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Relationships among perceived functional capacity, self-efficacy, and disability after dysvascular amputation

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Abstract

Background—Prosthesis rehabilitation after dysvascular transtibial amputation (TTA) is focused on optimizing functional capacity with limited emphasis on promoting health self-efficacy. Self-efficacy interventions decrease disability for people living with chronic disease, but the influence of self-efficacy on disability is unknown for people with dysvascular TTA.

Objectives—To identify if self-efficacy mediates the relationship between self-reported functional capacity and disability after dysvascular TTA.

Design—Cross-sectional, secondary data analysis.

Setting—Outpatient rehabilitation facilities.

Participants—Thirty-eight men (63.6 ± 9.1 years old) with dysvascular TTA.

Methods—Participants had been living with an amputation for less than 6 months and using walking as their primary form of locomotion using a prosthesis. The independent variable, functional capacity, was measured using the Prosthesis Evaluation Questionnaire-Mobility Scale

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(PEQ-MS). The proposed mediator, self-efficacy, was measured with the Self-Efficacy of Managing Chronic Disease questionnaire (SEMCD).

Main outcome measure—Disability was measured using the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) questionnaire.

Results—The relationship between self-reported functional capacity and disability is partially mediated by self-efficacy. Relationships between WHODAS 2.0 and PEQ-MS (r = −0.61), WHODAS 2.0 and SEMCD (r = −0.51), and PEQ-MS and SEMCD (r = 0.44) were significant (P < .01). Controlling for SEMCD (P = .04), the relationship between PEQ-MS and WHODAS 2.0 remained significant (P < .01). Statistically significant mediation was determined by a bootstrap method for the product of coefficients (95% CI: −2.23, −7.39).

Conclusions—This study provides initial evidence that the relationship between self-reported functional capacity and disability is partially mediated by self-efficacy after dysvascular TTA. The longitudinal effect of self-efficacy should be further examined to identify causal pathways of disability after dysvascular amputation. Furthermore, additional factors contributing to the relationship between self-reported functional capacity and disability need to be identified.

Keywords

Dysvascular Amputation; Self-efficacy; Physical Function; Complex Conditions; Disability

Introduction

The majority of lower limb amputations are due to dysvascular etiologies including peripheral artery disease (PAD) and diabetes mellitus (DM).[1] Rehabilitation outcomes following dysvascular amputation are poor, with people experiencing greater disability than 95% of the general population.[2] Severe disability may be related to the etiology of amputation and presence of high comorbidity burden.[1,3] Current prosthesis rehabilitation, regardless of etiology, is focused on maximizing functional capacity in the first year after amputation.[4] Despite improvements in performance and self-reported functional capacity after prosthesis rehabilitation,[5] people with dysvascular transtibial amputation (TTA) continue to report dissatisfaction with mobility,[6] have significant limitations in their ability to ambulate in the community,[7] and achieve 3 times fewer than the recommended 7,100 steps/day for people with disabilities.[8,9]

Self-efficacy, the belief in one's ability to execute a given behavior, may account for differences in disability status following dysvascular TTA and has been studied in various chronic conditions.[10,11] Effective behavior-based interventions use strategies (e.g., patient-directed goal setting, problem solving, self-monitoring during exercise) to specifically target improved self-efficacy.[12–15] For example, a group-mediated behavior-based intervention focused on enhancing self-efficacy among people with PAD increased participation in everyday physical activity, distance of walking in six minutes, and pain-free walking distance at six months.[16] Furthermore, self-efficacy mediates the effects of chronic pain perception and morbidity on disability outcomes for older adults.[17,18]

The extent to which self-efficacy attenuates disability outcomes after dysvascular TTA has not been established. Understanding the relationships between perceived functional capacity, patient self-efficacy, and disability is needed to inform the development of more effective rehabilitation interventions aimed at reducing long-term disability in an understudied, medically complex population with low odds of rehabilitation success. Therefore, the purpose of this study was twofold: 1) describe the relationships between perceived functional capacity, self-efficacy, and disability and 2) identify if self-efficacy mediates the relationship between self-reported functional capacity and disability after dysvascular TTA.

