Original Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2024 (4 Sep);38.102. https://doi.org/10.47176/mjiri.38.102

Factors Affecting Physical Activity in Iraqi Patients with Lower Limb Amputation

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Received: 20 Nov 2023 Published: 4 Sep 2024

Abstract

Background: Limb loss can negatively affect the psychological and physical well-being, mobility, and social life of people with lower limb amputation. Participating in physical activities is of great importance for these people. This study aimed to explore factors affecting the physical activity of Iraqi lower-limb amputees.

Methods: In this cross-sectional study, the participants were asked to fill out the Oswestry disability index (ODI) questionnaire, the 12-item short-form health survey (SF-12), the Trinity Amputation and Prosthesis Experience Scales (TAPES), and the International Physical Activity Questionnaire (IPAQ). The performance-based Timed Up and Go (TUG) test was also assessed. We used a hierarchical regression model to estimate the effect of some parameters on physical activity considering age, sex, and level of amputation.

Results: A total of 376 lower limb amputees, aged 20 to 67 years old, completed the tests. The TUG time (beta = 0.406; $P < 0.001$), mental component score of the SF-12 (beta = 0.214; $P < 0.001$), ODI (beta = –0.201; $P < 0.001$), and physical activity component of SF-12 (beta = 0.131; $P = 0.002$) had significant associations with physical activity.

Conclusion: The TUG time was the most critical factor in predicting physical activity. The mental score component of the SF-12 ranked second, showing the importance of family and social support for amputees in their physical activity and emphasizing the importance of including mental and psychosocial plans in the rehabilitation program of lower limb amputees. Low back pain should be taken seriously in lower limb amputees because of its prevalence and the effect of its related disability on the physical activity of amputees. Residual limb pain was also very prevalent. Although it did not contribute to our model, its negative effect on physical activity should not be underestimated.

Keywords: Lower Limb Amputation, Disability, Low Back Pain, Residual Limb Pain, Physical Activity, Quality of Life

Conflicts of Interest: None declared
Funding: None

Cite this article as: Flayyih Hassan Al-Falahi M, Jalali M, Babaee T. Factors Affecting Physical Activity in Iraqi Patients with Lower Limb Amputation. *Med J Islam Repub Iran.* 2024 (4 Sep);38:102. https://doi.org/10.47176/mjiri.38.102

Introduction

Amputation is the surgical removal of all or parts of a limb and is mainly performed to preserve a person's life (1). The leading causes of amputation may be different in different countries. Trauma can account for 80% of all amputations in countries with a recent history of war or civil conflict (2). Iraq has been profoundly affected by wars and conflicts in the past decades. In 2009, the Iraqi Ministry of Human Rights reported that 85,649 people were killed and 147,195 people were wounded between January 2004 and October 31, 2008 (3). However, little published data are available on the problems that Iraqi people with lower limb

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↑*What is "already known" in this topic:*
Participation in physical activity is crucial for lower limb amputees' overall health and quality of life, while limb loss can negatively impact their physical, psychological, and social well-being.

→*What this article adds:*
Although low back pain is a prevalent condition in Iraqi lower limb amputees that negatively affects their physical activity, mental health ranked second after functional mobility in the factors that influence physical activity. This finding highlights the need for a multidimensional supportive rehabilitation program for lower limb amputees to optimize their potential physical activity.

amputation (LLA) have encountered.

Amputations result in physical and psychological issues such as lower self-esteem, decreased daily activity and mobility, increased stress, depression, and a temporary or permanent decline in health-related quality of life (4, 5). The amputees do not only lose body parts morphologically but also experience functional losses, deficits in proprioception, coordination, and balance (6). Thus, they face difficulties in the society and in returning to normal daily life activities (7).

Regular physical activity is strongly recommended for people with LLA because of its benefits like health promotion and higher quality of life (1). However, some studies indicate that most people with LLA are not active enough to be classified as sufficiently active (8). This may predispose them, especially bilateral amputees, to increased cardiometabolic risks (9), other chronic health conditions like diabetes mellitus, and higher risk of morbidity and mortality (10). Sports participation and an active lifestyle are generally regarded as very important for those with LLA because they can promote coping mechanisms, psychological well-being, and self-confidence (11, 12).

