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Original Research

Factors Related to Indoor Prosthetic Use in Individuals with Unilateral Lower Limb Amputation

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Abstract

Background: The rate of indoor prosthetic use in people with lower limb amputation (LLA) is lower than that of outdoor use. Very few studies of indoor prosthetic use have been conducted, and no studies have focused on the perspective of instrumental activities of daily living (IADLs).

Objectives: To assess the indoor prosthetic use of individuals with unilateral LLA from the perspective of IADLs.

Study design: Cross-sectional study.

Methods: A total of 162 people with LLA participated in this study. Based on the information obtained from a questionnaire and medical records, the relationships between each outcome and indoor prosthetic use were assessed by univariate analysis and multivariate logistic regression analysis.

Results: Of the 110 respondents (72.8%), 6 participants did not use the prosthesis or used it for cosmesis. With respect to the prosthetic users (n = 104), 74 (71.2%) used their prosthesis indoors and outdoors and 30 (28.8%) used it only outdoors, but none used it indoors only. On univariate analysis, five items were identified: household size, amputation level, domestic chores and outdoor activities of the Frenchay Activities Index, and difficulty donning/doffing the prosthesis. Small household, transtibial amputation, and a high score on the domestic chores of the Frenchay Activities Index (cutoff value 9.0 points) were independently associated with indoor prosthetic use.

Conclusions: Training of motions that are desirable to use the prosthesis and participation in domestic chores frequently based on IADLs before hospitalization may increase the frequency of prosthesis use in people with transfemoral amputation who use their prosthesis outdoors.

Keywords

lower limb amputation, indoor prosthetic use, instrumental activities of daily living, donning and doffing the prosthesis

Background

Reacquisition of walking ability by using a prosthesis functionally in daily life is one of the primary goals of rehabilitation for individuals with lower limb amputation (LLA). Greater prosthetic use has been closely associated with a higher satisfaction level and a higher quality of life (QOL).[1,2] Thus, a rehabilitation approach to promote use of the prosthesis is required.

To evaluate prosthetic use, the wearing time of the prosthesis per day or the physical activity while wearing a prosthesis was used in previous studies, which reported that 86-90% of individuals with LLA used their prosthesis for outdoor activities, whereas 47-58% used it for indoor activities.[3,4] Furthermore, an epidemiological study of Japanese individuals with LLA reported a similar result (93.0% for outdoor activities and 60.1% for indoor activities).[5] In addition, the Houghton Scale is one of the evaluation indicators for classifying daily prosthetic use.[6] However, the scale does not assess the presence of indoor prosthesis use in outdoor prosthesis users. Therefore, to assess the situation of indoor prosthetic use, a new classification method is necessary.

Previous studies have shown that amputation level,[7] the ability to don the prosthesis,[7,8] one-leg balance,[9] locomotor capabilities with the prostheses,[7,8] socket-related problems,[7] the presence of indoor stairs,[8] and the surrounding circumstances such as sex,[2,10] marriage,[10] and employment status[11] were related to indoor prosthetic use. Instrumental activities of daily living (IADLs) reflect lifestyle[11] such as age, sex, and residence status, as well as factors that directly affect impairment and the ability to engage in activities of daily living (ADLs); it was hypothesized that affect indoor prosthetic use are strongly related to IADLs, which are influenced by physical function and background factors.

For example, individuals with LLA may use wheelchairs or stools instead of a prothesis to cook. By contrast, wearing a prosthesis may bring the individual more stability while standing to cook. Using the prosthesis to perform IADLs increases the frequency of prosthetic use and contributes to improving QOL and prosthetic satisfaction.[1] In general, the ADL independence level of individuals with LLA is often high[12]

even without the prosthesis. However, it has been reported that IADL declines earlier than ADL[13] and that ADL decline is related to the lower frequency of domestic chores.[14] Therefore, assessing indoor prosthetic use from the perspective of IADLs could contribute to improving the rehabilitation approach.

The Frenchay Activities Index (FAI), a widely used measure of IADLs, is a behavioral scale that measures the frequency of participation in activities ranging from preparing meals to working.[15,16] Excellent internal consistency (Cronbach alpha = 0.84) and interrater reliability (intraclass correlation coefficient = 0.78) and support for validity based on correlations with the Timed Up and Go Test, 2-minute walk test, Activities-specific Balance Confidence scale, and the mobility subscale of the Prosthetic Evaluation Questionnaire have been demonstrated in individuals with LLA.[17] Nevertheless, few studies have reported the relationship between the FAI and prosthetic use, especially indoor use. Therefore, the purpose of this study was to assess the indoor prosthetic use of individuals with unilateral LLA from the perspective of IADLs to clarify the activities that should be the focus in the rehabilitation approaches.

