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Self-Efficacy and Social Support are Associated with Disability for Ambulatory Prosthesis Users After Lower-Limb Amputation

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Abstract

Background: Interventions targeting psychosocial factors may improve rehabilitation outcomes for prosthesis users after lower-limb amputation (LLA), but there is a need to identify targeted factors for minimizing disability.

Objective: To identify psychosocial factors related to disability for prosthesis users after LLA in middle age or later.

Design: Cross-sectional study.

Setting: General community.

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Participants: Participants with LLA (N = 122) were included in this cross-sectional study if their most recent LLA was at least 1 year prior, they were ambulating independently with a prosthesis, and they were between 45 and 88 years old.

Interventions: Not applicable.

Main Outcome Measures: Disability, the primary outcome, was measured using the World Health Organization Disability Assessment Schedule 2.0 (WHODAS). Candidate psychosocial variables included self-efficacy, social support, and motivation, measured using the Self-Efficacy of Managing Chronic Disease questionnaire (SEMCD), Multidimensional Scale of Perceived Social Support questionnaire (MSPSS), and modified contemplation ladder (mCL), respectively. The hypothesis was that greater self-efficacy, social support, and motivation would be associated with lower disability when controlling for covariates.

Results: The covariate model, including etiology, age, sex, U.S. military veteran status, LLA characteristics, time since LLA, medical complexity, and perceived functional capacity, explained 66.1% of disability variability (WHODAS 2.0). Backward elimination of candidate psychosocial variables stopped after removal of motivation ($P = .10$), with self-efficacy ($P < .001$) and social support ($P = .002$) variables remaining in the final model. The final model fit was statistically improved ($P < .001$) and explained an additional 6.1% of disability variability when compared to the covariate model.

Conclusions: Greater self-efficacy and social support are related to lower disability after LLA. Findings suggest there may be a role for interventions targeting increased physical function, self-efficacy, and social support for ambulatory prosthesis users after LLA in middle age or later, especially when complicated by multiple chronic conditions.

Introduction

An estimated 1.6 million people in the United States were living with lower-limb amputation (LLA) in 2005, and 80% of them were older than 45 years old.[1] Furthermore, the number of people living with LLA is expected to rise to 2.2 million by 2020 and 3.6 million by 2050.[1] Activity limitations and life participation restrictions are common following LLA, and rehabilitation recommendations suggest optimizing disability outcomes using interdisciplinary approaches tailored to individual goals.[2] Conventional rehabilitation approaches focus on the physical sequelae after LLA, targeting prosthesis use for locomotion and mobility to improve disability.[2–4] Despite functional gains with physically focused interventions, severe disability for people with LLA near middle age or later remains common.[5–7]

The suboptimal rehabilitation outcomes for people with LLA near middle age or later suggest the presence of intervention targets that have gone unaddressed. Further, a longstanding bias towards research focused on young and relatively healthy people with LLA has limited the generalizability of findings towards older people with LLA with multiple comorbid conditions,[8] including those who use a prosthesis for locomotion. Although there is a growing body of evidence highlighting the significance of complicating factors (eg, multiple comorbid conditions), there continues to be a lack of clarity about etiology-specific influences (eg, traumatic, dysvascular) on rehabilitation outcomes for

people of similar age and time since LLA who use a prosthesis beyond 1 year post-LLA.[9–15] Theoretical underpinnings suggest factors ranging from age, chronic disease, adjustment, and social functioning may influence etiology-specific differences in rehabilitation outcomes within the first year of LLA, regardless of prosthesis use for locomotion.[14] Some of these characteristics, such as age or chronic disease, are largely nonmodifiable, whereas some psychosocial factors (eg, self-efficacy, social support, motivation) commonly associated with these characteristics have the potential to be targeted with behavioral intervention for people in middle age with LLA who use a prosthesis for locomotion.

Social cognitive theory, self-determination theory, and other behavioral frameworks have provided the foundation for developing behavioral interventions that target psychosocial mechanisms of health and rehabilitation outcomes in a variety of populations with chronic health conditions.[16–18] Common psychosocial targets include self-efficacy, social support, and motivation. Specifically for people with LLA, self-efficacy is associated with physical activity and disability, and social support by family, friends, and peers is consistently recommended to facilitate adaptation after LLA.[2,19,20] Motivation has also been implicated as a potential psychosocial target to improve physical activity after dysvascular LLA.[21] To date, there is an incomplete understanding of the specific psychosocial factors that influence disability for prosthesis users following traumatic and dysvascular LLA. Therefore, the purpose of this cross-sectional study was to identify psychosocial factors that have significant relationships with disability for prosthesis users after LLA in middle age or later. The hypothesis was that greater self-efficacy, social support, and motivation would be associated with lower disability.

