being and satisfaction an individual experiences in life. It can be assessed through various factors, including physical health, emotional well-being, social relationships, financial stability, education, and access to leisure and recreational activities. Quality of life is also influenced by cultural and societal factors, as well as by individual values and life goals. The World Health Organization developed an index known as the World Health Organization Quality of Life (WHOQOL), which comprises physical health, psychological well-being, social relationships, environment, level of independence, and spiritual dimensions [9]. Ensuring a positive quality of life is essential for achieving a holistic approach to patient management [14]. The concept of quality of life is closely related to several other constructs central to nursing practice, such as human needs, health, self-care, well-being, daily activities, and the existential dimensions of human life [15]. Numerous studies highlight the significant negative impact of lower limb injuries on patients' quality of life.

Fractures of the lower extremities have a negative impact on quality of life that persists for at least six months following the traumatic event, reflecting the psychosocial, physical, and emotional burden associated with the injury [16]. Prospective studies further indicate that patients often do not return to their pre-injury levels of quality of life in the domains of physical and psychological health even six months after trauma [17]. Similarly, systematic reviews report a substantial decline in quality of life resulting from fractures, particularly in the domain of physical functioning [18], with reductions identified across multiple dimensions, including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression [19].

Quality of life following lower limb trauma is determined by a multifactorial set of influences; among the most significant predictors are pain intensity, age, sex, injury severity, comorbidities, and psychosocial factors. These determinants may manifest in long-term changes in quality of life that persist even after treatment is completed. Despite the availability of systematic reviews addressing quality of life after severe trauma [20], the literature still lacks a sufficiently detailed identification of specific predictors of quality of life following lower limb injuries, particularly in relation to the type of injury, functional status, and rehabilitation trajectory. Kutiš et al.

[21] emphasize the necessity to examine the correlations among age, sex, and perceived pain intensity as an interactive framework within the context of demographic variables and perceived social support provided by healthcare professionals.

A consistent use of standardized instruments for measuring quality of life, as well as their integration with clinical, functional, and psychosocial parameters over the long term, remains insufficiently developed in the current literature. This gap calls for studies that systematically evaluate quality of life outcomes in relation to both demographic and treatment-related factors. Research findings have the potential to aid in the treatment and rehabilitation of patients by taking individual patient characteristics into account, thereby enabling the optimization of patient care and supporting long-term improvements in quality of life after lower limb injuries.

Given these considerations, it is essential to analyze the factors influencing quality of life following lower limb trauma. Based on existing evidence suggesting that sociodemographic and clinical variables may influence patient-reported outcomes, we formulated the working hypothesis that quality of life differs according to selected patient characteristics and treatment modalities. The aim of our study was to examine the extent of the relationship between quality of life and selected variables (age, sex, education, and type of treatment).

2. Methods and study sample

The study was conducted between June 2025 and September 2025 across several healthcare facilities, specifically trauma surgery outpatient clinics, orthopedic outpatient departments, and physiatric rehabilitation clinics. A multicenter recruitment approach was employed to enhance the heterogeneity of the study population and to capture patients at different stages of post-injury care. The research was carried out in accordance with applicable data protection legislation and the ethical standards of the respective healthcare institutions. Participant anonymity and voluntary participation were ensured throughout the research process.

The study included a total of 309 respondents. The largest proportion of participants (44.6%) were between 26 and 45 years of age. The youngest respondent was 18 years old, and the oldest was 80 years old. The mean age of the sample was 41.40 years, with a median of 40.0 and an SD of 15.83. Men accounted for 57.3% of the sample, while 42.7% were women. A total of 59.2% of respondents had completed secondary education. The most frequent lower limb injuries among our respondents were knee injuries (approximately 70%), followed by crural (lower-leg) fractures, ankle fractures, Achilles tendon injuries, femoral fractures, and calcaneal fractures. Most patients underwent subsequent rehabilitation treatment.

The study population consisted of patients who had sustained lower limb injuries of varying types and severity, including fractures, soft tissue injuries (e.g., ligamentous or muscular damage), and post-surgical conditions following trauma-related interventions. Due to the observational nature of the study, injury severity was not formally stratified using a standardized classification system; however, participants represented a spectrum ranging from less severe injuries managed conservatively to more complex cases requiring surgical treatment.