Methods

Participants

Participants were recruited from among the individuals with unilateral LLA who had undergone prosthetic rehabilitation in our facility; those who had completed the rehabilitation between April 2001 and March 2011 and prosthetic use had been confirmed by our prior survey in January 2013 (n = 90; transfemoral amputation, 48; knee disarticulation, 1; and transtibial amputation, 41) and those who had completed between April 2011 and March 2016 (n = 72; transfemoral amputation, 36; and transtibial amputation, 36). Self-administered questionnaires were mailed in July 2016 and September 2017, and they were completed in September 2016 and November 2017, respectively. Of the 162 potential participants, 110 returned eligible questionnaires, whereas six were found to have died and five were undeliverable, resulting in a response rate of 72.8% (110/151). Regarding the sample size, assuming a 95% confidence interval, a 50%

response rate, and a 10% margin of error, the sample size was calculated to be 96.[18] Therefore, the sample size of this study can show a certain significance. All participants were informed of the protocol and gave their written informed consent. This study was approved by the institutional ethics review board of the facility (approval number 1603), and it was conducted according to the principles of the Declaration of Helsinki. The patients underwent prosthetic rehabilitation guided by a physical therapist during their hospitalization. Some of the participants (n = 13) were re-hospitalized to evaluate their adaptation to the prostheses. After discharge, public services allow the provision or rental of welfare equipment and home visit or outpatient rehabilitation services.

Measures

Data were collected from medical records (age, sex, amputation level, and duration of hospitalization and postdischarge) and the questionnaires (household size, employment status, residual limb skin problem, one-leg standing balance, getting up from a chair/floor, situations of prosthetic use, ability to don prosthesis, assistive device for locomotion indoors, factors reducing the use of prosthesis indoors, Locomotor Capability Index-5 [LCI-5],[19,20] and FAI[15,16]). The status of one-leg standing balance on the unaffected limb was asked by a multiple-choice question: (1) possible without support >10 seconds, (2) possible without support ≤10 seconds, (3) possible with support, and (4) not possible.[9] The circumstances of prosthetic use were asked by a multiple-choice question: (1) nonuse or for cosmesis, (2) indoor only, (3) outdoor only, and (4) indoor and outdoor.

The LCI-5 is a 14-item questionnaire specifically designed to measure walking ability of individuals with LLA. Each item is graded into 4 ordinal levels, and a score is assigned from 0 (not able) to 4 (able to accomplish the activity without aids). The maximum score is 56; a higher score reflects a better level of locomotor independence. Several studies of individuals with LLA demonstrated that the LCI-5 showed good internal consistency, test-retest reliability, and construct validity.[19,20]

Meanwhile, the FAI is a 15-item questionnaire that consists of three factors: domestic chores (e.g. preparing meals, washing up, washing clothes, light housework, and heavy housework), leisure/work (e.g. social outings, pursuing hobby, outings/car rides, and gainful work), and outdoor activities.[15] In this study, the respondents were asked whether they used prostheses during each activity.

The items regarding the factors reducing the use of prostheses indoors were asked by multiple-choice questions: (1) residential circumstances (e.g. presence of stairs), (2) walking ability with a prosthesis (e.g. instability and inability to walk quickly), (3) socket-related problems (e.g. pain), and (4) donning and doffing the prosthesis (e.g. difficulty and complexity).

Statistical analysis

Individuals who selected "nonuse or for cosmesis" for prosthetic use were excluded from the analysis, those who used it "indoor only" and "indoor and outdoor" were classified as "indoors prosthetic use group", and those who did "outdoor only" were classified as "indoors prosthetic nonuse group". For continuous variables, the test of normality was used to determine the analysis method. Continuous variables (age at the survey, duration of hospitalization and postdischarge, LCI-5, and FAI) were compared using the Mann-Whitney U test, and categorical variables (sex, household size, amputation level, presence or absence of skin problems on the residual limb, one-leg standing balance, getting up from a chair/floor, ability to don the prosthesis, the aids used indoors with or without the prosthesis, ability to walk while carrying an object, and factors reducing the use of prostheses indoors) were compared using the Chi-square test or Fisher exact test to determine which variables differed significantly between the use and nonuse groups.