Evidence emphasizes a positive association between mobility, quality of life, and general satisfaction. Therefore, increasing mobility may be associated with better quality of life and satisfaction (13). However, some factors, such as chronic low back pain, hinder the activities of people with LLA, which is considered a secondary cause of disability (14, 15). Previous studies indicate that the prevalence of low back pain is significantly higher (52%-89%) among individuals with LLA compared with the general population (12%-45%) (16, 17). Moreover, people who have experienced an amputation often complain of other pains, such as phantom limb pain and residual limb pain (RLP) (18, 19). Compared with amputees without phantom pain, those with phantom limb pain have a lower health-related quality of life.

Iraq has been involved in many wars and conflicts in the past decades, and many people are living with LLA in this country. Thus, we need to understand the various aspects of life of the Iraqi people with LLA to help them improve their health and quality of life. Therefore, this study aimed to estimate the effects of disability related to low back pain, quality of life, RLP, and mobility on the physical activity of people with LLA.

Methods

This was a cross-sectional study. Before participating, the participants were asked to sign a written consent form. All the participants received prosthetic care from 2 rehabilitation centers (Sader Al-Qanat Physical Rehabilitation Center and Baghdad Physical Rehabilitation Center) in Baghdad.

The inclusion criteria were using their current prosthesis for at least 3 months before participation and being able to walk independently without an assistive device. The exclusion criteria were refusing to sign the written consent, unwillingness to continue the tests until the end, not returning the filled questionnaires and incomplete data.

Participants' demographic and clinical characteristics including age, sex, occupation, educational status, general health information, time since using prosthesis and amputation, level of amputation, residual limb length, and amputation cause were obtained. The questionnaires and tests used to evaluate the outcomes were the Oswestry disability index (ODI) questionnaire to assess disability related to low back pain, with a score ranging from 0 (no disability) to 100 (maximum disability), the Trinity Amputation and Prosthesis Experience Scales (TAPES) (the pain section to evaluate residual limb pain), the 12-item Short Form quality of life survey (SF-12) to assess health-related quality of life, the International Physical Activity Questionnaire (IPAQ) to evaluate the participant's physical activity level, and Timed Up and Go (TUG) test to measure the functional mobility (i.e., the time that a participant requires to complete the task that is standing up from a chair, walking for 3 meters, turning around the marked area, and returning to the chair and sitting down).

The questionnaires were distributed electronically or on paper according to participants' preferences. The valid and reliable Arabic versions of all questionnaires (20-23) were provided, and all the tests and surveys were administered according to their developers' instructions (24-27).

The TUG test showed a good intra- and interrater reliability (r = .93 and .96, respectively) for individuals with LLA (28). We estimated the sample size for this cross-sectional observational study based on the formula used for prevalence studies (29), since this study was part of another research aimed at low back pain prevalence in individuals with LLA.

Data Analysis

Descriptive statistics (means and standard deviations) and frequencies were reported for continuous and categorical variables. We used the Kolmogorov-Smirnov test, skewness, and kurtosis values to assess data normality. None of the parameters followed a normal distribution. The relationships between variables of interest were evaluated using Spearman's rho correlation coefficient. The strength of the correlation was considered as good to excellent ($r > 0.75$), moderate to good ($0.50 < r < 0.75$), small ($0.25 < r < 0.50$), and little to no correlation ($r < 0.25$) (30).

We used the Mann-Whitney test to compare the parameters between men and women. Analysis of variance (ANOVA), Kruskal-Wallis, and Chi-square tests were used to compare the studied parameters among different amputation levels. Hierarchical multiple regression was used to assess the ability of 5 measures (TUG time, ODI, SF-12 physical and mental component scores, and RLP) to predict the IPAQ after controlling the influence of age, sex, and amputation level. The data were analyzed using the Statistical Package for Social Sciences (SPSS) software Version 21. A threshold of .05 was considered as significant.

