



The Role of Balance on the Path to Quality of Life: A Cross-Sectional Study in Athletes with Lower Limb Amputation

Yařam Kalitesine Giden Yolda Dengenin Rolü:
Alt Ekstremitte Amputasyonlu Sporcularda Kesitsel
Bir İnceleme

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Makale Bilgisi/Article Information

Makale Türü/Article Types: Arařtırma Makalesi/Research Article

Geliř Tarihi/Received: 23 Mayıs/May 2025

Kabul Tarihi/Accepted: 06 Mart/March 2026

Yıl/Year: 2026 | Cilt – Volume: 17 | Sayı – Issue: 1 | Sayfa/Pages: 63-76

Atıf/Cite as: Çelik, H., Yamaner, E., Çeviker, A. "The Role of Balance on the Path to Quality of Life: A Cross-Sectional Study in Athletes with Lower Limb Amputation" Ondokuz Mayıs University Journal of Sports and Performance Research, 17(1), Mart 2026: 63-76.

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Etik Kurul Beyanı/Ethics Committee Approval: "Ethical approval for the study was obtained from the Hitit University Non-Interventional Research and Publication Ethics Committee with decision number 2024-27, dated 06/01/2025, following the committee meeting held on 25/12/2025."

THE ROLE OF BALANCE ON THE PATH TO QUALITY OF LIFE: A CROSS-SECTIONAL STUDY IN ATHLETES WITH LOWER LIMB AMPUTATION

ABSTRACT

There are many factors affecting the quality of life in athletes with lower extremity amputation. The place and importance of balance, which is a very important skill, among these factors have not been sufficiently investigated. In this study, it was aimed to investigate the relationship between balance and quality of life in athletes with lower extremity amputation and to evaluate it comparatively with the literature in terms of some demographic variables. The study included 30 randomly selected athletes aged 19-45 with lower extremity amputation using prostheses. Data were collected using a personal information form, the Berg Balance Scale, and the Trinity Amputation and Prosthesis Experience Scale. Berg Balance Scale scores showed a low but significant positive correlation with the “psychosocial adjustment” subdimension ($r=0.362$; $p<0.049$), and a low but significant negative correlation with the “activity restriction” subdimension ($r=-0.367$; $p<0.046$) of the Trinity Amputation and Prosthesis Experience Scale. Additionally, a moderate and significant positive correlation was found between the “psychosocial adjustment” and “prosthesis satisfaction” subdimensions ($r=0.643$; $p<0.000$). Based on the findings, it was observed that higher balance levels were associated with better quality of life in athletes with lower limb amputation. Balance levels and prosthesis satisfaction were associated with better psychosocial adjustment. Accordingly, individuals’ ability to adapt to their social environment, develop self-confidence, and maintain daily life skills may be associated with their balance control and experience with prosthesis use.

Keywords: Amputee Athletes, Lower Extremity Amputation, Balance, Quality of Life.