The variables that achieved significance on the Mann-Whitney U test, chi-square test, or Fisher exact test at the 0.05 level were then included in the multivariate logistic regression analysis. The Spearman rank correlation coefficient, correlation ratio, and coefficient of association were calculated to determine the strengths of the relationships between variables. Correlation coefficients <0.2 were very weak, ≥ 0-<0.4

were weak, ≥0.4-<0.7 were moderate, ≥0.7-<0.9 were strong, and ≥0.9 were very strong.[21] The model was simplified in a backward stepwise fashion by removing variables with a *P* value greater than 0.05.

The odds ratios and 95% confidence intervals were calculated for independent variables associated with indoor prosthetic use. Receiver operator characteristic curves were used to generate thresholds for the dichotomous classification of continuous variables. Statistical evaluation of the data was performed using EZR 1.33.[22]

In addition, for each item of domestic chores of the FAI in indoor prosthetic users, the rates of participating in housework and prosthetic use during activities were calculated.

Results

Ninety-two men and 18 women completed the questionnaire. The mean age of the respondents was 54.9 ± 17.9 years (range = 19-88 years); 54.5% had transfemoral amputations, and 45.5% had transtibial amputations. Trauma was the leading cause of amputation (55.5%), followed by tumor (21.8%), vascular disease (20.9%), and infection (1.8%). A total of 104 (94.5%) respondents were using the prosthesis at the time of the survey, whereas six participants (5.5%) did not use the prosthesis or used it for cosmesis. With respect to the use of the prosthesis for mobility, 74 prosthetic users (71.2%) reported using the prosthesis for both indoors and outdoors, 30 (28.8%) for only outdoors, and none for only indoors. The median duration of hospitalization and that of postdischarge were 121 days and 62.5 months for the indoor prosthetic users and 189 days and 62.5 months for the indoor prosthetic nonusers, respectively. The duration of hospitalization was significantly shorter in the indoor prosthetic users ($P < 0.01$). As for the demographic characteristics, there were no significant differences in age, sex, or employment status between the two groups, but the proportion of two-generation or three-generation families in household size was significantly higher in the indoor prosthetic nonusers ($P < 0.05$). Univariate analysis showed that indoor prosthetic use was significantly associated with household size ($P < 0.05$), amputation level ($P < 0.01$),

domestic chores ($P < 0.01$) and outdoor activities ($P < 0.05$) of the FAI, and difficulty donning and doffing the prosthesis ($P < 0.01$) (Table 1). The correlations between the outcome measures are presented in Table 2. No strong correlations were seen between variables. Therefore, household size, amputation level, domestic chores and outdoor activities of the FAI, and difficulty donning and doffing the prosthesis were subjected to multiple logistic regression analysis as independent variables; small household ($P < 0.05$), transtibial amputation ($P < 0.01$), and a high score on the domestic chores of the FAI ($P < 0.01$) were found to be independently associated with indoor prosthetic use (Table 1). Receiver operator characteristic analysis showed that the cutoff score for the domestic chores of the FAI to discriminate indoor use of the prosthesis from nonuse was 9.0. The sensitivity of indoor use prediction was 63.5% and specificity was 76.7% (Figure 1). The rate of participating in domestic chores and that of prosthetic use for each item of domestic chores of the FAI in indoor prosthetic users are presented in Table 3. Those who participated in each household chore accounted for more than 60% of indoor prosthetic users, and more than 90% of those used their prosthesis when performing any of them.

Table 1. Factors related to indoor prosthetic use.

	Indoors prosthetic user (n = 74)	**Indoors prosthetic nonuser (n = 30)**	***P***
Age at survey, median (IQR)	58.5(44.25-68.75)	48.5(27.25-66.50)	0.0646[a]
Sex: men, n (%)	62(83.8)	25(83.3)	1[b]
Household size, n (%)			<0.05[c]
Single/married couple	43(58.1)	10(33.3)	
Two/three-generation families	31(41.9)	20(66.7)	
Employment status, n (%)			1[c]
Employed	37(50.0)	15(50.0)	