Methods

Study Design

This cross-sectional study was part of a larger mixed-methods study, which aimed to explore and identify psychosocial factors that influence disability among ambulatory lower-limb prosthesis users in middle age or later. The quantitative findings reported here provide foundation knowledge (ie, identify psychosocial factors related to disability) to support the development and testing of rehabilitation interventions for people within this specific group. Data collection and analysis procedures for this study were informed by prior qualitative and quantitative research focused on the influence of psychosocial factors on rehabilitation outcomes after LLA.[19–22]

Participant Recruitment, Enrollment, and Data Collection Procedures

Participants were recruited through local hospitals, amputation specialty clinics, support groups, and nationally through the Amputation Coalition of America. Participants with dysvascular etiology were included if their most recent LLA (above ankle) was at least 1 year prior, they had a diagnosis of diabetes mellitus (DM) and/or peripheral artery disease (PAD), were ambulating independently with a prosthesis, and were between 45 and 88 years old. The inclusion criteria of independent ambulation with prosthesis use was selected to limit the potential influence of differing disability perceptions between people who use a prosthesis to walk and those who do not (including nonprosthesis users). Participants with

traumatic amputation were screened using the same inclusion criteria as participants with dysvascular LLA with the exception of having a diagnosis of DM and/or PAD. Further, traumatic etiology of LLA commonly occurs at a younger age.[13,23] Protracted durations of time since LLA could potentially influence disability. To minimize risk of bias, potential participants with traumatic LLA etiology were enrolled if they could be matched to a participant in the dataset with dysvascular LLA, based on time since amputation (±18 months). Participants were excluded if they had a cancer-related amputation, were not independently using a prosthesis for locomotion, or had recent and/or acute health conditions that potentially influence the stability of disability (eg, stroke within the prior 2 years, unstable cardiac condition, acute systemic infection). Participants who met the inclusion criteria were contacted by phone to obtain informed consent and complete data collection (January 2018 to August 2019). The study protocol was approved by the Colorado Multiple Institutional Review Board and Veterans Affairs Office of Research and Development.

Outcome Measures

The primary outcome, disability, was measured using the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0). The WHODAS 2.0 is recommended for use with people after LLA, is internally consistent (Cronbach alpha = 0.75–0.87), and assesses disability due to any health condition.[24–26] Items on the WHODAS 2.0 ask participants to indicate the amount of difficulty experienced when completing 12 common tasks over the past 30 days, where 1 indicates no difficulty and 5 indicates extreme difficulty.[27] A sum score was used in this analysis, where higher WHODAS 2.0 scores indicate greater severity of disability.[24]

Candidate psychosocial variables included self-efficacy, social support, and motivation. These variables were selected because of prior evidence demonstrating their potential influence on rehabilitation outcomes.[19–22] 22 Self-efficacy was measured using the Self-Efficacy of Managing Chronic Disease (SEMCD) questionnaire. This scale has high internal consistency (Cronbach alpha = 0.91), is valid for use with people with chronic conditions, and has previously been used with a sample of people with dysvascular LLA.[18,19] The SEMCD asks participants to rate their confidence in using strategies to minimize the effects of chronic disease on a scale of 1–10. An average SEMCD score was used in this analysis. Social support was measured using the Multidimensional Scale of Perceived Social Support (MSPSS).[28,29] The MSPSS is a 12-item measure of perceived social support across three domains (family, friends, and significant other) and has been previously been used with people who have LLA.[28–31] Additionally, the MSPSS is internally consistent (Cronbach alpha = 0.88) and reliable (r = 0.85).[28] The MSPSS asks participants to indicate to what degree they agree with 12 statements with responses ranging from 1 (very strongly disagree) to 7 (very strongly agree). A total sum MSPSS score was used in this analysis, where higher scores indicated greater perceived social support (possible score range: 12–84). Motivation was measured using a modified contemplation ladder (mCL). Contemplation ladders were initially developed using the trans-theoretical model of behavior change to measure motivation for smoking cessation.[32,33] Contemplation ladders have been modified to measure motivation for a variety of behaviors including diet and exercise[34] and were

modified for this study to measure motivation for physical activity. The mCL asks participants to rate their level of motivation to be physically active (1: very low to 7: very high).

