Original Article

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Quality of life and functional assessment in lower limb prosthetic patients at a referral outpatient clinic in Brazil

Avaliação funcional e de qualidade de vida em pacientes protetizados de membros inferiores em um centro ambulatorial de referência no Brasil

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ABSTRACT

Limb amputation is one is one of the main causes of human physical disability**. Objective:** Here, we carried out a functional and quality of life assessment of 172 lower limb amputees treated at a large outpatient clinic in Brazil. **Method:** This quantitative study was based on The Functional Measure for Amputees questionnaire (FMA) applied during medical consultations. **Results:** Most patients, particularly males, younger individuals and those with below-the-knee amputations, were able to independently perform daily tasks at home while using prostheses. In community ambulation, the use of support such as a cane and crutches were common, especially by women. **Conclusion:** Rehabilitation proved effective, leading to an average prosthesis usage of over 11 hours per day. The primary limitations to prosthesis use were perceptions of insufficient speed, fatigue, long distances to be covered and fear of falling.

Keywords: Amputees, Rehabilitation, Motor Skills, Functional Status

RESUMO

A amputação de membros é uma das principais causas de incapacidade física humana. **Objetivo:** Traçar um diagnóstico de funcionalidade no uso de próteses e avaliar a qualidade de vida de pacientes atendidos em uma clínica de amputados de um grande centro de reabilitação de Pernambuco. **Método**: Foi realizado um estudo observacional transversal baseado no The Functional Measure for Amputees questionnaire (FMA) aplicado durante consultas médicas. **Resultados:** A maioria dos pacientes, principalmente do sexo masculino, os mais jovens e aqueles com amputação abaixo do joelho, conseguiu realizar tarefas diárias em casa de forma independente quando usavam próteses. Na deambulação comunitária era comum o uso de apoios como bengala e muletas, principalmente entre as mulheres. **Conclusão:** A deambulação comunitária e uso da prótese são os principais fatores que indicam funcionalidade e qualidade de vida. Os pacientes utilizaram, em média, a prótese por mais de 11 horas/dia, os principais fatores limitantes para a utilização de prótese estão relacionados à percepção de não se movimentarem com rapidez suficiente, ao cansaço, à longa distância a ser percorrida ou ao medo de cair.

Palavras-chaves: Amputados, Reabilitação, Destreza Motora, Estado Funcional

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Nothing to declare

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INTRODUCTION

Limb amputation is a primary cause of physical disability, significantly limiting the ability to perform daily activities.[1] As consequence, this may lead to job loss and a decline in quality of life.[2] In more complex cases, amputation may even be associated with increased mortality.

According to the Nationwide Inpatient Sample data, approximately 115,000 individuals in the US undergo lower extremity amputations annually, with 50,000 to 60,000 of these being major amputations.[3] In 2017, trauma resulted in approximately 57.7 million amputations worldwide.[4] These amputations were most prevalent in East and South Asia, followed by Western Europe, North Africa and the Middle East, North America, and Eastern Europe. Only in the United States, diabetes-related vascular diseases led to over 188 amputations per 100,000 Medicare beneficiaries. In Brazil, the estimated annual amputation rate is 13.9 per 100,000 inhabitants.[5]

Vascular diseases associated or not to diabetes mellitus (DM), which commonly occur between the age of 50-70 years, and traumatic amputations, more common in younger individuals, are both the most frequent causes of amputations.[6] Neoplastic conditions, infections, and congenital malformations can also lead to limb amputation.[7]

Amputations at different levels of the limb have varying functional implications. The strategy of preserving the maximum possible limb length is generally valid and recommended.[8] Lower limb amputation (LLA) can lead to difficulties with balance, coordination, and mobility, in addition to the loss of strength and resistance. These changes can result in sensorimotor impairments.[9] LLA often impairs the ability to perform normal gait, limiting an individual's capacity to independently accomplish daily functional activities.[10] And even though rare, LLA can also lead to secondary musculoskeletal disorders, further impacting mobility and quality of life.[11]