Amputation level, n (%)			<0.01[c]
Transtibial amputation	44(59.5)	5(16.7)	
Transfemoral amputation	30(40.5)	25(83.3)	
Residual limb skin problem, n (%)			0.356[c]
Yes	20(27.0)	11(36.7)	
One-leg standing balance, n (%)			0.76[c]
Without support >10 s	49(66.2)	22(73.3)	
Without support ≤10 s	12(16.2)	3(10.0)	
With support	13(17.6)	5(16.7)	
Not able	0(0.0)	0(0.0)	
Getting up from a chair/floor, n (%)			0.243[b]
Without support	39(52.7)	13(43.3)	
With support	29(39.2)	11(36.7)	
With supervision/help	6(8.1)	6(20.0)	
Ability to don prosthesis, n (%)			0.288[b]
Alone	74(100.0)	29(96.7)	
With supervision/help	0(0.0)	1(3.3)	
Aids used indoors with prosthesis, n (%)			0.122[b]
None	70(94.6)	25(83.3)	
One cane/crutch	2(2.7)	2(6.7)	
Two canes/crutches/walker	2(2.7)	3(10.0)	
Aids used indoors without prosthesis, n (%)			0.546[b]
None	38(51.4)	12(40.0)	
Crutches/walker	24(32.4)	12(40.0)	

Wheelchair	11(14.9)	6(20.0)	
Ability to walk while carrying an object, n (%)			0.176[b]
Alone without aids	50(67.6)	20(66.7)	
Alone with crutches/walker	16(21.6)	3(10.0)	
With supervision/help	8(10.8)	7(23.3)	
LCI-5, median (IQR)	53.0(46.0-56.0)	52.5(42.5-56.0)	0.652[a]
FAI, median (IQR)			
Domestic chores	10.5(4.0-15.0)	4.5(0.25-7.75)	<0.01[a]
Leisure/work	6.0(3.25-8)	4.5(2.25-6.75)	0.106[a]
Outdoor activities	12(10-14)	10.5(7.25-12)	<0.05[a]
Factors reducing the use of prostheses indoors, n (%)			
Residential environment (e.g. presence of stairs)	3(4.1)	3(10.0)	0.352[b]
Walking ability with prosthesis (e.g. slowly)	8(10.8)	7(23.3)	0.126[b]
Socket-related problems (e.g. pain)	26(35.1)	17(56.7)	0.072[c]
Donning/doffing the prosthesis (e.g. difficulty)	18(24.3)	17(56.7)	<0.01[c]

Multivariate logistic regression analysis	**OR**	**95% CI**	***P***
Household size (single, married couple, or multi-generational families)	0.277	0.0923-0.833	<0.05
Amputation level (transtibial/transfemoral)	0.0698	0.0193-0.253	<0.01
FAI: Domestic chores (≤8/≥9)	1.18	1.07-1.31	<0.01
FAI: Outdoor activities	0.960	0.806-1.14	0.642
Difficulty donning/doffing the prosthesis	0.412	0.140-1.21	0.107

Abbreviations: 95% CI: 95% confidence interval; FAI, Frenchay Activities Index; IQR, interquartile ratio; LCI-5, Locomotor Capability Index-5; OR, odds ratio.
[a]Mann-Whitney U test, [b]Fisher exact test, [c]Chi-square test.

Table 2. Correlations between the outcome measures.

	Household size	Amputation level	Domestic chores of the FAI	Outdoor activities of the FAI	Difficulty donning/doffing the prosthesis
Household size	–				
Amputation level	.018[a]	–			
Domestic chores of the FAI	.204[b]*	.044[b]	–		
Outdoor activities of the FAI	.040[b]	.119[b]	.515[c],**	–	
Difficulty donning/doffing the prosthesis	.014[a]	.203[a],*	.172[b]	.251[b],**	–

Abbreviation: FAI, Frenchay Activities Index.
[a]Coefficient of association, [b]Correlation ratio, [c]Correlation coefficient.
**P < 0.05; **P < 0.01.*