Results

Studied Participants

A total of 397 eligible individuals with LLA were invited to participate in this study. Six questionnaires were not returned, 9 individuals did not sign the consent form, and 5

[DOI: 10.47176/mjiri.38.102]

had incomplete data. One participant was excluded because he had hip disarticulation. Finally, 376 questionnaires (296 men and 80 women) were validated, demonstrating a response rate of 95%. They completed all the intervention protocols.

The participants' ages ranged from 20 to 67 years old. A total of 331 participants (88%) were from the Baghdad governorate, and only 45 patients (22%) were from the other governorates. Also, 76% of the participants in the Baghdad governorate were from the Baghdad Physical Rehabilitation Center (BAG PRC), and the others were from the Sader Al Qanat Physical Rehabilitation Center (SAQ PRC). All the participants were using mechanical prostheses. Suspension system types were anatomical in 286 cases (76.1%), suction type in 59 cases (15.6%), and belt and strap in 31 cases (8.2%). The amputation causes were trauma in 188 cases, burns in 30 participants, vascular diseases in 12 participants, tumors in 19 participants, congenital limb deficiencies in 5 participants, and diabetic mellitus in 122 participants. Most participants were below-knee amputees (216 individuals, 57.4% of the total sample), followed by above-knee (87 individuals, 23.1% of the total sample), ankle disarticulation (62, 16.5% of the total sample), and knee disarticulation (11 individuals, 2.9% of the total sample).

The mean time since amputation was 157.10 months, and the mean time since using the current prosthesis was 41.52 months. Additionally, 25 participants with no back discomfort at all included 9 amputees with disarticulation below the knee, 4 amputees above the knee, 2 with disarticulation in the knee, and 10 with disarticulation in the ankle. 351 patients also mentioned having low back pain.

The mean and standard deviation of disability related to low back pain were measured by the ODI and other parameters based on the level of amputation (Table 1). The ODI, TUG, mental score of SF-12, and IPAQ had different means between men and women (Table 2). The relationships between age and the studied parameters are presented in Table 3.

Comparing the Parameters among Different Levels of Amputation

ODI: We did a one-way between-groups ANOVA to explore the impact of amputation level (ankle disarticulation, transtibial, knee disarticulation, and transfemoral) on disability related to low back pain, as measured by the ODI. There was a significant difference at $P < 0.05$ in ODI scores for the 4 amputation levels—$F (3, 372) = 4.517$; $P = 0.004$. Despite having a statistical significance, the actual difference in mean scores between the groups was relatively small. The effect size, calculated using the eta squared measure, was 0.03, a small effect size according to Cohen's d method. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for the ODI in ankle disarticulation level (M = 0.33; SD = 0.18) was significantly (P = 0.001) different from that of the transfemoral level (M = 0.48; SD = 0.25). Also, the mean score of the ODI for the transtibial level (M = 0.37; SD = 0.19) was significantly (P = 0.007) different from that of the transfemoral level (M = 0.48; SD = 0.25). The mean of the ODI in knee disarticulation level (M = 22.10; SD = 4.15) was not significantly different from other amputation levels.

TUG: There was a significant difference at $P < 0.05$ in TUG times for the 4 amputation levels—$F (3, 372) = 47.629$; $P < 0.001$. The effect size, calculated using the eta squared measure, was 0.27, considered a large effect size according to Cohen's d method. Post-hoc comparisons using the LSD test indicated that the mean score for TUG in ankle disarticulation level (M =16.06; SD = 3.06) was significantly different from that of transfemoral (M = 23.80; SD = 4.07; $P < 0.001$), transtibial (M =19.63; SD = 4.11; P

Table 1. The descriptive statistics of the studied parameters

Level of amputation	N	ODI (Mean±SD)	RLP prevalence (%)	Duration of pain episodes (minutes)	Level of stump pain (Median)	QoL Physical component (Mean±SD)	QoL Mental component (Mean±SD)	TUG time (seconds)	IPAQ (Mean±SD)
Ankle disarticulation	62	0.33±0.18	12.2%	65.32±77.11	2.00	32.38±8.40	39.86±8.11	16.06±3.06	5932.21±5456.89
Transtibial	216	0.38±0.19	57.5%	118.68±93.84	3.00	30.32±6.39	38.89±7.44	19.62±4.10	4732.35±4418.30
Knee disarticulation	11	0.32±0.18	2.7%	95.45±83.59	3.00	29.49±5.89	38.26±7.76	20.45±4.86	4409.18±3299.77
Transfemoral	87	0.45±0.25	27.6%	161.38±89.08	4.00	29.70±5.85	37.54±6.97	23.80±4.07	3065.62±2699.06