YAŞAM KALİTESİNE GİDEN YOLDA DENGENİN ROLÜ: ALT EKSTREMİTE AMPUTASYONLU SPORCULARDA KESİTSEL BİR İNCELEME

ÖZ

Alt ekstremitte amputasyonu olan sporcularda yaşam kalitesini etkileyen birçok faktör vardır. Çok önemli bir beceri olan denge bu faktörler içerisinde yeri ve önemi yeterince araştırılmamıştır. Bu çalışmada, ilişkisel tarama modeli ile amputasyon geçirmiş sporcularda denge ile yaşam kalitesi arasındaki ilişkinin incelenmesi ve bazı demografik değişkenler açısından literatürle karşılaştırmalı olarak değerlendirilmesi amaçlanmıştır. Araştırma grubu, rastgele yöntemle seçilen, alt ekstremitte amputasyonu geçirmiş ve protez kullanan, yaşları 19-45 arasında değişen 30 sporcudan oluşmuştur. Veri toplama aracı olarak, araştırmacı tarafından hazırlanan kişisel bilgi formuna ek olarak; denge değerlendirmesi için Berg Denge Ölçeği, yaşam kalitesi değerlendirmesi için ise Trinity Amputasyon ve Protez Deneyim Ölçeği kullanılmıştır. Katılımcıların Berg Denge Ölçeği skorları ile Trinity Amputasyon ve Protez Deneyim Ölçeği'nin birinci kısmında yer alan alt boyutlardan "psikososyal uyum" arasında pozitif yönlü, düşük düzeyde anlamlı bir ilişki ($r=0,362$; $p<0,049$); "aktivite kısıtlılığı" alt boyutu ile ise negatif yönlü, düşük düzeyde anlamlı bir ilişki saptanmıştır ($r=-0,367$; $p<0,046$). Ayrıca, Trinity Amputasyon ve Protez Deneyim Ölçeği'nin birinci bölüm alt boyutlarından "psikososyal uyum" ile "protez memnuniyeti" arasında pozitif yönlü, orta düzeyde anlamlı bir ilişki tespit edilmiştir ($r=0,643$; $p<0,000$). Elde edilen bulgular doğrultusunda, alt ekstremitte amputasyonu geçirmiş sporcularda denge düzeyi arttıkça yaşam kalitesinin de yükseldiği görülmüştür. Denge düzeyi ve protez memnuniyeti, bireylerin psikososyal uyumu ile ilişkili bulunmuştur. Bu doğrultuda; bireylerin sosyal çevreye uyum sağlama, öz güven geliştirme ve günlük yaşam becerilerini sürdürülebilir kapasiteleri, denge kontrolü ve protez kullanım deneyimiyle ilişkili olabileceği düşünülmektedir.

Anahtar Kelimeler: Ampute Sporcular, Alt Ekstremitte Amputasyonu, Denge, Yaşam Kalitesi.



INTRODUCTION

Sports activities that support the physical and psychological well-being of individuals following lower extremity amputation are associated with the development of balance abilities. Previous research also indicates that psychological and environmental factors in sport settings may influence athletes' well-being and

sport-related outcomes (Özkan *et al.*, 2026). Balance not only enhances mobility but also reinforces individuals' independence and self-confidence by reducing risks encountered in daily life. In addition, studies conducted in sport sciences emphasize that athletes' psychological and social environments play an important role in shaping their overall well-being and performance outcomes (Uzun *et al.*, 2025). In this context, better balance abilities in athletes with lower extremity amputation may be associated with not only their athletic performance but also their social integration and overall quality of life.

Individuals with lower extremity amputation and elderly individuals frequently encounter the risk of falling while performing daily living activities. Complications resulting from falls can lead to serious health problems and even fatal outcomes, particularly for elderly individuals and amputees. Amputation is a major trauma that significantly affects an individual's functional capacity and ability to perform daily activities (Dajpratham *et al.*, 2008; Deans *et al.*, 2008). Regardless of the cause of amputation, impairments in balance, muscle strength, and mobility may negatively impact an individual's general health status and, consequently, significantly reduce their quality of life. The extent to which quality of life is affected following lower extremity amputation may vary depending on several factors, such as the applied prosthetic rehabilitation, the individual's psychological condition, social support systems, and the course of physical rehabilitation (Raya *et al.*, 2010).

One of the main factors affecting the quality of life in amputee individuals is the loss of mobility resulting from the loss of a limb. The use of prostheses has the potential to compensate for this loss and contribute to the reintegration of individuals into social life (Bayramlar, 2007). For individuals with lower extremity amputation, the selection of appropriate prosthetic components and ensuring that the prosthesis meets functional requirements are of great importance (Yinanç, 2024). Following the fitting of the prosthesis, completing the adaptation process is critical for facilitating reintegration into society (Demirdel and Bayramlar, 2014). During this process, training on prosthesis use and functional training is essential. In this context, rehabilitation programs designed to improve individuals' quality of life and support their reintegration into social life highlight leisure activities, sports, and exercise as key contributing factors (Bayramlar, 2009).

This study aims to contribute to the existing literature by examining the association between balance and quality of life in athletes with lower extremity amputation. Although numerous studies have investigated balance and quality of life following amputation, the majority of these have focused on the general population, while research specifically centered on athletes with lower limb amputation remains limited. In this context, the findings of this study are expected to inform strategies for rehabilitation processes, enhance understanding of the functional effects of prosthesis use, and evaluate the role of physical activity in relation to qua-

lity of life following amputation—thereby contributing to the athletic performance of individuals with lower extremity amputation. Accordingly, the main objective of this research is to examine the associations between balance measures and quality of life in athletes with lower extremity amputation and to interpret the findings within a field-specific context.