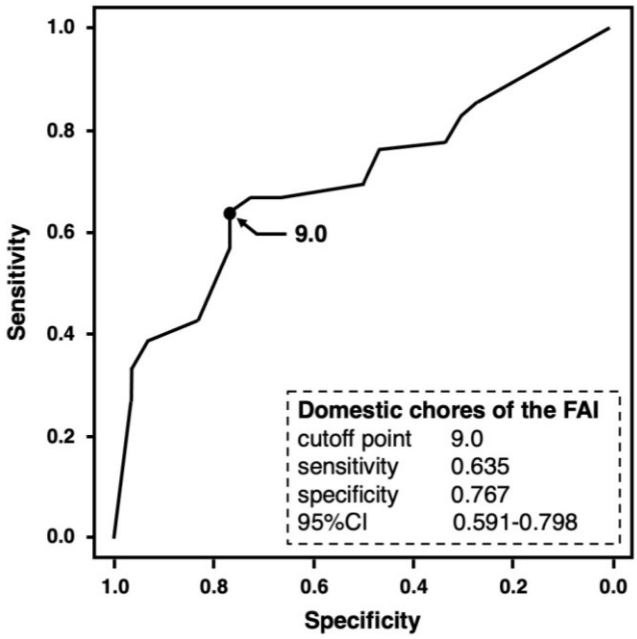

Figure 1. Receiver operator characteristic analysis for the domestic chores of the FAI.
95% CI, 95% confidence interval; FAI, Frenchay Activities Index.

Table3. Rates of participating and prosthetic use for each item of domestic chores of the FAI in indoor prosthetic users.

	Rate of participating（n = 74）	Rate of prosthesis use
Preparing meals, n (%)	46(62.3)	44/46(93.5)
Washing up, n (%)	55(74.3)	53/55(92.7)
Washing clothes, n (%)	46(62.3)	44/46(93.5)
Light housework, n (%)	58(78.4)	56/58(94.8)
Heavy housework, n (%)	50(67.6)	49/50(96.0)

Abbreviation: FAI, Frenchay Activities Index.

Discussion

Although examinations of the effects of prosthetic use on satisfaction and QOL of individuals with LLA have focused on frequency of use[1,2,10] and appropriateness,[23] the factors related to indoor prosthetic use are not well understood; this study examined the factors that may determine indoor prosthetic use in those with LLA who use their prosthesis outdoors. Based on the multivariate logistic regression analysis used in this study, small household ($P < 0.05$), transtibial amputation ($P < 0.01$), and a high score on the domestic chores of FAI (cutoff value was 9.0 points) were independently associated with indoor prosthetic use. Gunawardena[7] reported that a higher level amputation is a factor of less prosthetic use indoors, and this study showed a similar result. It has also been reported that individuals with transfemoral amputations had greater difficulties donning the prosthesis than those with transtibial amputations and significantly less ability to walk with the prosthesis.[8] Indoors, individuals with LLA don and doff the prosthesis frequently, and a complicated task has a negative effect on the use of prosthesis.[8] Individuals with LLA must adjust sockets and suspensions in a semistanding position, which requires strength and standing balance on the unaffected limb,[8] in particular, except for the pin lock transfemoral prosthesis with silicone liner. Appropriate prosthesis options including suspension systems for transfemoral prostheses should be selected

from the perspective of easy donning and doffing. For example, when a person with a transfemoral amputation needs sitting activities on the chair/floor, such as preparing meals and washing up, donning and doffing the prosthesis frequently because of pain and discomfort caused by interference between the socket and the seat or pressure on the groin by the socket, and/or have a standing balance problem, the silicone liner with shuttle lock systems which can be donned in sitting position is better suited than the common suction sockets while standing.[24] By contrast, the transtibial prosthesis can be worn easily in a sitting position regardless of the suspension systems. In addition, the difference in the suspension systems is also related to functional efficiency,[25,26] but the types of prosthetic components and the degree of ease of donning and doffing of the prosthesis have not been evaluated, which is necessary to consider in future studies, particularly for transfemoral amputation. Because donning the prosthesis without difficulty was related to the use of the prosthesis outdoors,[8] it is necessary to determine the suspension system for outdoor mobility in consideration of heat and sweating inside the prosthetic socket,[3] in addition to the perspectives presented in this study.

Regarding walking ability,[8,23] which is associated with the use of prostheses and level of amputation, in this study, there was no difference between the two groups in the walking ability indicated by the required aids and the LCI-5. However, LCI-5 showed a ceiling effect[21] (percentage of individuals with maximum score; user: nonuser = 37.0%: 36.7%) in both groups; it was not possible to clarify whether there was a difference in walking ability between the two groups. Therefore, to clarify the relationship with use of the prosthesis indoors, it may be necessary to assess mobility using other tools.