Table 2. The comparisons of the main studied parameters between males and females

Variables	ODI	TUG	Physical Score SF-12	Mental Score-12	IPAQ	RLP
Mann-Whitney U	9077.500	7212.500	10203.500	9948.000	9867.000	11736.000
Wilcoxon W (Wilcoxon rank sum test)	53033.500	51168.500	13443.500	13188.000	13107.000	14976.000
Z	-3.207	-5.377	-1.897	-2.194	-2.288	-0.169
P-value (2-tailed)	<0.001*	<0.001*	0.052	0.021*	0.022*	0.866

Grouping Variable: Sex
*Significance level: 0.05

Table 3. The correlation coefficients between age and the studied parameters (n=376)

Variable	ODI	TUG	Physical Score SF-12	Mental Score-12	IPAQ	RLP
Correlation Coefficient	0.673**	0.420*	-0.087	-0.361*	-0.495**	0.216*
P-value (2-tailed)	<0.001	<0.001	.092	<0.001	<0.001	<0.001

*Significance level: 0.05
**Significance level: 0.01

[DOI: 10.47176/mjiri.38.102]

< 0.001), and knee disarticulation levels (M = 20.45; SD = 4.86; *P* = 0.001). Also, the mean score of the TUG time for the transtibial level was significantly different from that of the transfemoral level (*P* < 0.001). The mean of the TUG time in the knee disarticulation level was not significantly different from the transtibial level of amputation but had a significant difference from the transfemoral amputation level (*P* = 0.009).

SF-12 Mental Component Score: The SF-12 mental score for the 4 amputation levels was not significantly different (*P* = 0.287).

SF-12 Physical Component Score: The SF-12 physical score for the 4 amputation levels was not significantly different (*P* = 0.246).

IPAQ: The Kruskal-Wallis test revealed a significant difference in the IPAQ score between the 4 amputation levels (P < 0.001). The mean rank of ankle disarticulation level was higher than other levels.

RLP: A Chi-square test was used to explore the associations between levels of amputation and RLP. The result indicated a significant association between the level of amputation and RLP status (*P* < 0.001; phi = 0.264).

Bivariate Correlation Analysis between IPAQ and the Studied Parameters

Table 4 shows the coefficients of the bivariate correlation between IPAQ and the main studied parameters and some of the general parameters of the study. Hierarchical multiple regression was used to assess the ability of 5 measures (TUG time, ODI, SF-12 physical and mental, and RLP) to predict the IPAQ after controlling the influence of age, sex, and amputation level. The ANOVA table indicated that the model is significant as a whole—including both blocks of variables (*P* < 0.001). Preliminary analyses were conducted to ensure there was no violation of normality, linearity, multicollinearity, and homoscedasticity assumptions. Age, sex, and amputation level were entered at step 1, explaining 18.6% of the variance in IPAQ.

After entering other variables in step 2, the total variance explained by the model as a whole was 27.3%, (P < 0.001). The 3 control measures explained an additional 27.3% of the variance in the IPAQ after considering age, sex, and amputation level, R squared change was 0.273 (*P* < 0.001). Based on their beta levels, they are listed in the following order of significance:

TUG time (beta = –0.406; *P* < 0.001); the mental score of the SF-12 (beta = 0.214; *P* < 0.001), ODI (beta = –0.201; P < 0.001), and the physical score of the SF-12 (beta = 0131; P = 0.002) made a significant contribution to the final model. The RLP made a nonsignificant contribution to the model (beta = –0.024; *P* = 0.559).

Discussion

This study aimed to assess whether the studied 5 measures (TUG time, ODI, SF-12 physical and mental, and RLP) can predict the IPAQ based on age, sex, and amputation level. The regression model showed that the TUG time is the first predictor of the IPAQ among other studied parameters. This finding is consistent with the related literature. Many studies on healthy people and patients have revealed associations between mobility and physical activity (31-35). Self-reported mobility, functional mobility, and balance confidence have been reported to decrease in lower limb amputees (36, 37).