Materials/Methods

Participants

Baseline data from a randomized clinical trial aimed at improving rehabilitation outcomes after dysvascular transtibial amputation (TTA) were analyzed for the purposes of this study. Data for this analysis were collected by a physical therapist during a baseline test, before clinical trial randomization and intervention. Briefly, participants were recruited from outpatient rehabilitation clinics throughout the front range of Colorado and the Veterans Affairs Eastern Colorado Health Care System. Individuals between 50 and 85 years of age were included in the study if they had a dysvascular TTA less than 6 months prior to enrollment and were walking independently using a prosthesis with or without an assistive device. Individuals were excluded if they used a wheelchair as a primary form of locomotion, their amputation was due to cancer or trauma, or they had unstable cardiac, neurologic, or orthopedic conditions. The study protocol was approved by the Colorado Multiple Institutional Review Board and Veterans Affairs Research and Development office.

Variables

Variables were selected due to hypothesized relationships among self-reported functional capacity, disability, and self-efficacy based on the International Classification of Functioning and Social Cognitive theory (Figure 1). More specifically, we hypothesized that greater self-reported functional capacity would be associated with greater self-efficacy, leading to reduced disability. Descriptive variables including age, body mass index, number of comorbid conditions, and weeks since amputation were also collected.

Independent Variable—Self-reported functional capacity was assessed with the 12-item Prosthesis Evaluation Questionnaire – Mobility Scale (PEQ-MS). The PEQ-MS is a well-established, commonly used outcome measure with demonstrated reliability (ICC=0.73–0.90) and internal consistency (Cronbach's alpha=0.96) for use with people who have dysvascular TTA.[19,20] Participants were asked to rate the amount of difficulty they perceive completing a range of ambulation and transfer tasks (e.g., walk in confined spaces, walk up a steep hill, sit down and get up from a chair); with scores ranging from being unable or hardly able (0) to having no problems (4). An average score across the 12-item questionnaire was used in the analysis (score range: 0–4).

Dependent Variable—Self-reported disability was assessed with the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) 12-item questionnaire.

[21,22] The WHODAS 2.0 was developed to measure disability due to any health condition across domains of cognition, mobility, self-care, getting along, life activities, and participation.[22] The WHODAS 2.0 has strong internal consistency (Cronbach's alpha=0.89) and has demonstrated severe disability with people who have dysvascular TTA.[2,23] Participants in this study were asked to rate the amount of difficulty completing 12 daily activities (e.g., learning a new task, taking care of household responsibilities, joining community activities) over the past 30 days, with scores ranging from 1 (no difficulty) to 5 (extreme difficulty/cannot do).[22] Overall disability was calculated by summing the scores for the 12 items; higher scores indicated greater disability (score range: 12–60).

Mediating Variable—The Self-Efficacy of Managing Chronic Disease (SEMCD) scale was used to assess participant confidence in using strategies to minimize the negative effects of chronic disease on everyday living. The SEMCD consists of 6 questions in domains related to symptom control, emotional functioning, and communicating with physicians and others. The questionnaire is internally consistent (Cronbach's alpha=0.91) and valid for use with people living with a variety of chronic conditions, including DM and PAD.[24] Participants indicated their confidence on a scale of 1 (not confident) to 10 (totally confident). An average score was obtained over the 6 items and used in the analysis (score range: 1–10).

Statistical Analysis/Analysis Plan

Sample size was determined by the parent randomized control trial (NCT01929018). Univariate linear regression and Pearson correlation coefficients (r) were used to identify statistically significant relationships between self-reported functional capacity, self-efficacy, and disability. In the presence of significant relationships ($P < .05$), mediation analysis was used to assess the hypothesized relationship among self-reported disability, self-reported functional capacity, and self-efficacy for chronic disease management (Figure 1). The intent was to test if the independent variable (I; PEQ-MS) was related to the dependent variable (Y; WHODAS 2.0) through the mediating variable (M; SEMCD). Testing mediation requires analysis of regression coefficients from 3 equations: (1) The total effect of the independent variable (τ) on the dependent variable ($Y = \beta_{0(1)} + \tau I + \varepsilon_{(1)}$), (2) the effect of the independent variable (α) on the mediating variable ($M = \beta_{0(2)} + \alpha I + \varepsilon_{(2)}$), and (3) the effect of the independent variable on the dependent variable (τ') when the mediating variable (β) is added to regression one ($Y = \beta_{0(3)} + \beta M + \tau' I + \varepsilon_{(3)}$). The null hypothesis is then $H_{O:}\ \tau\text{-}\tau' = 0$ or $H_O: \alpha\beta = 0$. The nature of cross-sectional data precludes the assessment of causal directionality of variables in our analysis. Additionally, sample size limitations prevented inclusion of covariates in regression models.