Since the primary goal in the rehabilitation of lower limb amputees is to facilitate their full reintegration into society, maximizing their physical, mental, emotional, and social capabilities,[12] a deeper understanding of the health challenges faced by these individuals can enhance rehabilitation efforts, improving function and quality of life following amputation.[13] Enabling lower limb amputees to walk can lead to improved self-care, reduced dependence, increased social interaction, and decreased isolation. Therefore, predicting the success of amputee rehabilitation often involves evaluating their ability to use prostheses and their capacity for community ambulation.[14] Prostheses are designed to provide individuals with functionality, as satisfactory aesthetic appearance and a sense of bodily completeness.[15]

To restore form and function of the amputated limb and enhance the well-being of prosthesis users, several approaches consider the patient's perception of health, as well as their vocational and psychological capabilities.[16]

Functional assessment is a valuable tool for measuring the outcomes of rehabilitation and the effectiveness of therapeutic interventions10. Beyond functional assessment, various other tools, particularly validated quality of life questionnaires, have contributed to measuring functional improvements resulting from rehabilitation and can even aid in prognostic assessment.[17]

In Brazil, data from the Ministry of Health indicate that 95% of amputations performed within the public health system (named in Brazil as Sistema Único de Saúde - SUS) in 2011 were of lower limbs.[18]

OBJECTIVE

The present study aimed to assess the functional use of prostheses and evaluate the quality of life of patients treated at an amputee clinic within a large rehabilitation center in Pernambuco, Brazil. It intended, therefore, to evaluate the impact of prostheses on the daily lives of amputee patients.

METHOD

We conducted a cross-sectional observational study, following recommendations and guidelines of the EQUATOR network and the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist.[19] Amputee patients using prostheses were submitted to functional and quality of life assessment through a questionnaire. The study was conducted from 01/11/2019 to 01/12/21, at the amputee clinic of the Associação de Assistência à Criança Deficiente (AACD), in the Recife municipality, state of Pernambuco, Brazil.

A total of 172 patients aged 18 or older with lower limb amputations were included in this study. Amputation levels included hip disarticulation (HD), transfemoral (TF), knee disarticulation (KD), and transtibial (TT) amputations, on one or both sides of the body. Participants had been using prostheses for at least six months.

Patients with lower limb amputations were excluded from the analysis if they had not attended a medical consultation at the center during the study period, used a prosthesis different from those offered by the public health system (SUS), or were still undergoing rehabilitation.

To assess the functionality and quality of life of amputees, we applied the Functional Measure for Amputees (FMA) questionnaire during medical consultations. The FMA correlates prosthesis use with the performance of daily activities. The FMA questionnaire consisted of 13 multiple-choice questions (individually evaluated). It differentiated between individuals who use prostheses for indoor and outdoor mobility, with specific questions tailored to each group. The FMA questionnaire was previously adapted and validated for Portuguese[10] and was applied by physicians involved in this research, following a standardized protocol.

Qualitative variables were described using frequency and confidence intervals. Quantitative variables were summarized with measures of central tendency (mean and median) and measures of dispersion (standard deviation, interquartile range, minimum, and maximum). Since the quantitative variables of interest (age, and prosthesis days and hours of use) did not exhibit normal distribution (Kolmogorov-Smirnov test, $p<0.05$), nonparametric tests were conducted.

Associations between qualitative variables were tested using the chi-square test. Associations between quantitative and qualitative variables were assessed with the Wilcoxon test (for variables with two categories) or the Kruskal-Wallis test (for variables with three or more categories). When necessary, post-hoc tests (chi-square or Dunn) with Bonferroni correction were employed to identify specific differences. Spearman's correlation was used to assess correlations among quantitative variables.