The inclusion criteria for participation were the following: having sustained a lower limb injury within a period of at least 1 to 3 months prior to data collection, being age 18 years or older, and providing informed consent. This time frame was selected to include patients in the early to intermediate phase of recovery, although some variability in rehabilitation progress between participants cannot be excluded. Exclusion criteria included severe visual impairment, the presence of cognitive disorders, and refusal to participate in the study.

Participants were recruited sequentially during standard outpatient appointments. Eligible patients were approached by trained healthcare personnel, informed about the purpose and procedures of the study, and invited to participate. No financial or other incentives were provided. Although all participants met the inclusion criteria, full comparability in terms of recovery stage, injury severity, and rehabilitation exposure cannot be assumed.

The standardized WHOQOL-BREF questionnaire (World Health Organization Quality of Life–BREF) was utilized to assess quality of life. This instrument is a condensed version of the original WHOQOL-100, developed by the WHOQOL Group under the auspices of the World Health Organization. The WHOQOL-BREF consists of 26 items, of which 24 are divided into four domains: physical health (including factors such as pain, energy, sleep, mobility, and dependence on medical treatment), psychological health (encompassing both positive and negative affect, self-perception, cognitive functioning, and emotional status), social relationships (covering personal relationships and perceived social support), and environment (including aspects like safety, access to health care, financial resources, and living conditions). The remaining two items assess the individual's overall perception of quality of life and satisfaction with health.

Responses are recorded on a 5-point Likert scale. Domain scores are calculated as the mean of the relevant items within each domain and are then transformed to a standardized scale, where higher scores reflect better perceived quality of life. The WHOQOL-BREF has been thoroughly validated across diverse populations, including individuals with chronic conditions and patients undergoing orthopedic interventions. The instrument exhibits satisfactory psychometric properties, with Cronbach's alpha coefficients for the individual domains typically greater than 0.70, indicating acceptable to high internal consistency [22].

We expanded the questionnaire with custom-designed items to collect sociodemographic data (age, sex, education, employment status, and marital status) and additional questions regarding the type of treatment received (e.g., conservative vs. surgical management), enabling subsequent analysis of the relationships between patient characteristics and treatment outcomes. Questionnaires were administered in paper-based form during outpatient visits, with respondents completing them independently; assistance was provided only when clarification of items was required. This approach was intended to minimize interviewer bias while ensuring comprehension. A total of 420 questionnaires were distributed, with a final return rate of 309 completed questionnaires (75%).

Before conducting statistical analyses, the normality of the data was verified using the Kolmogorov–Smirnov test, which confirmed the absence of normal distribution across most of the examined variables. Therefore, non-parametric statistical tests were used for inferential analysis, including the Mann–Whitney U test, the Kruskal–Wallis test followed by Dunn's post hoc test pairwise comparisons, the non-parametric Spearman correlation coefficient, and contingency tables based on chi-square statistics. Statistical significance was assessed using the conventional threshold of $p < 0.05$.

Data were initially entered into a database in MS Excel format and subsequently processed using InStat® software (version 3.02, GraphPad Software, USA). All participants received written and verbal information about the study and provided informed consent prior to participation. Confidentiality and data protection were maintained throughout the study in compliance with applicable regulations. The study was conducted in accordance with the ethical standards of the Declaration of Helsinki for research involving human subjects.

3. Results

Using the WHOQOL-BREF questionnaire, we examined the influence of selected sociodemographic factors (sex, age, education) and clinical factors (type of treatment) on quality of life.

As shown by the results presented (Table 1), statistically significant differences were observed between the individual categories when compared with the expected counts that would be present if sex had no influence on the perception of quality of life (QoL). Neither men nor women included individuals who rated their quality of life as very poor. However, only 6 men perceived their QoL as poor, whereas the expected count would be 15. In contrast, only 12 women would be expected to perceive their QoL as poor, yet the actual number was 21.