METHOD

Participants

The study population consisted of athletes residing in Türkiye who had undergone unilateral lower extremity amputation. The sample included 30 male athletes aged between 19 and 45 years, selected randomly, all of whom had undergone unilateral lower extremity amputation. Participants were included if they had been using their prosthesis for at least one year, were able to walk independently without assistive devices, and were classified as at least K3 level according to the Medicare Functional Classification Level. Individuals with bilateral lower extremity and/or upper extremity amputation or those with chronic orthopedic and/or neurological conditions unrelated to the amputation were excluded from the study. Data were collected through face-to-face interviews.

Data Collection Tools

This study was conducted within the framework of a correlational survey model. The survey model is a research approach that enables generalizations about a study group by collecting data from a broad participant base (Karasar, 2016; Büyüköztürk et al., 2017). In addition to a personal information form prepared by the researcher, the following standardized instruments were used: the “Berg Balance Scale (BBS),” whose Turkish validity and reliability were established by Şahin et al. (2008), and the “Trinity Amputation and Prosthesis Experience Scales (TAPES),” developed by Gallagher et al. (2004) and adapted into Turkish by Topuz et al. (2011).

Personal Information Form

The personal information form, developed by the researchers, was designed to collect data on the demographic characteristics of the participants involved in the study.

Berg Balance Scale (BBS)

The Berg Balance Scale (BBS), developed to evaluate individuals’ balance levels, is a measurement tool whose Turkish validity and reliability were established by Şahin et al. (2008). The scale consists of 14 items grouped under three sections.

Each item is scored between 0 and 4 based on the individual's performance. A score of 0 is given if the individual is unable to perform the activity, and a score of 4 is assigned if the activity is completed independently. The maximum score obtainable from the scale is 56. Based on scoring: 0-20 points indicate a severe balance impairment, 21-40 points indicate an acceptable balance level, and 41-56 points indicate good balance. The application of the scale takes approximately 10-20 minutes (Berg et al., 1989; Blum & Korner-Bitensky, 2008; Downs et al., 2013; Downs, 2015).

Trinity Amputation and Prosthesis Experience Scale (TAPES)

The Trinity Amputation and Prosthesis Experience Scale (TAPES), developed by Gallagher et al. (2004) and validated in Turkish by Topuz et al. (2011), was used to evaluate amputees' experiences with prosthesis use, levels of adaptation, satisfaction, and quality of life. Participants were informed about the scale, and the application commenced after ensuring their understanding of the items. The scale consists of two main sections. The first section includes three subdimensions: psychosocial adjustment, activity restriction, and prosthesis satisfaction. The second section contains questions related to prosthesis use and amputation, such as duration of prosthesis use, general health status, and physical capacity (Gallagher et al., 2004).

Data Analysis

The data obtained in this study were analyzed using the SPSS 23.0 statistical software package. The normality of the variables was evaluated by examining skewness and kurtosis coefficients, and it was determined that the data were normally distributed. To determine whether there were significant differences in scale scores based on participants' demographic variables, parametric tests including t-test, ANOVA, and Pearson correlation analysis were employed. A significance level of $p < 0.05$ was accepted for all analyses.

RESULTS

A total of 30 male athletes with lower extremity amputation participated in the study. The participants' mean age was 24.93 ± 2.63 years; mean duration of engaging in sports was 4.06 ± 1.65 years; mean daily prosthesis use was 5.13 ± 2.04 hours; mean total duration of prosthesis use was 4.73 ± 1.87 years; and the mean time elapsed since amputation was 9.86 ± 3.30 years (Table 1).

Table 1. Demographic and amputation-related information of the participants

Variables	n: 30
	mean±sd
Age (years)	24.93 ± 2.63
Duration of Sports (years)	4.06 ± 1.65
Duration of Daily Prosthesis Use (hours)	5.13 ± 2.04
Duration of Prosthesis Use (years)	4.73 ± 1.87
Duration Since Amputation (years)	9.86 ± 3.30

n: number of individuals, sd: standard deviation.