All statistical tests were conducted using a two-tailed alpha (p-value) of 0.05 and a 95% confidence interval (CI). Analyses were performed using R (version 4.1.0, Camp Pontanezen© 2021 - The R Foundation for Statistical Computing Platform)[20] and the RStudio environment (version 1.4.1717© 2009-2021, RStudio, PBC), or IBM SPSS Statistics for Windows (version 25, IBM Corp., Armonk, N.Y., USA).

All participants in this research provided written informed consent through a Term of Free and Informed Consent (Termo de Consentimento Livre e Esclarecido - TCLE). The study was approved by an ethics committee under certificate number CAAE: 90333018.5.0000.0085/3.668.584.

RESULTS

This study evaluated the sociodemographic and clinical characteristics of 172 patients. The majority were male (84.3%), with transtibial amputations (58.72%) on the left side of the body (55.81%), and an average age of 48 years (± 15.72).

Regarding patients' the perception of quality of life and functionality, 78.49% of patients were able to put on their prosthesis by themselves without any difficulty.

When performing daily tasks with their prostheses, most patients could accomplish them independently: getting up from a chair (95.93%); picking up an object from the floor while standing (81.98%); getting up from the ground (62.21%); walking around the house (93.60%), walking outside on smooth floors (79.07%); walking outside on irregular ground, for example, on grass, gravel, or slopes (64.53%); walking outside in bad weather, such as in the rain (66.28%), climbing stairs with a handrail (81.40%); descending stairs with a handrail (83.72%); going up on the sidewalk (77.91%); walking up on sidewalks (77.91%); walking down on sidewalks (79.07%); climbing some stairs without a handrail (52.33%); descending some stairs without a handrail (50.00%); walking while carrying an object, such as a cup or a glass, a purse or a bag (85.47%).

Among participants, 81.40% consistently used their prostheses for indoor mobility, and 80.23% used them for nearly all daily activities, even with the assistance of crutches or walkers. Among factors that may prevent the use of the prosthesis indoors, 91.67% cite the perception of insufficient speed and 83.3% cite fatigue as factors preventing their use. When going outdoors, 83.72% of participants consistently used their prostheses, and 77.91% used them for nearly all outdoor activities. Among factors that may prevent the use of the prosthesis for outdoors locomotion, 82.14% cite insufficient speed, fatigue (82.14%), fear of falling (67.86%) and long distances to be covered (67.86%).

Regarding the ability to walk a desired distance with the prosthesis without stopping, 44.77% reported no limitations. However, while the majority did not experience falls while using the prosthesis, a significant number (45.35%) reported at least one fall.

Among patients, 70.35% require no additional aids to perform activities with prostheses at home. When aids are needed, crutches are the most common (19.19%). Outdoors, 43.60% use no mobility aids, while an equal percentage utilize crutches.

During daily activities, both indoors and outdoors, while most patients (37.79%) had returned to their pre-amputation activities, 29.07% were limited to indoor activities. Only 22.67% reported ceasing most of their activities. Patients reported using their prostheses for an average of 11.44 (± 3.72) hours per day.

The association between gender and functional characteristics showed that women are more dependent on getting up from a chair (p= 0.012), getting up from the floor (p= 0.015), walking outside on a smooth floor (p<0 .01), walking outside on irregular ground (p= 0.01) or in the bad weather (p<0.01), climbing stairs with (p= 0.01) or without a handrail (p<0.01), descending stairs (p<0.01), and walking up (p<0.01) or down sidewalk (p<0.01). At home, they also use a wheelchair more often than men (p= 0.044).

On the other hand, men were more likely to engage in walking activities with their prostheses than women (p< 0.01). They also covered greater distances (p<0.01) and were less likely to require walking aids when outdoors (p<0.01). Additionally, males were more likely to partially or fully return to their pre-amputation activities (p= 0.04).

Due to the limited number of patients with KD and HD amputations, an analysis of the influence of different amputation levels was constrained. However, it was observed that patients with HD were less likely to independently get up from a chair compared to those with TF or TT amputations (p< 0.01). Additionally, patients with TT amputations demonstrated greater independence in descending sidewalks compared to those with TF amputations (p= 0.05) (Table 1).