In this study, a moderate to good bivariate correlation was seen between physical activity and TUG time in line with the literature, which confirmed the previous hypothesis that TUG is a useful clinical index for understanding motor characteristics (38). Also, as expected, the higher the level of amputation, the longer is the TUG time.

An interesting finding of the regression model was the contributing role of the mental score of the SF-12 to the model, even higher than the disability related to low back pain. Deans et al. found a less strong relationship between physical and functional elements of TAPES and the quality of life measure. However, they reported a very strong correlation between scores on the social elements of each questionnaire. This finding somehow supports the contribution of the mental score of the SF-12 in our regression model, which was more important than the physical score. Although their study had a small sample size, the role of having good social relationships with family and friends is irrefutable in the rehabilitation of lower-limb amputees. Maintaining physical activity in these people would be more practical within a supportive sociable environment (39).

LLA is a negative stressor that deteriorates a person's psychosocial and physical life and is associated with anxiety and stress. Thus, stress management methods may reduce these conditions and improve the mental quality of life (40). Previous studies suggest that improving coping strategies is associated with higher levels of physical and psychosocial functioning (40). Therefore, if the goal is to increase the physical activity in lower limb amputees, the plan must focus not only on physical components but also on including psychosocial parameters.

According to our findings, there was a high prevalence of back pain after amputation. Moreover, 85% of the participants had some level of back pain daily or several times per week graded as severe or moderate disability based on ODI. Lower limb amputees are more likely to experience back pain due to a number of factors. Load magnitude and load-

Table 4. The relationship between IPAQ and the demographic and general characteristics of the participants

Variables	Age	Cause	Months since amputation	ODI	TUG	SF-12 Physical component	SF-12 Mental component
Correlation Coefficient	-0.495	-0.368	0.348	-0.527	0.662	0.282	0.463
P-value (2-tailed)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

*Significance level:0.05

[DOI: 10.47176/mjiri.38.102]

bearing patterns change after amputation and need adaptations that may predispose lower limb amputees to increased risk of low back pain (41), origin from different sources, such as the amputation level (42), prosthetic-dependent factors such as components, alignment, socket fit, and length (length discrepancy with sound leg) (43-45). Other factors like age, the reason for amputation, and the time since amputation are among the non-prosthetic potential reasons (46).

Some researchers discuss that increased loads, affected balance, greater rotational movements in the lumbar spine, and changes in trunk-pelvic association in these individuals complete a cycle of events that make low back pain more common in lower limb amputees (41). However, in a systematic review, Sivapuratharasu et al concluded that higher prevalence of low back pain in amputees is a complex phenomenon with different interweaving causes and cannot be attributed directly to certain contributing factors (47). The presence of residual pain in the stump and a phantom limb have been reported to be positively associated with the development of low back pain (48). Low back pain is a leading cause of disability in lower limb amputees (49).

In our regression model, the disability related to low back pain was the third factor in importance associated with physical activity. Our result was in agreement with Devan et al in that 64.1% of their participants had low back pain, and 39.1% reported restricted physical activity due to low back pain (14). Based on our results, disability related to low back pain was more severe in transfemoral amputees. Future studies investigating low back pain coping strategies and using objective PA outcome measures might further clarify the relationship between PA and low back pain in this population (14).

Although RLP did not significantly contribute to our model, 78.2% of the studied population experienced it. Among them, 22% reported distressing RLP while using the prosthetic leg. Our result was in agreement with the study of Ephraim et al. They found that most amputees (95%) experience one or more types of amputation-related pain. Phantom pain was reported most often (79.9%), with 67.7% reporting pain in the remaining extremities and 62.3% back pain (50).

Contrary to our expectations, RLP did not significantly contribute to the regression model. Atar et al. found a significant correlation between RLP (but not sound limb pain) and kinesiophobia and related this finding to the physical activity limitation in traumatic lower limb amputees (51).