It was determined that 33.3% of the participants had postgraduate education, 46.7% had undergraduate education, 16.7% had high school education, and 3.3% had completed primary education. Regarding the side of amputation, 50% of the participants had left lower limb amputation, and 50% had right lower limb amputation. When the causes of amputation were examined, 62.5% were due to vascular reasons, 11% were due to traumatic causes, and 26.5% were due to other reasons. In terms of prosthesis use, 53.3% of the participants reported that they were using their first prosthesis, while 46.7% were using their second prosthesis. Additionally, based on the amputation level, 56.7% had transtibial and 43.3% had transfemoral amputations (Table 2).

Table 2. Demographic and amputation-related information of the participants

Demographic Variable	Sub-Group	f	%
Education Level	Primary School	1	3.3
	High School	5	16.7
	University	14	46.7
	Post Graduate	10	33.3
Amputee Side	Right	15	50.0
	Left	15	50.0
Cause of Amputation	Traumatic	7	11.0
	Vascular	8	62.5
	Other	15	26.5
How Many Prosthesis	First Prosthesis	16	53.3
	Second Prosthesis	14	46.7
Amputation Level	Below the Knee	17	56.7
	Above the Knee	13	43.3

f: frequency, %: percentage value (percentage equivalent of the frequency according to the total number of samples).

According to the participants' reports on phantom pain, 60% stated that they experienced it very rarely, while 40% reported no phantom pain at all. Regarding stump pain, 76.7% indicated that they did not experience any stump pain, whereas 23.3% stated that they experienced it very rarely (Table 3).

Table 3. Frequency values of participants' stump and phantom pain

Variables		f	%
Phantom Pain	Very Little	18	60.0
	Never	12	40.0
Stump Pain	Very Little	7	23.3
	Never	23	76.7

f: frequency, %: percentage value (percentage equivalent of the frequency according to the total number of samples).

A positive, low-level correlation was found between participants' Berg Balance Scale (BBS) scores and the "psychosocial adjustment" subdimension of the first part of the Trinity Amputation and Prosthesis Experience Scales (TAPES) ($r = 0.362$; $p = 0.049$). In contrast, a negative, low-level correlation was observed between BBS scores and the "activity restriction" subdimension ($r = -0.367$; $p = 0.046$). However, no statistically significant correlation was found between prosthesis satisfaction and BBS scores ($p > 0.05$). Additionally, a moderate, positive, and statistically significant correlation was identified between the psychosocial adjustment and prosthesis satisfaction subdimensions of TAPES ($r = 0.643$; $p = 0.000$) (Table 4).

Table 4. The relationship between Berg Balance Scale and TAPES part 1

		Psychosocial Adjustment	Activity Restriction	Prosthesis Satisfaction
BBS Total Score	r	0.362	-0.367	0.231
	p	0.049*	0.046*	0.219
	n	30	30	30
Psychosocial Adjustment	r	-	-0.211	0.643
	p	-	0.262	0.000*
	n	-	30	30
Activity Restriction	r	-0.211	-	-0.117
	p	0.262	-	0.540
	n	30	-	30
Prosthesis Satisfaction	r	0.643	-0.117	-
	p	0.000*	0.540	-
	n	30	30	-

*p<0.05

**Pearson correlation analysis, r: correlation coefficient, p: significance level-p value, n: number of individuals, BBS: Berg Balance Scale.

Note: Effect size estimates (r^2) indicated that BBS scores accounted for approximately 13% of the variance in psychosocial adjustment ($r^2 = 0.13$) and 14% in activity restriction ($r^2 = 0.14$), while psychosocial adjustment accounted for approximately 41% of the variance in prosthesis satisfaction ($r^2 = 0.41$).

Table 5. The relationship between Berg Balance Scale and data related to amputation and TAPES part 2

		Time Since Amputation	Age at Amputation	Daily Prosthesis Wearing Time	General Health Status	General Physical Capacity
BBS Total Score	r	0.179	-0.109	-0.018	0.189	0.227
	p	0.345	0.567	0.924	0.317	0.213
	n	30	30	30	30	30

Pearson correlation analysis, r: correlation coefficient, p: significance level-p value, n: number of individuals, BBS: Berg Balance Scale.