We observed that patients with TF amputation were younger than those with TT amputation (p= 0.002). Also, patients who could independently put on their prostheses were younger than those requiring assistance (p< 0.01). In general, patients who could independently climb or descend stairs with a handrail were younger than those requiring assistance from someone nearby (p= 0.0348). In this case, the post-hoc test was unable to identify specific differences (p= 0.017) (Figure 1). Patients who could independently climb (p< 0.01) or descend (p= 0.005) sidewalks (Figure 2), or independently climb (p= 0.05) or descend (p= 0.007) some stairs without a handrail were generally younger than those requiring assistance (Figure 3).

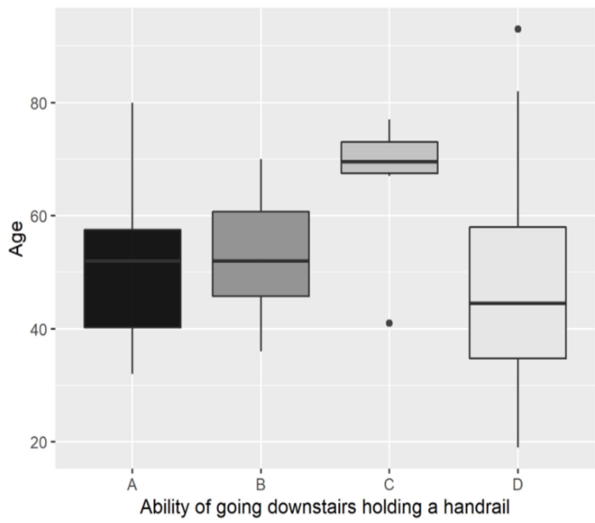

Figure 1. Boxplot of age according to the ability of descending stairs holding a handrail (A= No; B= Yes, if someone helps me; C= Yes, if someone is nearby; D= Yes, by myself)

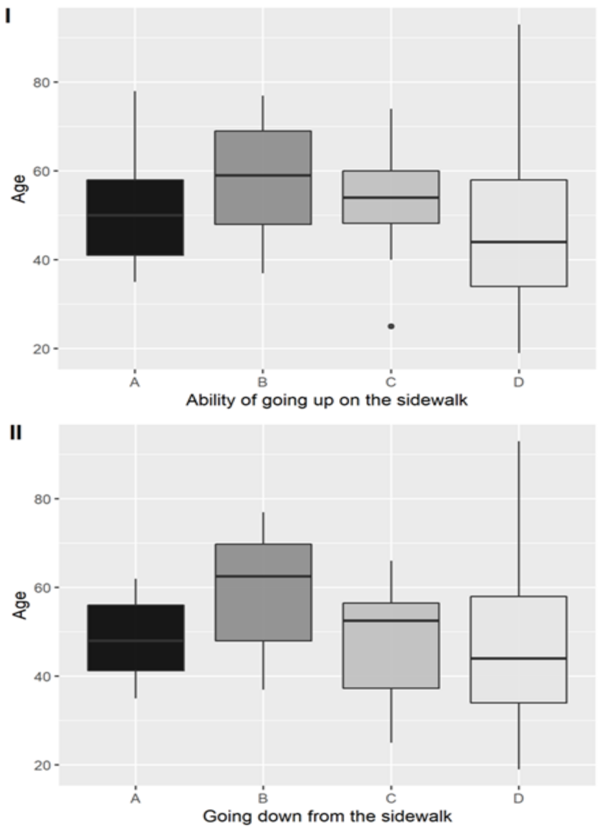

Figure 2. Boxplot of age according (I) to the ability of climbing sidewalks and (II) descending sidewalks (A= No; B= Yes, if someone helps me; C= Yes, if someone is nearby; D= Yes, by myself)