Limitations

This current study is limited by the small number of cases based on the level of amputation. The majority of our participants had transtibial or transfemoral levels of amputations, and the sample size in knee or ankle disarticulation groups was limited. Therefore, all interpretations regarding the knee or ankle disarticulation groups should be carried out with caution. An additional limitation of the current study was the absence of individuals with bilateral lower amputation. Therefore, the generalizability of our findings may not be fitted to those with bilateral lower limb amputations. Considerably more work will need to be done to determine related factors for physical activity of individuals with bilateral lower limb amputation.

Conclusion

The TUG time was the most important factor in predicting physical activity. Mental score of the SF-12 ranked second, which shows the importance of family and social support for amputees' participation in physical activity. This emphasizes the importance of including mental and psychosocial plans in the rehabilitation programs for lower-limb amputees. More than 80% of the participants who had back pain daily or several times per week reported severe or moderate disability that hindered their physical activity. Despite the high prevalence of RLP, this condition did not seem to have a significant impact on physical activity.

Authors' Contributions

M.F.H., the conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article, and revising it critically for important intellectual content, final approval of the version to be submitted; M.J., the conception and design of the study, analysis, and interpretation of data, revising the article critically for important intellectual content, and final approval of the version to be submitted; T.B., the conception and design of the study, analysis, and interpretation of data, revising the article critically for important intellectual content, and final approval of the version to be submitted.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.1401.569).

Acknowledgment

The authors would like to thank the participants for their cooperation with the study.

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Steen Jensen J. Life expectancy and social consequences of through-knee amputations. Prosthet Orthot Int. 1983;7(2):113-5.
2. Esquenazi A. Amputation rehabilitation and prosthetic restoration. From surgery to community reintegration. Disabil Rehabil. 2004;26(14-15):831-6.
3. Todd M. Iraq's official death toll supports unofficial tally October 2009 [updated June 2017]. Available from: https://psmag.com/economics/iraq-official-death-toll-supports-unofficial-tally-3406.
4. Dudkiewicz I, Gabrielov R, Seiv-Ner I, Zelig G, Heim M. Evaluation of prosthetic usage in upper limb amputees. Disabil Rehabil. 2004;26(1):60-3.
5. Williams LH, Miller DR, Fincke G, Lafrance JP, Etzioni R, Maynard C, et al. Depression and incident lower limb amputations in veterans with diabetes. J Diabetes Complications. 2011;25(3):175-82.
6. Kovač I, Kauzlarić N, Živković O, Mužić V, Abramović M, Vuletić Z, et al. Rehabilitation of lower limb amputees. Periodicum Biologorum. 2015;117(1):147-59.
7. Andrysek J, Klejman S, Steinnagel B, Torres-Moreno R, Zabjek KF, Salbach NM, et al. Preliminary evaluation of a commercially available

videogame system as an adjunct therapeutic intervention for improving balance among children and adolescents with lower limb amputations. Arch Phys Med Rehabil. 2012;93(2):358-66.