Men rated their QoL as “good” in as many as 81 cases (compared with an expected count of 69), whereas women rated their QoL as “good” in only 39 cases (expected count: 51). The differences between sexes were statistically significant ($\chi^2 = 19.08$; $df = 3$; $p < 0.001$), supporting the assumption that sex may be an important factor influencing the subjective assessment of QoL.

Table 1. Sex-Related Differences in Patients’ Quality of Life

Parameters	Quality of Life				Total
	Poor	Neither poor nor good	Good	Very good	
Male	6 (15)	33 (33)	81 (69)	57 (60)	177
Female	21 (12)	24 (24)	39 (51)	48 (45)	132
Total	27	57	120	105	309

Legend: $\chi^2=19.08$; number of degrees of freedom = 3; $p < 0.001$. The expected counts for each category are provided in parentheses

Spearman’s correlation analysis revealed a mild negative association between patients’ age and their subjective assessment of quality of life ($R = -0.36$; $p < 0.001$). Higher age was associated with lower quality of life scores, indicating that increasing age is accompanied by a gradual decline in perceived comfort and life satisfaction (Table 2).

Table 2. Correlation Between Patients’ Age and Their Perceived Quality of Life

QoL versus:	n	R	CI		p
			-95%	+95%	
Age	309	-0.36	-0.46	-0.26	< 0.001

Legend: n – number of patients, R – Spearman’s correlation coefficient, CI – confidence interval for the location of the correlation coefficient, p - the test statistic value for the difference between the observed correlation coefficient and the null value.

The analysis (Table 3) showed that individuals with primary education reported the lowest QoL (median = 3.0), whereas those with secondary and tertiary education demonstrated higher median QoL scores (both medians = 4.0). These two groups were very similar, with no statistically significant differences between them (Dunn’s test, $p > 0.05$). Patients with primary education exhibited lower QoL compared with those with secondary or tertiary education, who reported higher levels of QoL, with no evident difference between the latter two groups. These findings suggest that a lower level of education is associated with a slightly poorer perception of quality of life.

Table 3. The Impact of Patients' Education Level on Their Quality of Life

Education	<i>n</i>	$\bar{x}$	<i>sd</i>	x_m	<i>min.</i>	<i>max.</i>	p_{KW}	p_D		
								Primary	Secondary	Tertiary
Primary	12	3.3	1.1	3.0	2	5	0.038	-	*	ns
Secondary	183	4.0	0.9	4.0	2	5		*	-	ns
Tertiary	114	3.9	1.0	4.0	2	5		ns	ns	-

Legend: *n* – number of patients, $\bar{x}$ – arithmetic mean, *sd* – standard deviation, x_m – median, *min.* – minimum value, *max.* – maximal value, p_{KW} – the Kruskal–Wallis test statistic, p_D – the test statistic value of Dunn's pairwise test: * – $p < 0.05$, ns – $p > 0.05$.

A total of 183 individuals underwent surgical treatment, while 126 individuals received conservative treatment (Table 4). Both groups showed the same median value (median = 4.0) and identical minimum (*min* = 2) and maximum observed scores (*max* = 5; Table 4). Based on these results, we can conclude that surgical and conservative treatments do not differ in their effects on patients' perceived quality of life.

Table 4. The Impact of Treatment on Patients' Quality of Life

Treatment	<i>n</i>	$\bar{x}$	<i>sd</i>	x_m	<i>min.</i>	<i>max.</i>	<i>p</i>
Surgical	183	3.9	1.0	4.0	2	5	0.519
Conservative	126	4.0	0.8	4.0	2	5	

Legend: *n* – number of patients, $\bar{x}$ – arithmetic mean, *sd* – standard deviation, x_m – median, *min.* – minimal value, *max.* – maximal value, *p* – the Mann–Whitney U test statistic

3. Discussion

The main objective of our research was to analyze selected determinants of quality of life among patients after lower limb trauma. The results indicate that quality of life is influenced by several demographic determinants. A statistically significant difference in quality of life was identified based on patients' sex, as well as a weak negative correlation between quality of life and age. In contrast, no statistically significant differences in quality of life were found between the different types of treatment for lower limb injuries.