MacKinnon et al compared 14 methods for testing the null hypothesis, generally differing in the way the variance of $\tau\text{-}\tau'$ or $\alpha\beta$ is computed and whether the test statistic is normally distributed[25]. The most powerful test when the null hypothesis was false and yielding the most accurate type I error rate was the product of coefficients test, $\alpha\beta \pm CL\sqrt{(\alpha^2\sigma^2_\beta + \beta^2\sigma^2_\alpha)}$ where $\sigma_{\alpha\beta} = \sqrt{(\alpha^2\sigma^2_\beta + \beta^2\sigma^2_\alpha)}$. Confidence intervals for $\alpha\beta_{SEMCD}$ were obtained using the bootstrap method. We also report the effect of adding the mediator to the model (ie, τ and τ'). Full mediation is indicated if τ' is no longer significant when controlling for

the mediating variable (SEMCD). Partial mediation is indicated if τ' is less than τ but remains statistically significant when controlling for the mediating variable (SEMCD).

Results

One hundred three people were screened and full data were collected from 38 men enrolled in the study. People did not enroll because they declined participation (n=12), did not meet inclusion criteria (n=27), or were unable to be contacted (n=26). Participants with dysvascular TTA had a mean age of 63.6 years (SD: ± 9.1), body mass index of 30.6 kg/m^2 (±8.6), 6.6 comorbid conditions (±2.5), and 17.9 weeks (±6.6) since amputation. The average WHODAS 2.0 score was 38.5 (±8.8), PEQ-MS score 2.5 (±0.8), and SEMCD score of 7.7 (±1.7). There were no significant differences in descriptive characteristics between Veteran (n=20) and non-Veteran (n=18) participants (Table 1).

Relationships between WHODAS 2.0 and PEQ-MS (r = −0.61), WHODAS 2.0 and SEMCD (r = −0.51), and PEQ-MS and SEMCD (r = 0.44) were significant (Table 2). The point estimate for the total effect of PEQ-MS on WHODAS 2.0 (τ) was −6.93 and PEQ-MS on SEMCD (α) was 0.99 (Table 3). When adding SEMCD to model 1, the effect of PEQ-MS on WHODAS 2.0 was reduced and remained significant ($\tau' = -5.44$). Bootstrap 95% confidence intervals of $\alpha\beta$SEMCD do not include zero (−7.39, −2.23). The non-inclusion of zero in the bootstrap confidence intervals demonstrate significant mediation effect of PEQ-MS on WHODAS 2.0 by SEMCD. The effect of PEQ-MS maintaining significance when SEMCD was added to the model, indicates the significant mediation is partial. Since the effect of PEQ-MS on WHODAS 2.0 remained significant after adding SEMCD to the model, there was not full mediation.

Discussion

The results of this study demonstrate that self-efficacy partially mediates the relationship between self-reported functional capacity and disability among individuals with dysvascular TTA. Specifically, higher self-efficacy for chronic disease management results in lower levels of disability. Partial mediation suggests other factors, such as performance-based functional capacity, may also account for disability outcomes after dysvascular TTA.

Our findings build on prior evidence indicating that greater self-efficacy results in lesser disability. The effect of self-efficacy in health behavior for people with chronic disease has been well established by Bandura and others; [10,11,26] yet, to the best of our knowledge, this is the first study to explore the mediation effect of self-efficacy with people who have dysvascular TTA. Schulz et al.[17] demonstrated self-efficacy partially mediated the relationship between pain intensity and pain-related disability for older adults with more than three comorbid conditions, yet the focus on pain in this population prevents generalization of these findings to people with dysvascular TTA. McAuley et al.[27] demonstrated partial mediation effect of self-efficacy and functional performance on the relationship between physical activity and disability in older women. Although not specifically related to individuals with dysvascular TTA, the evidence agrees with our

findings of partial mediation effect of self-efficacy within the larger context of self-reported physical function and disability with patients who have complex medical conditions.