8. Langford J, Dillon MP, Granger CL, Barr C. Physical activity participation amongst individuals with lower limb amputation. Disabil Rehabil. 2019;41(9):1063-70.
9. Ladlow P, Nightingale TE, McGuigan MP, Bennett AN, Koumanov F, Phillip R, et al. Influence of traumatic lower-limb amputation on physical activity, body composition, and cardiometabolic risks: A descriptive preliminary study. Pm r. 2023;15(4):413-25.
10. Haskell WL, Blair SN, Hill JO. Physical activity: health outcomes and importance for public health policy. Prev Med. 2009;49(4):280-2.
11. Bijnen FC, Caspersen CJ, Feskens EJ, Saris WH, Mosterd WL, Kromhout D. Physical activity and 10-year mortality from cardiovascular diseases and all causes: The Zutphen Elderly Study. Arch Intern Med. 1998;158(14):1499-505.
12. Shephard RJ. Benefits of sport and physical activity for the disabled: implications for the individual and for society. Scand J Rehabil Med. 1991;23(2):51-9.
13. Wurdeman SR, Stevens PM, Campbell JH. Mobility Analysis of AmpuTees (MAAT I): Quality of life and satisfaction are strongly related to mobility for patients with a lower limb prosthesis. Prosthet Orthot Int. 2018;42(5):498-503.
14. Devan H, Tumilty S, Smith C. Physical activity and lower-back pain in persons with traumatic transfemoral amputation: a national cross-sectional survey. J Rehabil Res Dev. 2012;49(10).
15. Ehde DM, Smith DG, Czerniecki JM, Campbell KM, Malchow DM, Robinson LR. Back pain as a secondary disability in persons with lower limb amputations. Arch Physic Med Rehabil. 2001;82(6):731-4.
16. Kusljugić A, Kapidzić-Duraković S, Kudumović Z, Cickusić A. Chronic low back pain in individuals with lower-limb amputation. Bosn J Basic Med Sci. 2006;6(2):67-70.
17. Hammarlund CS, Carlström M, Melchior R, Persson BM. Prevalence of back pain, its effect on functional ability and health-related quality of life in lower limb amputees secondary to trauma or tumour: a comparison across three levels of amputation. Prosthet Orthot Int. 2011;35(1):97-105.
18. Smith DG, Ehde DM, Legro MW, Reiber GE, del Aguila M, Boone DA. Phantom limb, residual limb, and back pain after lower extremity amputations. Clin Orthop Relat Res. 1999;361:29-38.
19. Krzemińska S, Kostka A. Influence of Pain on the Quality of Life and Disease Acceptance in Patients with Complicated Diabetic Foot Syndrome. Diabetes Metab Syndr Obes. 2021;14:1295.
20. Algarni AS, Ghorbel S, Jones JG, Guermazi M. Validation of an Arabic version of the Oswestry index in Saudi Arabia. Ann Phys Rehabil Med. 2014;57(9-10):653-63.
21. Massarweh R, Sobuh MM. The Arabic Version of Trinity Amputation and Prosthetic Experience Scale-Revised (TAPES-R) for Lower Limb Amputees: Reliability and Validity. Disability, CBR & Inclusive Development. 2019;30(1):44-56.
22. Haddad C, Sacre H, Obeid S, Salameh P, Hallit S. Validation of the Arabic version of the "12-item short-form health survey" (SF-12) in a sample of Lebanese adults. Arch Public Health. 2021;79(1):56.
23. Helou K, El Helou N, Mahfouz M, Mahfouz Y, Salameh P, Harmouche-Karaki M. Validity and reliability of an adapted Arabic version of the long international physical activity questionnaire. BMC Public Health. 2017;18(1):49.
24. Fairbank J, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. Physiotherapy. 1980;66(8):271-3.
25. Gallagher P, MacLachlan M. The Trinity Amputation and Prosthesis Experience Scales and quality of life in people with lower-limb amputation. Arch Phys Med Rehabil 2004;85(5):730-6.
26. Care RH. 12-Item Short Form Survey (SF-12). Available from: https://www.rand.org/health-care/surveys_tools/mos/12-item-short-form.html.
27. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35(8):1381-95.
28. Schoppen T, Boonstra A, Groothoff JW, de Vries J, Göeken LN, Eisma WH. The Timed "up and go" test: reliability and validity in persons with unilateral lower limb amputation. Arch Phys Med Rehabil. 1999;80(7):825-8.
29. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121-6.
30. Portney L, Watkins M. Foundations of clinical research: applications to practice. 3rd edn Philadelphia. USA: FA Davis Co. 2015.