Covariate variables were selected based on evidence of their potential influence on disability after LLA. These variables included LLA etiology, demographics (age, sex, U.S. military veteran status), amputation level, bilateral involvement, time since amputation, medical complexity, and perceived functional capacity.[10,11,35–38] Medical complexity was measured using the Functional Comorbidity Index (FCI). The FCI is a self-report questionnaire of the presence of chronic conditions (eg, anxiety, depression, osteoarthritis) that are known to influence physical function in older adults and people with disabilities.[39,40] Perceived functional capacity was measured using the Prosthesis Evaluation Questionnaire - Mobility Subscale (PEQ-MS). The PEQ-MS is a reliable (intraclass correlation coefficient = 0.73–0.90) and internally consistent measure (Cronbach alpha = 0.96) specifically designed for people with LLA.[41–43] The PEQ-MS asks participants to rate the amount of difficulty completing 12 mobility tasks on a scale of 0 (inability to complete) to 4 (no difficulty). An average of the 12 PEQ-MS items was used in this analysis.

Statistical Analysis

Analysis for this cross-sectional study was conducted using SAS statistical software (SAS Institute Inc., Cary, NC). Amputation level (below knee, through or above knee) and bilateral/unilateral involvement was condensed into one variable (LLA characteristic) that was included in the regression model. Only one participant had bilateral LLA of mixed amputation level; therefore, this participant was grouped with participants who had bilateral below knee LLA. Covariate and candidate psychosocial variables met assumptions of linear regression modeling, except time since amputation, which was log transformed due to nonnormality. A covariate model was developed using a generalized linear model to identify the amount of variability explained by covariates alone (R^2 and $_{Adj}R^2$) and model fit (−2 log likelihood). Then, a full model including all covariates and candidate psychosocial variables was analyzed using backward elimination to identify the most parsimonious model. In this analysis, covariates were forced to remain in the model, and one candidate psychosocial variable with the highest *P* value was removed per cycle until only candidate psychosocial variables with a *P* value <.05 remained in the model. Finally, covariate and final model fit was compared using difference in −2 log likelihood score and degrees of freedom against a chi-square distribution, where $P < .05$ indicated better model fit. Additionally, a sensitivity analysis with participants who had LLA with DM and/or PAD was conducted to identify if there were different findings by etiology. Multicollinearity was assessed using the variance inflation factor (VIF) in both covariate and final models (VIF > 5 indicating potential multicollinearity). Analysis was limited to a maximum of 11 variables to prevent model overfitting (variable to participant ratio < 1:10).

A priori power analysis (G*Power) indicated a sample size of 120 participants with eight covariate variables had at least 80% power to detect an effect size as small as 0.07, 0.08, and 0.09 with one, two, and three candidate psychosocial variables, respectively.

Results

Consent to contact was obtained from 262 potential participants and 126 participants were enrolled (Figure 1). Four participants missing the primary outcome were excluded from the analysis. The final dataset included 122 participants (Table 1).

The covariate model including LLA etiology (traumatic or dysvascular), age, sex, U.S. military veteran status, LLA characteristic, time since LLA (log transformed), medical complexity (FCI), and perceived functional capacity (PEQ-MS) explained 66.1% of the variability in disability as measured by the WHODAS 2.0 (Table 2). Backward elimination of candidate psychosocial variables from the full model, where covariates were forced to remain, stopped following removal of the motivation variable (mCL; $P = .10$), with the self-efficacy (SEMCD; $P < .001$) and social support (MSPSS; $P = .002$) variables remaining in the final model. The final model explained 72.2% of WHODAS 2.0 variability, an additional 6.1% of explained variability above the covariate only model. Difference in −2 log likelihood score was 18.5 with 2 degrees of freedom and, compared to a chi-square distribution, indicated significantly improved model fit ($P < .001$). Findings from the sensitivity analysis demonstrated inclusion of only participants with dysvascular LLA were no different than the primary analysis. VIF was <5 for all variables in covariate and final models.