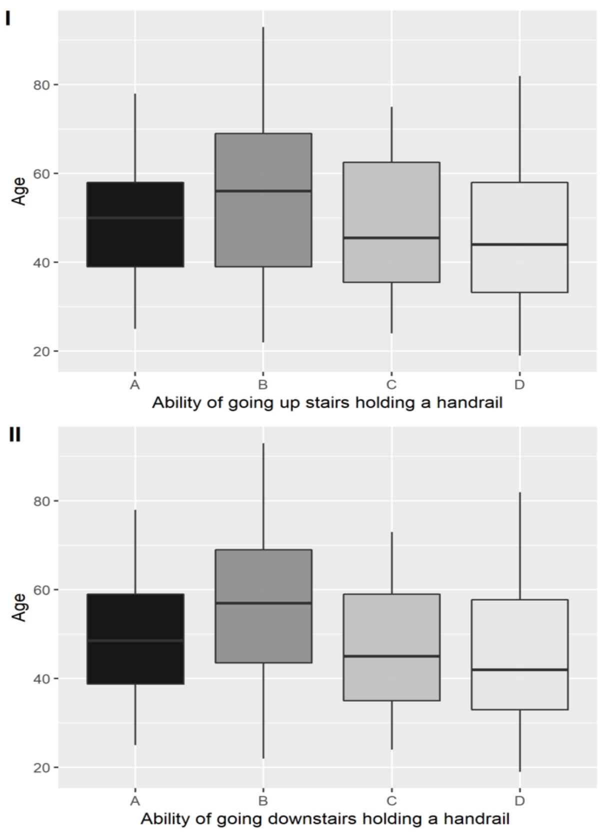

Figure 3. Boxplot of age according (I) to the ability of climbing stairs holding a handrail and (II) to the ability of descending stairs holding a handrail (A= No; B= Yes, if someone helps me; C= Yes, if someone is nearby; D= Yes, by myself)

Patients who rarely used wheelchairs for indoor activities were generally younger than those who relied on wheelchairs for half of their activities (p= 0.002). Additionally, patients who avoided using their prostheses due to fatigue in the non-amputated limb were younger than those without this issue (p= 0.05) (Figure 4).

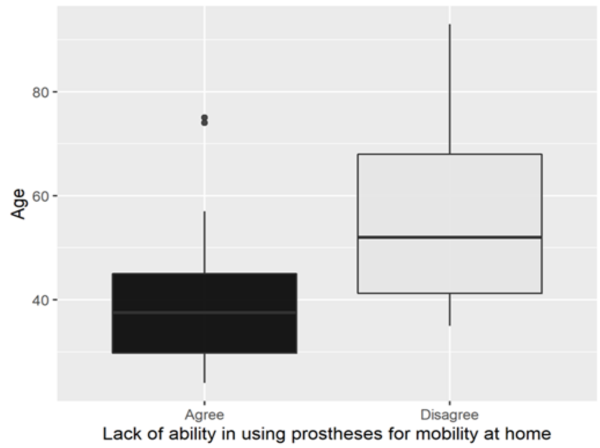

Figure 4. Boxplot of age according to disability in using prostheses for mobility indoor as they showed problems in the non-amputated leg

Patients requiring crutches for outdoor mobility were generally older than those who did not use crutches (p= 0.002) (Figure 5). Differences observed among other groups were not statistically significant, likely due to the small sample sizes.

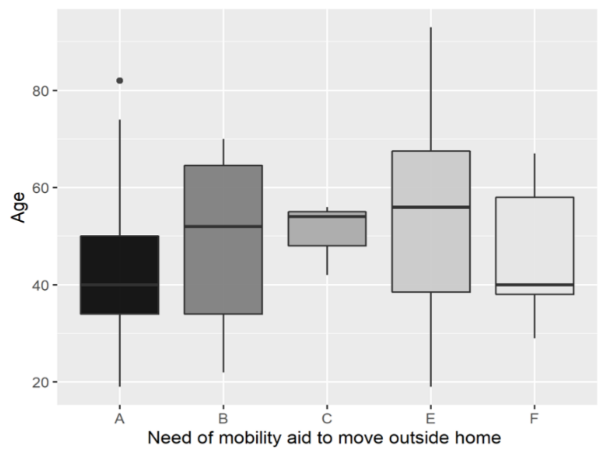

Figure 5. Boxplot of age according to the need of mobility aids when going outdoors (A= Do not need assistence; B =Walking with one cane; C= Walking with two canes; D= Walking with a four feet cane; E= Walking with cructches; F= Walking with walker)