The relationship between participants' Berg Balance Scale (BBS) scores and the items in the second part of the Trinity Amputation and Prosthesis Experience Scales (TAPES) was analyzed. The results indicated that there was no statistically

DISCUSSION

In this study, the relationship between balance and quality of life in athletes with lower limb amputation was evaluated in comparison with existing literature in terms of various demographic variables. The literature emphasizes that regardless of the cause of amputation, impairments in balance, strength, and mobility result in a deterioration of overall health status (Raya et al., 2010), which in turn negatively affects quality of life (Aydın and Atıç, 2018). These findings are consistent with the results of our study. Although the correlations observed in our Results were statistically significant, their magnitudes were generally low to moderate. Therefore, these findings should be interpreted cautiously as associative relationships rather than strong predictive or causal effects.

In our study, a low-level positive correlation was found between Berg Balance Scale (BBS) scores and the "psychosocial adjustment" subdimension of the first part of the Trinity Amputation and Prosthesis Experience Scale (TAPES). This finding suggests that higher balance levels are associated with better psychosocial adjustment. Additionally, a low-level negative correlation was identified between BBS scores and the "activity restriction" subdimension, indicating that higher balance scores are associated with lower activity restrictions. Given the low magnitude of these associations, they should not be overinterpreted as indicating strong predictive relationships. These results are consistent with literature indicating that participation in sports after amputation is associated with enhanced social adjustment and confidence in balance, and that physical activity may contribute positively to adaptation processes (Hudson, 2022). It has also been emphasized that psychosocial adjustment is a significant determinant of quality of life in individuals with transtibial amputation (Luthi, 2020).

The literature indicates that following lower limb amputation, the quality of daily activities such as walking, driving, and working declines, which may lead to a significant reduction in overall quality of life. Godlwana et al. (2020) demonstrated that an eight-week strengthening and balance exercise program improved strength, balance, and quality of life scores. Additionally, various sports have been shown to be associated with improvements in balance and quality of life in individuals with unilateral amputation (Yazicioglu et al., 2007). These findings are consistent with the results of our study.

Studies clearly demonstrate the link between physical and psychological health in individuals with lower limb amputation. Accordingly, the importance of holistic

rehabilitation approaches that address both biomechanical and psychological factors is emphasized (Moini et al., 2023). Through rehabilitation, appropriate trunk muscle engagement can be achieved, allowing for more efficient postural control that minimizes fall risk during tasks such as obstacle negotiation in daily life (Marigold et al., 2005; Molina-Rueda et al., 2016). These findings support the notion that amputation is not solely a physical loss but also a condition that impacts an individual's psychological and social well-being (Oğul, 2005). Consistent with this literature, our study also identified a relationship between balance and quality of life in athletes with lower limb amputation.

In our study, no significant relationship was found between prosthesis satisfaction and Berg Balance Scale (BBS) scores. This result may be explained by the variability in individual compatibility due to the use of different socket and prosthesis types, as well as differing prosthetic technologies, among participants with varying levels of amputation. The individual adaptation of prostheses may not have had a clear effect on balance. Furthermore, no significant relationship was found between the duration of prosthesis use and BBS scores; this suggests that personal adaptation factors may play an important role in the process of achieving balance with a prosthesis. A moderate positive correlation was found between the psychosocial adjustment and prosthesis satisfaction subdimensions of the first part of the TAPES in amputee athletes. This indicates a moderate associative relationship between these constructs, such that higher prosthesis satisfaction is associated with better psychosocial adjustment. This result suggests that amputee athletes with higher prosthesis satisfaction may report better adaptation to social life and higher perceived quality of life. Although studies investigating psychosocial adjustment after amputation are limited in the literature, the available findings (Asano et al., 2008; Miller et al., 2001) are consistent with the results of our study. However, no significant relationship was found between the subdimensions of the second part of the TAPES and the BBS scores of the participants.

In conclusion, balance levels were significantly associated with quality-of-life-related outcomes among athletes with lower extremity amputation. However, the observed associations were generally low to moderate, and thus should be interpreted as correlational rather than implying strong predictive or causal effects. Higher balance and greater prosthesis satisfaction were associated with better psychosocial adjustment, which constitutes a key component of overall quality of life. The focus of this study on amputee athletes is considered to make a noteworthy contribution to the literature. Given that existing studies primarily address the general amputee population, the current study provides new perspectives for rehabilitation processes and athletic performance by concentrating specifically on athletes.