Discussion

The purpose of this study was to identify psychosocial factors that have significant relationships with disability for prosthesis users after LLA in middle age or later. Greater self-efficacy and social support were associated with lower disability, explaining an additional 6.1% of disability as measured by the WHODAS 2.0. Counter to the hypothesis, greater motivation, as measured by a modified contemplation ladder, was not associated with lower disability.

Results of the current study support and extend the knowledge of relationships between physical function, psychosocial factors, and disability outcomes for people who use a prosthesis after LLA in middle age or later. Historically, psychosocial concerns have had limited focus during rehabilitation, with physical function as the primary target of conventional rehabilitation following both traumatic and dysvascular LLA.[2–4] Findings from the final regression model in this study reinforce prior evidence of association between perceived physical function and rehabilitation outcome.[11,15] Specifically, for every one-point increase in perceived functional capacity (PEQ-MS; 0: unable to 4: no difficulty), the disability score (WHODAS 2.0) was 5 points lower, indicating lower disability. The inclusion of self-efficacy and social support in the final model explained a significantly greater amount of disability variability when compared to the covariate alone model.

The combined influence of perceived functional capacity and psychosocial factors with disability was consistent with prior studies for people with LLA.[19–21] This study extends knowledge of potential rehabilitation targets post-LLA by quantitatively analyzing associations of multiple psychosocial variables within the context of clinical covariates (eg,

LLA characteristics, time since LLA) that potentially influence disability outcomes. The additional explained variability, above clinical covariates, suggests self-efficacy and social support should be considered as potential targets for rehabilitation intervention among lower-limb prosthesis users.

Although rehabilitation interventions commonly target the physical sequelae after LLA, interventions targeting increased self-efficacy and social support are less common. Self-efficacy and social support, critical components of social cognitive theory, are long recognized as factors associated with health and disability outcomes for people with chronic health conditions.[16] Social cognitive theory has informed the development of a group-based self-management program for people with LLA that resulted in improved self-efficacy and perceived physical function, where participants were 56 years old on average and number of comorbid health conditions was not specifically reported.[22] Unfortunately, widespread use of behaviorally informed rehabilitation interventions after LLA is limited and understudied. Further research is needed to develop and test interventions that improve physical function and psychosocial factors associated with long-term outcomes following LLA.[44]

There are plausible hypotheses for why motivation was not significantly associated with disability. The trans-theoretical model and self-determination theory posit motivation as a critical factor toward achieving behavior change, yet single measures of motivation, as in a modified contemplation ladder, can be an inconsistent predictor of future action.[32] Prediction inconsistency is likely owing to complex mechanisms of self-efficacy, perceived behavioral benefits, social environment, or motivation type that influence the transition from motivation to action.[17,21,45,46] For example, Castonguay and Miquelon analyzed the relationships among motivation types, minutes of moderate-vigorous physical activity (MVPA), and acute diabetes-related symptoms in a sample of 165 adults with type 2 DM.[47] Findings indicated that there was a significant indirect effect of intrinsic and extrinsic motivation to acute diabetes-related symptoms, mediated through MVPA.[47] Relationships between other motivation types (eg, amotivation) and MVPA were not identified. Significant relationships among specific motivation types is an example of the knowledge needed to understand the mechanisms of transition from motivation to action. The current cross-sectional study was not designed to fully examine the complex relationships of factors that influence motivation. Further, a relationship between motivation and disability may not have been identified because the modified contemplation ladder used in the present study was not specifically validated for prosthesis users after LLA. Longitudinal research, using psychometrically sound measures, is needed to understand the transition from motivation to action and develop rehabilitation interventions for this specific population.

Participants in the current study sample were using a prosthesis for ambulation, at least 1 year post-LLA, 62.5 ± 8 years old, and had six comorbid conditions on average. Medical complexity was significantly associated with disability, and etiology did not explain a significant portion of disability variability in the final model. Although etiology is emphasized as an influential factor in rehabilitation post-LLA,[2] literature suggests the influence of comorbid conditions may be more meaningful. For example, the number of comorbid conditions is negatively associated with physical function outcome for people with non-vascular LLA.[48] Further, history of stroke, peripheral vascular disease, or anxiety/panic

disorders are associated with physical function outcomes in another retrospective cohort of nearly 600 people with LLA of any etiology.[9] In the present study, the number of comorbid conditions was used as a covariate in an analysis focused on identifying psychosocial factors influencing disability. Despite the need for further research focusing on the influence of specific health conditions, findings from this suggest that comorbid health conditions, a common feature of those with dysvascular LLA, may be an important indicator of disability for people over 45 years old with traumatic or dysvascular LLA.