The Relationship Between Sex and Quality of Life

The results of our study demonstrated a statistically significant difference between men and women in the assessment of quality of life after lower limb trauma. Women rated their quality of life more frequently in the lower categories compared with men. This finding may reflect an interaction of biological, psychological, and social factors. Several epidemiological studies consistently report lower quality of life scores among women compared to men [5, 23], not in the physical domain but rather in aspects related to mental health and return to work [24]. These results corroborate the hypothesis that sex may affect the subjective assessment of health status subsequent to lower limb trauma. They also indicate that sex-related differences may be shaped by additional variables such as injury severity, presence of comorbidities, access to rehabilitation, psychosocial support, differences in social roles, and psychological coping strategies.

The Relationship Between Age and Quality of Life

In our study, we identified a mild negative correlation between patients' age and their quality of life, indicating a gradual decline in subjectively assessed quality of life with increasing age. This finding is consistent with previously published data [16,

25], which report that advancing age is associated with significant limitations in physical activity, slower functional recovery, and a higher degree of restrictions, all of which negatively influence the subjective perception of quality of life. Several studies, including our own, suggest that increasing patient age is associated with decreasing quality of life after lower limb trauma. This decline depends not only on the type of injury but also on multiple accompanying factors such as a higher prevalence of chronic diseases, a pre-existing physical condition, and an increased risk of complications during treatment. Moreover, it is important to emphasize that older age may be linked to greater social isolation and reduced social participation, which can substantially contribute to the subjective perception of quality of life following injury.

The Relationship Between Education Level and Quality of Life

Education is widely regarded as an important determinant of health and quality of life. Vitalis et al. [26], in their research conducted on patients following arthroscopic knee joint surgery, reported a positive association between higher levels of education and better mental health outcomes, suggesting a potential interrelationship between socioeconomic factors and postoperative outcomes. At the same time, they emphasize the importance of implementing comprehensive and individualized rehabilitation strategies. Van Son et al. [17] did not identify significant differences in quality of life in relation to education level, whereas several other authors suggest that lower educational attainment may be associated with poorer quality of life [27, 28, 29, 30].

Our study observed a similar pattern; however, we should approach the strength and interpretation of this relationship with caution. Patients with primary education reported lower quality of life compared with those with secondary and tertiary education. Although this finding may suggest a potential association, it does not allow for firm conclusions regarding a causal or robust relationship. One possible explanation is that higher educational attainment may be associated with better health literacy, more effective coping strategies, and greater ability to navigate the healthcare system, all of which may positively influence subjective perceptions of quality of life. However, our data does not directly support these explanations, which remain speculative. Caution is necessary when interpreting this preliminary observation, as our study's group with primary education was the smallest ($n = 12$).

Further supporting this cautious interpretation, statistically significant differences in QoL were observed only between patients with primary versus secondary education (Dunn's posttest, $p < 0.05$) but not between primary and tertiary education (Dunn's posttest, $p > 0.05$). Although no statistically significant differences were found between the median QoL of patients with secondary and tertiary education (both medians = 4.0), a significant difference emerged only between the primary and secondary education groups. This non-uniform pattern of results complicates the interpretation and weakens the evidence for a consistent gradient effect of education on QoL. This raises the question of what distinguished the tertiary-educated group such that no differences were observed between them and the primary-education group.

A likely explanation lies in methodological limitations rather than true population effects. The most plausible explanation is the nonrepresentativeness of the primary-education subgroup, specifically its small size and potential internal heterogeneity, which likely reflects the low population proportion of individuals with only primary education in Slovakia. This phenomenon is probably a consequence of Slovakia being classified as a country with a very high Human Development Index (HDI), to which

educational attainment contributes substantially [31]. Consequently, sampling bias cannot be excluded, and the observed differences may be unstable.

Therefore, our findings should be considered exploratory, and their generalization, particularly in comparison with studies conducted in different populations [27, 28, 29, 30], requires considerable caution.

The Relationship Between Treatment Modality and Quality of Life

In our study, no statistically significant relationship was found between the type of treatment and the quality of life of patients after lower limb trauma. This finding indicates that the treatment modality may not be the principal determinant of long-term quality of life outcomes. Instead, the impact may depend on the nature of the injury and the clinical condition of the patient.