Future studies may focus on the associations of sport-specific static and dynamic balance exercises, as well as training methods, with quality of life of athletes

with lower extremity amputation. Such research should take into account variables such as the types of prostheses used, the level of amputation (transtibial vs. transfemoral), and the different balance skills required by various sports disciplines. Additionally, it is recommended that healthcare providers develop comprehensive rehabilitation programs for individuals with lower limb amputation, especially in the early phases of rehabilitation. These programs should include early prosthetic fitting along with balance and proprioceptive training to promote positive physical and psychosocial adaptation following amputation. The findings of this study are valuable for informing the development of such rehabilitation strategies. Moreover, the importance of approaches focusing on early prosthetic use and balance training processes has been clearly demonstrated. Particularly for amputees who maintain an active lifestyle through sports, investigating the long-term effects of sport-specific balance training and proprioceptive exercises on quality of life could make a significant contribution to the literature. Individualizing rehabilitation practices in this direction may be beneficial in enhancing both psychosocial adjustment and functional independence.

CONCLUSION AND RECOMMENDATIONS

- The findings of this study can be summarized as follows:
- It was found that balance is positively associated with quality of life in athletes with lower limb amputation.
- Balance is particularly related to psychosocial adjustment and contributes to reducing activity restrictions.
- No significant relationship was found between prosthesis satisfaction and balance. This may be due to factors such as different levels of amputation, varying socket-prosthesis types, and individual adaptation processes.
- The importance of early prosthesis fitting and balance training in rehabilitation programs should be emphasized.
- The results of this study suggest that balance training plays a critical role in improving post-amputation quality of life and should be integrated into rehabilitation programs.
- Overall, these findings should be considered preliminary and interpreted with caution, as they are based on a limited sample and a cross-sectional design.
- Limitations and Recommendations for Future Studies:

- The limited sample size restricts the generalizability of the results. Future studies including a larger sample from various sports disciplines could offer a more comprehensive interpretation of the findings.
- This study included only male athletes. Future research should be expanded to include female amputee athletes.
- Variables such as amputation level, socket-prosthesis type, and sport discipline should be examined in detail, and differences between static and dynamic balance should be evaluated.
- The sample consisted solely of athletes from Turkey. Considering cultural and social factors, international studies are needed for comparative analyses.
- Longitudinal follow-up was not conducted in this study. Future research should examine how balance changes over time and how individuals adapt to prosthesis use in the long term. A follow-up study comparing long-term differences between athletes with amputation who participate in sports and those who do not is also recommended.

This study provides a scientific basis for the development of rehabilitation approaches specific to athletes with lower limb amputation by revealing the relationship between balance level and quality of life. In particular, the finding that balance training is associated with better psychosocial adjustment and lower activity restriction highlights the importance of balance-focused interventions in rehabilitation programs. Furthermore, the lack of a significant relationship between prosthesis satisfaction and balance suggests that prosthetic compatibility and individual adaptation processes should be evaluated from a multidimensional perspective. The findings obtained from athletes contribute to the development of strategies aimed at improving the quality of life of individuals with amputation in both clinical and athletic contexts. This research fills a gap in the literature regarding amputee athletes, which has been limited in scope, and serves as a unique reference for future studies. Nevertheless, the present results should be regarded as preliminary and require confirmation in larger, more diverse, and longitudinal samples.

Acknowledgment

We would like to express our sincere gratitude to all the volunteers who participated in this study.

Conflict of Interest Statement

No financial support was received for this article. The authors declare that there are no conflicts of interest between the authors and any individual and/or institution.

Author Contribution Rates

Design of Study: HÇ (%50), EY (%30), AÇ (%20)

Data Acquisition: HÇ (%50), EY (%40), AÇ (%10)

Data Analysis: HÇ (%40), EY (%40), AÇ (%20)

Writing Up: HÇ (%40), EY (%40), AÇ (%20)

Submission and Revision: HÇ (%40), EY (%30), AÇ (%30)

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