Veteran and non-Veteran participants in this sample were similar, having an average of six or more co-morbid conditions in the presence of severe disability as measured by the WHODAS 2.0. Our findings suggest self-efficacy of chronic disease management may be a target of intervention to improve chronic disability with Veterans and non-Veterans. In addition to complex medical histories, people with dysvascular TTA commonly have poor health behaviors including history of smoking,[28] non-adherence with diabetes management recommendations,[29] and low levels of physical activity.[8] Behavior-based interventions targeting improved self-efficacy have been developed to increase physical activity behavior with people who have PAD or DM[16,30] and improve health outcomes for those specifically with DM.[31] Unfortunately, integration of behavior-based rehabilitation strategies targeting improved self-efficacy after dysvascular TTA are not common.

Developing interventions to improve self-efficacy for chronic disease management within rehabilitation may improve long-term disability after dysvascular TTA. Although not specifically addressed with this study, functional performance may account for the remaining portion of the relationship between self-reported physical function and disability.[27] Current prosthesis rehabilitation targeting range of motion, strength, and balance effectively improves functional performance, regardless of etiology, health behaviors, or comorbidity burden.[4] Persistence of severe disability outcomes following rehabilitation suggest the presence of rehabilitation targets that have gone unaddressed, such as self-efficacy. Integration of behavior-based strategies to improve self-efficacy, including patient-directed goal setting, problem solving, and self-monitoring during exercise may enable participants to seek greater participation in life roles and decrease chronic disability.

There are several study limitations to consider. Cross-sectional data from 38 men were used for analysis may bias the findings of this analysis and limit generalizability. Larger sample size studies that include women are needed to provide greater statistical power for making robust inferences about the effect of self-efficacy on disability.[25] In addition, our partial mediation findings suggest that other factors beyond self-efficacy may also contribute to the relationship between self-reported functional capacity and disability. Although similarities between Veterans and non-Veterans were identified in this study, future work should clarify potential differences between groups (e.g., diagnosis of PTSD). Furthermore, the cross-sectional nature of the data limits our ability to assess for causal directionality of self-efficacy and self-reported functional status on disability. Longitudinal studies will be required to determine causal directionality and how the effects of self-efficacy may change over time. Finally, the results of this study are based on self-reported functional capacity and further study is needed to identify how performance-based measures (e.g., timed up and go, two-minute walk, gait speed) of functional capacity may influence disability outcomes with relation to self-efficacy.

Conclusion

This exploratory data analysis identified significant relationships between self-reported functional capacity, self-efficacy, and disability for people with dysvascular TTA. Although causality is not definitive, this mediation analysis of cross-sectional data provided initial evidence that the relationship between perceived functional capacity and self-reported disability is partially mediated by self-efficacy after dysvascular TTA. Additionally, the absence of full mediation suggests that other factors, beyond self-efficacy, may also partially account for the relationship between self-reported functional capacity and disability. Further research is needed to identify additional targets of rehabilitation intervention and determine if interventions specifically targeting self-efficacy in this population reduce disability after dysvascular TTA.