Finally, the high medical complexity of participants in this study suggests there may be a role for rehabilitation interventions to better address self-management strategies for comorbid disease. Considering the positive outcomes of self-management programs for people with chronic disease and LLA, behavioral interventions targeting self-efficacy and social support in the setting of LLA may have potential to improve disability for people who have greater medical complexity and disability than in previously reported intervention studies. To date, no interventions specifically designed to improve disability for lower-limb prosthesis users in middle age or later with high medical complexity have been designed or tested. Interventions tailored to people with high medical complexity could potentially integrate novel approaches, such as the group-based approaches to chronic disease self-management and self-management following LLA programs.[18,22]

Study Limitations

The cross-sectional nature of this study limits the ability to analyze change over time or attribute causality of covariate or psychosocial variables to disability after LLA in middle age or later. There are also socioeconomic and psychosocial variables (eg, resilience) that potentially influence disability outcome that were not included in this analysis. Additionally, the minimal clinically important difference score for WHODAS 2.0 score with people who have LLA is yet to be established; a better understanding of clinical implications for WHODAS 2.0 is needed. The study sample comprised of ambulatory prosthesis users who were predominantly men with LLA more than a year previously potentially limits generalizability of findings (eg, nonprosthesis users). Finally, the absence of performance-based functional capacity prevents further analysis of relationships among perceived functional capacity and psychosocial variables with disability. Future work should include larger proportions of women, identify the minimally clinically important difference score for the WHODAS 2.0, examine the psychometric properties of psychosocial measures for people with LLA (eg, motivation), consider longitudinal changes of psychosocial variables, and include performance-based functional capacity measures, especially in the first year post-LLA.

Conclusions

Self-efficacy and social support are significantly related to disability outcome for ambulatory prosthesis users after LLA near middle age or later when controlling for covariates. Additionally, greater comorbidity burden, as opposed to dysvascular etiology, was associated with self-reported disability. Findings from this study suggest there may be role for

interventions targeting increased physical function, self-efficacy, and social support to improve disability for people who use a prosthesis after LLA in middle age or later.

Disclosure:

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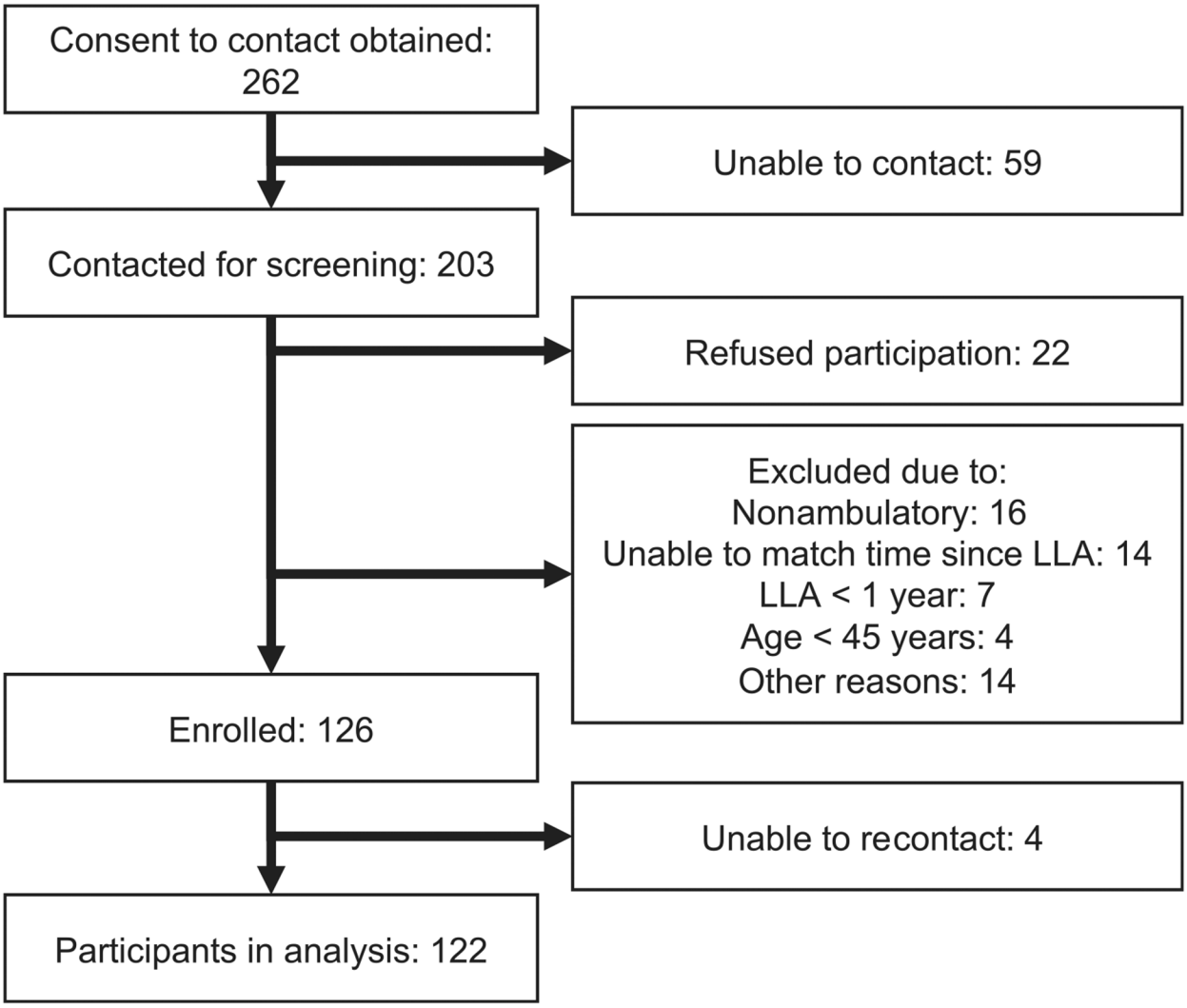