As shown in Table 3, more than 90% of indoor prosthetic users who performed domestic chores were using their prosthesis to complete the activities. Frequent participation in domestic chores, such as preparing meals, washing clothes, and housework, positively affected indoor prosthetic use, which has not been previously identified as an important factor. IADL reflects lifestyle,[11] and a previous study reported that the activity shown by the FAI is negatively affected by older age, men, and living together[27]; Tsuya et al[28]

reported that an increased number of household members had a negative impact on the frequency of participation in domestic chores. The present results showed that household size had an effect on indoor prosthetic use; the indoor prosthetic nonuse group included significantly more two-generation or three-generation families (use group: nonuse group = 41.9%: 66.7%). The cutoff value of nine of the domestic chores of the FAI means that preparing meals and washing up are performed twice a week or less, and washing clothes, light housework, and heavy housework are performed once to three times a month. The results based on the multivariate logistic regression analysis suggested that more frequent participation in domestic chores contributed to more indoor prosthetic use. However, household activities such as cooking involve complex dual tasking; evaluations from cognitive and physical perspectives are required. Indeed, lower participation in domestic chores after LLA may be due to lack of functional abilities or overprotective supports by families. In either case, the criteria for frequency of participation in domestic chores in this study will be helpful to understand the circumstances of indoor prosthesis use. Accordingly, training of motions desirable for frequent participation in domestic chores with the prosthesis may increase the frequency of indoor prosthetic use for individuals with unilateral LLA who use their prosthesis outdoors.

Study limitations

This study has several biases. First, more individuals with transfemoral amputation were included in this study than other studies[29-32] because they are considered to have lower success rates for prosthetic rehabilitation and are often referred to our facility that is specialized in prosthetic rehabilitation. Because amputation level was shown to be a strong associated factor, when further study is performed, amputation level should be taken into account, such as narrowing the target to subjects with transfemoral amputation. Second, there is a possibility that prosthetic nonusers and individuals with low activity may have not responded to the questionnaires. Third, regarding household size, in Japan, as with Western countries, the proportion of single-person and couple-only households is high.[33] However, in Japan, sexual division of

domestic chores still exists, and the time spent for participating in domestic chores by Japanese men is shorter than in Western countries.[28] Therefore, the results may differ in other countries.

Finally, this was a retrospective study, and the causal associations between indoor prosthetic use and the other extracted factors are not clear. A future prospectively study is desirable.

Conclusion

Training of motions that are desirable for using the prosthesis and participation in domestic chores frequently based on IADLs before hospitalization may increase the frequency of indoor prosthetic use in people with transfemoral amputation who use their prostheses outdoors.

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Declaration of Conflicting Interests

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References

1. Chen MC, Lee SS, Hsieh YL, et al. Influencing factors of outcome after lower-limb amputation: a five-year review in a plastic surgical department. *Ann Plast Surg* 2008; 61: 314–318.

2. Bilodeau S, Hébert R, Desrosiers J. Lower limb prosthesis utilisation by elderly amputees. *Prosthet Orthot Int* 2000; 24: 126–132.

3. Hagberg K, Brånemark R. Consequences of non-vascular trans-femoral amputation: a survey of quality of life, prosthetic use and problems. *Prosthet Orthot Int* 2001; 25: 186–194.

4. Zidarov D, Swaine B, Gauthier-Gagnon C. Life habits and prosthetic profile of persons with lower-limb amputation during rehabilitation and at 3-month follow-up. *Arch Phys Med Rehabil* 2009; 90: 1953–1959.

5. Hayashi Y, Mori Y, Kawamura J. Epidemiological study on the lower limb amputees. *Jpn Soc Prosthet Orthot* 1999; 15: 163–170.

6. Houghton AD, Taylor PR, Thurlow S, et al. Success rates for rehabilitation of vascular amputees: implications for preoperative assessment and amputation level. *Br J Surg* 1992; 79: 753–755.

7. Gunawardena NS. Factors affecting functional outcome of lower limb amputee soldiers in two Districts of Sri Lanka. Thesis (MD Community Medicine), Post-Graduate Institute of Medicine, University of Colombo, 2002.

8. Gauthier-Gagnon C, Grise MC, Potvin D. Enabling factors related to prosthetic use by people with transtibial and transfemoral amputation. *Arch Phys Med Rehabil* 1999; 80: 706–713.

9. Schoppen T, Boonstra A, Groothoff JW, et al. Physical, mental, and social predictors of functional outcome in unilateral lower-limb amputees. Arch Phys Med Rehabil 2003; 84(6): 803–811.