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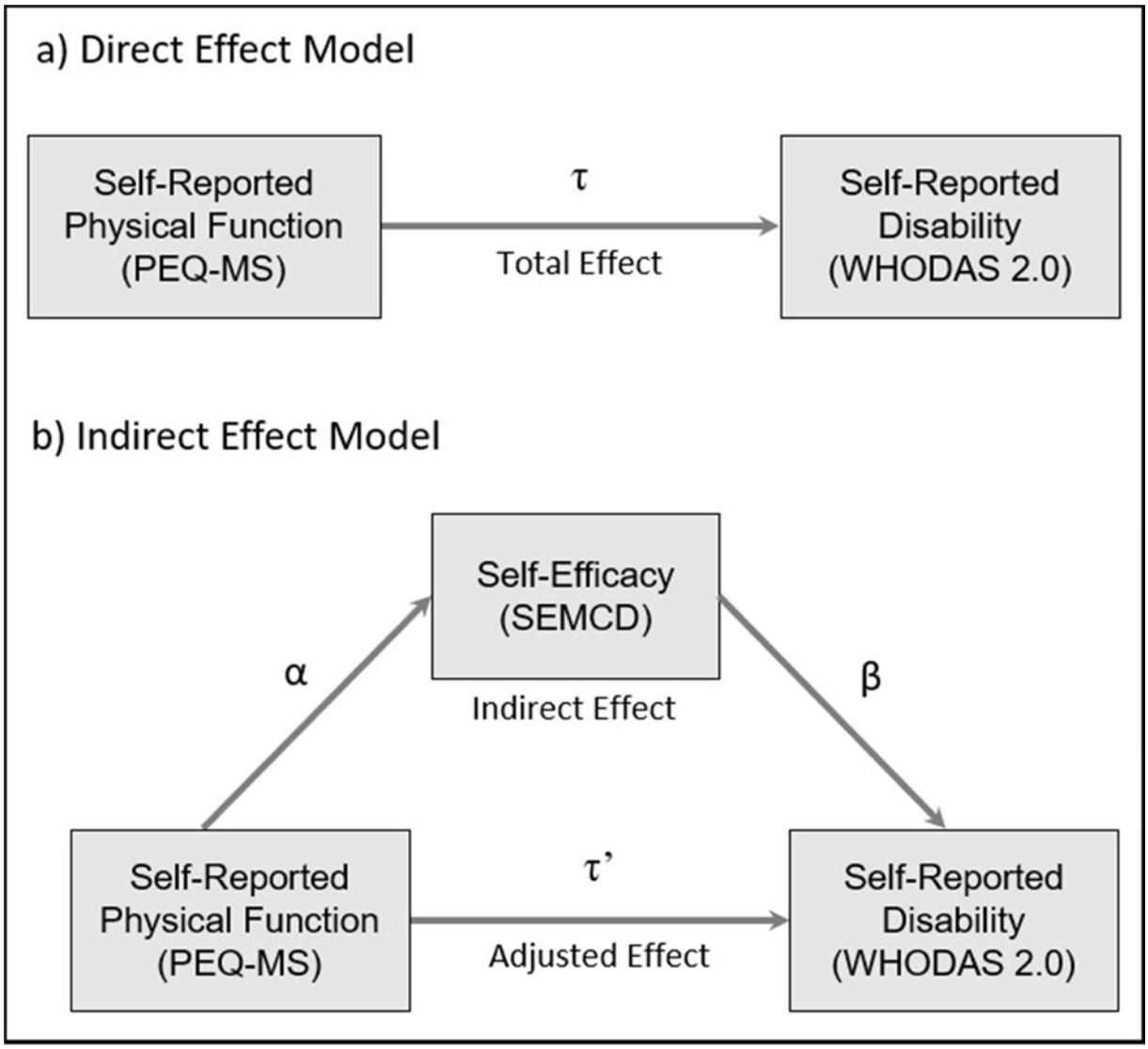

Figure 1.
Proposed relationships among Self-Reported Physical Function, Self-Reported Disability, and Chronic Disease Management Self-Efficacy

Table 1

Participant characteristics by Veteran/non-Veteran status *

	Non-Veteran (n = 18)	Veteran (n = 20)	p
Age (years)	61.00 ± 9.39	65.85±8.39	.63
Body mass index (kg/m^2)	30.83 ±7.75	30.44±9.45	.41
Comorbid conditions (number)	6.00±2.33	7.10±2.61	.63
Time since amputation (weeks)	21.50±4.34	14.70±6.74	.07
WHODAS 2.0 score	38.22±8.02	38.80±9.698	.44
PEQ-MS score	2.53±0.79	2.53±0.78	.97
SEMCD score	7.35±1.87	8.025±1.61	.53

* Values are mean ± SD

WHODAS 2.0 = World Health Organization Disability Schedule 2.0; PEQ-MS = Prosthesis Evaluation Questionnaire Mobility Scale; SEMCD = Self Efficacy of Managing Chronic Disease Questionnaire

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Table 2

Relationships between variables of interest

	PEQ-MS		SEMCD	
	r	**R^2**	**r**	**R^2**
WHODAS 2.0	−0.61 (p<.001)	0.37	−0.51 (p=.001)	0.26
PEQ-MS			0.44 (p=.006)	0.19

Table 3

Parameter estimates of regression equations

	Tau (p)	Tau‘ (p)	Alpha (p)	Beta (p)	R^2
Eq 1: PEQ-MS	−6.93 (p<.001)				0.37
Eq 2: SEMCD			0.99 (p=006)		0.19
Eq 3: PEQ-MS & SEMCD		−5.44 (p=.002)		−1.50 (p=042)	0.44