Table 1. Association between amputation level (hip disarticulation - HD, transfemoral - TF, knee disarticulation - KD, transtibial - TT) and qualitative variables

	Amputation level									
	KD		HD		TF		TT		Total	p - value
	N	% (IC95%)	N	% (IC95%)	N	% (IC95%)	N	% (IC95%)	N	
Side of the body										
On both sides	0	0 (0-0)	0	0 (0-0)	0	0 (0-0)	2	2 (0.4-6.2)	2	0.01
On the right side	5	100 (100-100)	2	100 (100-100)	19	29.7 (19.6-41.6)	48	47.5 (38-57.2)	74	
On the left side	0	0 (0-0)	0	0 (0-0)	45	70.3 (58.4-80.4)	51	50.5 (40.8-60.1)	96	
Total	5	100 (100-100)	2	100 (100-100)	64	100 (100-100)	101	100 (100-100)	172	
Post-Hoc: KDxHD p= NE; **DJxTF p= 0.04**; KDxTT p= 0.4; HDxTF p= 1; HDxTT p= 1; TFxTT p= 0.2*										
Q2A Getting up from the chair										
No	0	0 (0-0)	1	50 (6.1-93.9)	0	0 (0-0)	0	0 (0-0)	1	<0.01
Yes, if someone helps me	0	0 (0-0)	0	0 (0-0)	2	3.1 (0.7-9.6)	3	3 (0.8-7.7)	5	
Yes, if someone is nearby	0	0 (0-0)	0	0 (0-0)	0	0 (0-0)	1	1 (0.1-4.5)	1	
Yes, by myself	5	100 (100-100)	1	50 (6.1-93.9)	62	96.9 (90.4-99.3)	97	96 (90.9-98.6)	165	
Total	5	100 (100-100)	2	100 (100-100)	64	100 (100-100)	101	100 (100-100)	172	
*Post-Hoc: KDxHD p= 1; KDxTF p= 1; KDxTT p= 1; **HDxTF p<0.01**; **HDxTT p<0.01**; TFxTT p= 1*										
Q2K Descending a sidewalk										
No	0	0 (0-0)	0	0 (0-0)	7	10.9 (5-20.3)	3	3 (0.8-7.7)	10	0.05
Yes, if someone helps me	0	0 (0-0)	1	50 (6.1-93.9)	3	4.7 (1.3-12)	14	13.9 (8.2-21.6)	18	
Yes, if someone is nearby	0	0 (0-0)	0	0 (0-0)	6	9.4 (4-18.3)	2	2 (0.4-6.2)	8	
Yes, by myself	5	100 (100-100)	1	50 (6.1-93.9)	48	75 (63.5-84.3)	82	81.2 (72.7-87.9)	136	
Total	5	100 (100-100)	2	100 (100-100)	64	100 (100-100)	101	100 (100-100)	172	
*Post-Hoc: KDxHD p= 1; KDxTF p= 1; KDxTT p= 1; HDxTF p= 0.4; HDxTT p= 1; **TFxTT p=0.05***										
Q7C Using a prosthesis outdoors can be physically demanding										
Agree	0	0 (0-0)	0	0 (0-0)	13	92.9 (85.7-100)	10	83.3 (75-100)	23	0.02
Disagree	1	100 (100-100)	1	100 (100-100)	1	7.1 (0-19.1)	2	16.7 (8.3-40.9)	5	
Total	1	100 (100-100)	1	100 (100-100)	14	100 (100-100)	12	100 (100-100)	28	
Post-Hoc: KDxHD p= NE; KDxTF p= 1; KDxTT p= 1; HDxTF p= 1; HDxTT p= 1; TFxTT p= 1; Hip disarticulation (HD); Transfemoral (TF); Knee disarticulation (KD); Transtibial (TT)*										