The literature in this area presents mixed findings. Loggers et al. [32] report a lower incidence of adverse events associated with conservative treatment compared with surgical procedures. Conversely, Fioravanti et al. [33] describe improved functional outcomes and enhanced quality of life following surgical treatment. These discrepancies likely reflect differences in patients' clinical conditions, as treatment selection depends on multiple factors, particularly the type and severity of the injury, as well as the patient's overall medical status. Subsequent physiotherapy plays a significant role in treatment. Systematically planned exercise not only improves physical parameters but also positively affects psychological aspects, thereby contributing to a better subjective perception of quality of life. Structured physical activity transforms the patient into an active agent in the management of their pain [12]. Physical activity represents a protective factor for health, with evidence supporting its beneficial effects in both healthy individuals and those with various medical conditions [34].

Therefore, a complex interplay of treatment approaches, functional status recovery, and psychosocial determinants likely shapes the quality of life after lower limb trauma.

Future research should prioritize longitudinal study designs aimed at systematically monitoring patients following lower-limb injuries. Such investigations should encompass a comprehensive set of outcome variables, including pain intensity, functional mobility, psychological resilience, perceived social support, return-to-work trajectories, and the economic burden associated with prolonged work incapacity.

Furthermore, it is essential to examine rehabilitation-specific factors that may critically influence recovery outcomes. These include, but are not limited to, the timing of rehabilitation initiation, the intensity and frequency of therapeutic interventions, patient adherence to prescribed rehabilitation protocols, the utilization of assistive devices, and the level of functional independence achieved during the recovery process. An optimal methodological approach would involve at least two assessment points separated by a minimum interval of six months. Such a design would allow for a robust evaluation of temporal changes in quality of life throughout the convalescence period and facilitate the identification of determinants associated with more favorable recovery trajectories. In addition to these variables, future studies should also explore further dimensions of rehabilitation impact. These may include the role of individualized versus standardized rehabilitation protocols, the effectiveness of multidisciplinary rehabilitation teams, and the integration of digital health technolo-

gies such as tele-rehabilitation or wearable monitoring systems. Investigating patient-related factors such as motivation, health literacy, coping strategies, and comorbidity profiles may further elucidate variability in recovery outcomes.

Moreover, there is a need to assess biomechanical parameters, neuromuscular control, and movement quality using advanced motion analysis techniques to better understand functional restoration. The inclusion of patient-reported outcome measures (PROMs) alongside objective clinical indicators would provide a more holistic evaluation of treatment efficacy. Finally, comparative studies examining different rehabilitation models and healthcare system approaches could yield valuable insights for optimizing clinical practice and resource allocation.

4. Conclusions

Scientific studies, together with the findings of our research, indicate a reduced quality of life among patients following lower limb injury, influenced by multiple determinants. The most significant among these are age, sex, and, to some extent, education level. In contrast, the type of treatment did not demonstrate a statistically significant impact on quality of life assessment. From the perspective of improving quality of life, a holistic approach within healthcare and nursing practice appears essential, as it comprehensively addresses the physical, psychological, social, and environmental aspects of the patient's life. Implementing such an approach supports the patient's return to independence and autonomy, facilitates engagement in everyday activities, and may substantially contribute to higher subjective satisfaction and perceived quality of life.

Limitations of the Study

The cross sectional design of the study does not allow for causal inferences to be drawn from the observed relationships. The time elapsed since the injury ranged from one to three months, which may influence the subjective assessment of quality of life during the recovery period. It is also important to consider that the group of respondents with primary education was relatively small, which may limit the generalizability of the findings.

Ethics approval: The research was conducted in accordance with the principles and ethical guidelines outlined in the Ethics Committee of Alexander Dubček University of Trenčín (Approval No. 1-007/EK/2026), which is based on the Principles of Research Practice in Scientific Publishing. All participants were informed about the purpose and procedures of the study and provided informed consent prior to participation. The study was conducted in accordance with the ethical standards of the Declaration of Helsinki for research involving human subjects.

Data Availability Statement: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request

Conflict of interest: The authors have no conflict of interest to declare.

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