10. Raichle KA, Hanley MA, Molton I, et al. Prosthesis use in persons with lower- and upper-limb amputation. *J Rehabil Res Dev* 2008; 45: 961–972.

11. Bond MJ, Clark MS, Smith DS, et al. Lifestyle activities of the elderly: composition and determinants. *Disabil Rehabil* 1995; 17: 63–69.

12. Panesar BS, Morrison P, Hunter J. A comparison of three measures of progress in early lower limb amputee rehabilitation. *Clin Rehabil* 2001; 15: 157–171.

13. Spector WD, Katz S, Murphy JB, et al. The hierarchical relationship between activities of daily living and instrumental activities of daily living. *J Chronic Dis* 1987; 40: 481–489.

14. Ogawa Y, Iwasaki K, Yasumura S. A longitudinal study on health status and factors relating to it in elderly residents of a community. *Nihon Koshu Eisei Zasshi* 1993; 40: 859–871.

15. Holbrook ME, Skilbeck CE. An activities index for use with stroke patients. *Age Ageing* 1983; 12: 166–170.

16. Turnbull JC, Kersten P, Habib M, at al. Validation of the Frenchay Activities Index in a general population aged 16 years and older. *Arch Phys Med Rehabil* 2000; 81: 1034–1038.

17. Miller WC, Deathe AB, Harris J. Measurement properties of the Frenchay Activities Index among individuals with a lower limb amputation. *Clin Rehabil* 2004; 18: 414–422.

18. KP Suresh, S Chandrashekara: Sample size estimation and power analysis for clinical research studies. *J Hum Reprod Sci* 2012; 5: 7–13.

19. Franchignoni F, Orlandini D, Ferriero G, et al. Reliability, validity, and responsiveness of the locomotor capabilities index in adults with lower-limb amputation undergoing prosthetic training. *Arch Phys Med Rehabil* 2004; 85: 743–748.

20. Condie E, Scott H, Treweek S. Lower limb prosthetic outcome measures: a review of the literature 1995 to 2005. *J Prosthet Orthot* 2006; 18: 13–45.

21. Andresen EM. Criteria for assessing the tools of disability outcomes research. *Arch Phys Med Rehabil* 2000; 81(12 Suppl 2): S15–S20.

22. Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. *Bone Marrow Transplant* 2013; 48: 452–458.

23. Van Eijk MS, Van der Linde H, Buijck B, et al. Predicting prosthetic use in elderly patients after major lower limb amputation. *Prosthet Orthot Int* 2012; 36: 45–52.

24. Haberman LJ, Bedotto RA, Colodney EJ. Silicone-only suspension (SOS) for the above-knee amputee. *J Prosthet Orthot* 1992; 4: 76–85.

25. Gholizadeh H, Abu Osman NA, Eshraghi A, et al. Transtibial prosthesis suspension systems: systematic review of literature. *Clin Biomech* 2014; 29: 87–97.

26. Gholizadeh H, Abu Osman NA, Eshraghi A, et al. Transfemoral prosthesis suspension systems: a systematic review of the literature. *Am J Phys Med Rehabil* 2014; 93: 809–823.

27. Hachisuka K, Chisaka H, Kawazu T, et al. Applied Activities of Daily Living and its standard value determined according to Frenchay Activities Index Scores for randomly sampled middle and advanced age people living at home. *Jpn J Rehabil Med* 2001; 38: 287–295.

28. Tsuya NO, Bumpass LL, Choe MK, et al. Employment and household tasks of Japanese couples, 1994–2009. *Demogr Res* 2012; 27: 705–718.

29. Ohmine S, Kimura Y, Saeki S, et al. Community-based survey of amputation derived from the physically disabled person's certification in Kitakyushu City, Japan. *Prosthet Orthot Int* 2012; 36: 196–202.

30. Sawamura S. *Amputation and prosthesis*. Tokyo: Ishiyaku Publisher, 2007: 1–16.

31. Amtmann D, Morgan SJ, Kim J, et al. Health-related profiles of people with lower limb loss. *Arch Phys Med Rehabil* 2015; 96: 1474–1483.

32. McWhinnie DL, Gordon AC, Collin J, et al. Rehabilitation outcome 5 years after 100 lower-limb amputations. *Br J Surg* 1994; 81: 1596–1599.

33. National Institute of Population and Social Security Research. *Population Statistics*, http://www.ipss.go.jp/syoushika/tohkei/Popular/P_Detail2021.asp?fname=T07-32.htm.