**NE: Non-existent calculation*

DISCUSSION

Limb amputation is a traumatic experience for any patient, leading to a new reality regarding mobility, body image, and social consequences that can impact quality of life. Prostheses play a crucial role in enabling patients to partially or fully resume pre-amputation activities. In this study, we evaluated the effects of prosthesis use on patients' daily lives through functional assessment and their self-reported quality of life following rehabilitation.

The epidemiological profile of the patients primarily consisted of males with transtibial amputations, predominantly on the left side of the body, and an average age of 48 years. The older age of patients may be attributed to potential delays in seeking specialist care or accessing specialized health services, both preventively and during acute phases of related diseases. Some studies indicate that amputations often occur at an older age, around 60 years.[21]

Functionality is achieved when patients can perform motor tasks with prostheses both indoors and outdoors. In this study, patients generally demonstrated satisfactory functional outcomes in both environments.

When using prostheses, most patients could perform tasks independently (1) indoors: easily putting on the prosthesis, rising from a chair, picking up an object from the floor while standing, getting up from the floor, walking indoors without assistive devices; (2) outdoors: walking on smooth (regular) ground, on irregular or bumpy ground, and in the bad weather; climbing and descending sidewalks. Regarding assistive devices, an equal number of patients either did not use any or utilized walking aids; (3) indoors and outdoors: climbing and descending stairs with a handrail, climbing and descending stairs without a handrail, walking while carrying an object in hands.

Our findings indicate that patients were independent in both simple and complex daily tasks. However, greater caution was observed when performing activities outdoors, where a significant number of patients utilized assistive devices. When outdoors, crutches were primarily used for safety rather than to address functional limitations. Indoors, patients often avoided using prostheses due to perceived insufficient speed and fatigue. These factors, along with fear of falling and long distances, were cited as limitations for outdoor prosthesis use.

Literature reports a wide range of success rates for prosthesis use among amputees, with percentages varying from 5%[22] to 100%.[23] The varying success rates reported in the literature may be attributed to differing definitions of successful rehabilitation. These definitions often include living independently at home, performing daily activities effectively, and maintaining satisfactory mobility.[24] However, the gold standard in rehabilitation for amputees remains the restoration of community ambulation.[25] In this sense, the ability to walk approximately 500 meters independently has been identified as a benchmark for independent living.[26] Community ambulation is considered a key factor in quality of life, as it directly influences the ability to live independently and participate in community activities.[27]

While most patients reported returning to their pre-amputation activities, a significant group argued it happens only indoors, while outdoors only few activities are performed as before. This suggests a balance between these two groups of patients, with a third group who stopped performing the majority of activities. Further research is needed to identify the factors influencing this variation.

A positive indicator of functionality and quality of life was the daily duration of prosthesis use. Patients reported wearing their prostheses for an average of 12 hours per day, seven days a week, suggesting effective rehabilitation and stump health.

Quality of life measures that encompass a broad range of experiences should be encouraged. This aligns with a broader trend in the human and biological sciences to value a wider range of outcomes beyond symptom control, mortality reduction, and increased life expectancy. This approach can lead to more effective interventions and restructured care programs.[28]

When stratifying results by functional association and perceived quality of life, women were found to be more dependent on a majority of daily activities (getting up from a chair, getting up from the floor, walking outside on regular, irregular floors, or in bad weather, climbing stairs with or without a handrail, descending steps, walking up and down sidewalks). Indoors, women were more likely to use wheelchairs compared to men.