31. Bohannon RW, Williams Andrews A. Normal walking speed: a descriptive meta-analysis. Physiotherapy. 2011;97(3):182-9.
32. Gonzales JU, Shephard J, Dubey N. Steps per Day, Daily Peak Stepping Cadence, and Walking Performance in Older Adults. J Phys Act Res. 2015;23(3):395-400.
33. Handlery R, Fulk G, Pellegrini C, Stewart JC, Monroe C, Fritz S. Stepping After Stroke: Walking Characteristics in People With Chronic Stroke Differ on the Basis of Walking Speed, Walking Endurance, and Daily Steps. Phys Ther. 2020;100(5):807-17.
34. Stevens SL, Fuller DK, Morgan DW. Leg strength, preferred walking speed, and daily step activity in adults with incomplete spinal cord injuries. Top Spinal Cord Inj. 2013;19(1):47-53.
35. Master H, Thoma LM, Christiansen MB, Polakowski E, Schmitt LA, White DK. Minimum Performance on Clinical Tests of Physical Function to Predict Walking 6,000 Steps/Day in Knee Osteoarthritis: An Observational Study. Arthritis Care Res. 2018;70(7):1005-11.
36. Sions JM, Arch ES, Horne JR. Self-Reported Functional Mobility, Balance Confidence, and Prosthetic Use Are Associated With Daily Step Counts Among Individuals With a Unilateral Transtibial Amputation. J Phys Act Health. 2018;15(6):423-9.
37. Newton KL, Evans C, Osmotherly PG. The Timed Up and Go and Two-Minute Walk Test: exploration of a method for establishing normative values for established lower limb prosthetic users. Eur J Physiother. 2016;18(3):161-6.
38. Buttery AK, Martin FC. Knowledge, attitudes and intentions about participation in physical activity of older post-acute hospital inpatients. Physiotherapy. 2009;95(3):192-8.
39. Deans SA, McFadyen AK, Rowe PJ. Physical activity and quality of life: A study of a lower-limb amputee population. Prosthet Orthot Int. 2008;32(2):186-200.
40. Desmond DM, MacLachlan M. Coping strategies as predictors of psychosocial adaptation in a sample of elderly veterans with acquired lower limb amputations. Soc Sci Med. (1982). 2006;62(1):208-16.
41. Schmid-Zalaudek K, Fischer T, Száva Z, Lackner HK, Kropiunig U, Bittner C, et al. Kinetic Gait Parameters in Unilateral Lower Limb Amputations and Normal Gait in Able-Bodied: Reference Values for Clinical Application. J Clin Med. 2022;11(10).
42. Varrecchia T, Serrao M, Rinaldi M, Ranavolo A, Conforto S, De Marchis C, et al. Common and specific gait patterns in people with varying anatomical levels of lower limb amputation and different prosthetic components. Hum Mov Sci. 2019;66:9-21.
43. Goujon H, Bonnet X, Sautreuil P, Maurisset M, Darmon L, Fode P, et al. A functional evaluation of prosthetic foot kinematics during lower-limb amputee gait. Prosthet Orthot Int. 2006;30(2):213-23.
44. Baum BS, Schnall BL, Tis JE, Lipton JS. Correlation of residual limb length and gait parameters in amputees. Injury. 2008;39(7):728-33.
45. Chow DH, Holmes AD, Lee CK, Sin SW. The effect of prosthesis alignment on the symmetry of gait in subjects with unilateral transtibial amputation. Prosthet Orthot Int. 2006;30(2):114-28.
46. Hermodsson Y, Ekdahl C, Persson BM, Roxendal G. Standing balance in trans-tibial amputees following vascular disease or trauma: a comparative study with healthy subjects. Prosthet Orthot Int. 1994;18(3):150-8.
47. Sivapuratharasu B, Bull AMJ, McGregor AH. Understanding Low Back Pain in Traumatic Lower Limb Amputees: A Systematic Review. Arch Rehabil Res Clin Transl. 2019;1(1-2):100007.
48. Devan H, Hendrick P, Hale L, Carman A, Dillon MP, Ribeiro DC. Exploring factors influencing low back pain in people with nondysvascular lower limb amputation: a national survey. PM R. 2017;9(10):949-59.
49. Sadowski PK, Battista S, Leuzzi G, Sansone LG, Testa M. Low Back Pain in People With Lower Limb Amputation: A Cross-Sectional Study. Spine (Phila Pa 1976). 2022;47(22):1599-606.
50. Ephraim PL, Wegener ST, MacKenzie EJ, Dillingham TR, Pezzin LE. Phantom pain, residual limb pain, and back pain in amputees: results of a national survey. Arch Phys Med Rehabil. 2005;86(10):1910-9.
51. Örücü Atar M, Demir Y, Tekin E, Kılınç Kamacı G, Korkmaz N, Aydemir K. Kinesiophobia and associated factors in patients with traumatic lower extremity amputation. Turk J Phys Med Rehabil. 2022;68(4):493-500.