Figure 1.
Flow diagram of participant recruitment and enrollment. LLA = lower limb amputation.

Table 1

Sample characteristics (N = 122)

Variable	n(%)
Male	108(89)
Veteran	53 (43)
Caucasian (non-Hispanic)	92 (75)
Dysvascular etiology	100(82)
LLA Characteristics	
Unilateral BKA	83(68)
Unilateral AKA	25 (20)
Bilateral LLA	14(11)
	Mean (SD)
Age (years)	62.5 (8)
Months since amputation	59.5 (58)
WHODAS 2.0	22.0 (8)
FCI	5.8(3)
PEQ-MS	2.7(0.8)
SEMCD	7.5(2)
MSPSS	66.7(14)
Motivation	5.2(1)

LLA = lower-limb amputation; BKA = below knee amputation; AKA = above knee amputation; PEQ-MS = Prosthesis Evaluation Questionnaire - Mobility Subscale; MSPSS = Multidimensional Scale of Perceived Social Support; FCI = Functional Comorbidity Index; WHODAS 2.0 = World Health Organization Disability Assessment Schedule 2.0; SEMCD = Self-Efficacy of Managing Chronic Disease.

Table 2

Disability regression modeling output

	Model Statistics				Predictor Statistics		
	R^2	$_{Adj}R^2$	Δ R^2	Δ −2 Log Likelihood	β	SE	*P* value
Covariate model	.686 *	.661	…	…			
Final model	.747 *	.722	.061	18.5 †			
Age					−0.09	0.052	.082
Female					1.54	1.28	.23
Dysvascular etiology					−1.81	1.09	.10
Time since amputation ‡					0.006	0.50	.99
FCI					0.54	0.16	.002
Bilateral LLA §					−0.85	1.22	.49
Unilateral AKA §					1.12	1.02	.27
Veteran					−0.16	0.84	.85
PEQ-MS					−5.09	0.66	<.001
SEMCD					−1.02	0.28	<.001
MSPSS					−0.10	0.031	.002

SEMCD = Self-Efficacy of Managing Chronic Conditions; MSPSS = Multidimensional Scale of Perceived Social Support; SE = Standard Error; PEQ-MS = Prosthesis Evaluation Questionnaire - Mobility Subscale; FCI = Functional Comorbidity Index; LLA = lower-limb amputation; AKA = above knee amputation.

* $P < .001$.

† Chi-square, 2 dof: final model fit significantly improved ($P < .001$).

‡ Log transformed due to nonnormality.

§ Unilateral Below knee amputation reference group.