Men, on the other hand, were more independent when using prostheses, both indoors and outdoors. This included walking without assistive devices, covering greater distances, and partially or fully returning to pre-amputation activities. While the literature does not consistently report gender differences among amputees, some studies have linked certain functional difficulties more frequently to women. These difficulties may include challenges in adapting to changing roles, often related to family responsibilities, particularly with partners, and issues related to body image.[29]

We observed that age were similar between genders and amputation levels, but among amputations levels, we found that younger patients were more likely to undergo transfemoral amputations. This finding may be attributed to the underlying causes of amputation, as trauma was the primary cause in this age group.

Younger patients were more likely to independently put on their prostheses, climb or descend sidewalks, and climb or descend stairs with or without handrails. Also, younger patients were more likely to use prostheses without any assistive devices and rarely required wheelchairs. Interestingly, patients who avoided using their prostheses due to fatigue in the non-amputated limb were also younger. This may be attributed to other complications in that limb related to the initial trauma.

High-income countries typically report a higher prevalence of below-the-knee amputations in both sides.[30] But in contrast, we observed a higher number of above-the-knee amputations in the left side.

Due to the limited number of patients with KD and HD amputations, an analysis of the influence of different amputation levels was constrained. However, it was observed that patients with HD were less likely to independently get up from a chair compared to those with TF or TT amputations. Additionally, patients with TT amputations demonstrated greater independence in descending sidewalks compared to those with TF amputations. Regarding body side, patients with left limb amputations tended to engage in fewer walking activities with their prostheses than those with right limb amputations. Further research is needed to explore this finding.

Among patients who do not use prostheses for outdoor activities, those with transarticular amputations (hip or knee) reported fewer complaints of fatigue compared to other amputation levels. This finding may be attributed to the distribution of weight on the prosthesis. Patients with hip disarticulations have a larger weight-bearing surface compared to those with knee amputations, which involves distal weight-bearing.

Participants evaluated their functionality and quality of life with the prosthesis, with the majority reporting independence in performing daily activities. Most patients used their prostheses outdoors and did not require any assistive devices at home. Approximately half of the participants used their prostheses for community ambulation. Descending stairs without a handrail was the activity with the lowest rate of independent performance. However, 50% of participants were still able to accomplish this task without assistance.

The level of amputation, along with the length of the residual limb, is relevant to the rehabilitation process. These factors are crucial considerations for the surgical team, as they can significantly impact the patient's functional capacity and gait quality following the procedure. Amputations at different levels of the limb have varying functional implications. The strategy of preserving the maximum possible limb length is generally valid and recommended.[8]

Preserving longer residual limb lengths can enhance a patient's walking ability,[30] significantly impacting walking distance and gait speed.[31] While distal amputations offer potential benefits, the risks of revision surgeries must be carefully considered. Ultimately, the ideal amputation stump is the longest possible with adequate soft tissue coverage.[32]

Among patients who do not use prostheses outdoors, the most commonly cited reasons were insufficient speed and fatigue, followed by prosthesis-related issues, fear of falling, and long distances. Problems in the contralateral limb were reported by half of the participants who did not use their prostheses. These issues may be attributed to factors such as age, amputation level, time between amputation and rehabilitation, comorbidities, physical conditioning, emotional factors, and family support.

Approximately half of the participants reported being able to walk as far as desired with their prostheses. However, the same percentage had experienced falls while using them. Among those who had discontinued prosthesis use, most had done so within the past year.

CONCLUSION

The study demonstrated that the majority of patients, particularly males, younger individuals, and those with below-the-knee amputations, regained limb function and experienced improved quality of life, enabling independent performance of daily tasks both indoors and outdoors. Even though the use of some mobility support has been common, most patients successfully utilized their prostheses for a significant portion of the day.

The primary limitations to prosthesis use were perceptions of insufficient speed, fatigue, long distances to be covered, and fear of falling. These challenges could be mitigated by the public health system offering improved components, such as enhanced suspensions, more comfortable, durable, and resilient materials, prosthetic feet that reduce energy expenditure, and enhanced patient physical conditioning.

Future studies could evaluate medium and long-term changes in functionality and quality of life among amputees using prostheses.

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