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## A cross-sectional assessment of factors related to pain intensity and pain interference in lower limb prosthesis users

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### Abstract

**Objective**—To determine relationships between pain site(s) and pain intensity/interference in people with lower limb amputations.

**Design**—Cross-sectional survey.

**Setting**—Community.

**Participants**—Lower limb prosthesis users with unilateral or bilateral amputations (n=1296, mean time since amputation = 14.1 years).

**Intervention**—Not applicable.

**Main Outcome Measures**—Patient-Reported Outcomes Measurement Information System (PROMIS) Pain Intensity (1-item to assess average pain), PROMIS Pain Interference (4-item short form to assess the consequences of pain in desired activities), and questions that asked participants to rate the extent to which each of the following were a problem: residual limb pain, phantom limb pain, knee pain on the non-amputated side, back pain, and shoulder pain.

**Results**—Nearly three-quarters of participants (72.1%) reported problematic pain in one or more of the listed sites. Problematic phantom limb, back, and residual limb pain were reported by 48.1%, 39.2%, and 35.1% of participants, respectively. Knee pain and shoulder pain were less commonly identified as problems (27.9% and 21.7%, respectively). Participants also reported significantly ( $p<.0001$ ) higher pain interference (T score=54.7, SD=9.0) than the normative sample based on the U.S. population (T score=50.0, SD=10.0). Participants with lower limb amputations rated their pain intensity on average at 3.3 (SD=2.4) on a 0–10 scale. Pain interference ( $\rho=.564$ ,  $p<.0001$ ) and intensity ( $\rho=.603$ ,  $p<.0001$ ) were positively and significantly correlated with number of pain sites reported.

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**Conclusion**—Problematic pain symptoms, especially residual limb, phantom limb, and back pain, affect the majority of prosthetic limb users and have the potential to greatly restrict participation in life activities.

### Keywords

Amputation; pain; artificial limb; health surveys; phantom limb; residual limb; back; knee; shoulder

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### Introduction

Pain is extremely common in people with lower limb amputation (LLA). Up to 90% of people report persistent pain following amputation, including phantom limb pain (PLP) and residual limb pain (RLP).<sup>1–3</sup> PLP refers to pain experienced in the missing limb.<sup>4</sup> Approximately 58–79% of people with LLA experience some degree of PLP.<sup>1–3, 5</sup> In contrast, RLP is felt in the remaining limb and is often related to issues such as prosthetic socket pressure, skin abrasions, infections, adherent scars, neuromas, or bone spurs.<sup>4</sup> RLP occurs in 61–76% of people with LLA.<sup>1–3, 5</sup>

Back, contralateral limb, and shoulder pain are also common,<sup>1–3, 6, 7</sup> affecting up to 71%,<sup>2</sup> 50%,<sup>3</sup> and 31%<sup>1</sup> of people with LLA, respectively. Pain in these sites can result from compensatory strategies adopted when using a prosthesis.<sup>8–11</sup> While the prevalence of PLP and RLP decreases<sup>12</sup> or remains relatively stable over time,<sup>2, 3</sup> a study of 812 people with LLA found that intensity and bothersomeness of back pain and contralateral limb pain increase with time.<sup>3</sup> In addition, back pain has been reported to interfere with life activities (i.e., pain interference) more than amputation-related pain.<sup>13</sup>

Understanding pain characteristics and predictors in people with amputation is important because pain can be associated with poor rehabilitation outcomes. For example, people with PLP and RLP have reported poorer acceptance of the prosthesis and more prosthesis-related restrictions than people without pain.<sup>14</sup> Similarly, 54% of older veterans with LLA reported that pain-related concerns are a barrier to engagement in physical activity.<sup>15</sup> Another study found that back pain, RLP, and PLP all contribute to pain-related disability.<sup>16</sup> In addition, risk for depression increases in those with chronic back, contralateral, phantom, and residual limb pain.<sup>3</sup>

Previous studies have reported pain experiences in people with LLA,<sup>1–3</sup> but focused primarily on pain prevalence and predictors. Less is known about the relationship between sources of problematic pain and the degree of pain interference and pain intensity experienced. In addition, prior studies<sup>1, 3, 6</sup> included prosthesis users and non-users, so results may not characterize pain in the context of prosthesis use. The purpose of this study was to determine the contributions of pain from five sites to individuals' reported pain interference and intensity. We hypothesized that pain from all sites would contribute to both pain intensity and interference. Further, we hypothesized that back and residual limb pain would have the strongest relationships with pain interference and intensity because these sites have been identified as worst<sup>1</sup> or most interfering<sup>13</sup> in previous literature.

## Methods

This study was an analysis of cross-sectional data collected between 2011–2014 for development of the Prosthetic Limb User’s Survey of Mobility (PLUS-M), a self-report measure of prosthetic mobility.<sup>17</sup> Recruitment for the original study was targeted to identify individuals with specific characteristics; 250 people with transtibial amputation from trauma, transtibial amputation from dysvascular causes, transfemoral amputation from trauma, transfemoral amputation from dysvascular causes, and bilateral amputation were sought.

## Participants

Eligibility criteria included: (1) age of 18 years or older, (2) unilateral or bilateral amputation below the hip and at or above the ankle, (3) regular use of a prosthesis to walk, and (4) the ability to read, write, and understand English. People with upper limb amputations were excluded. Procedures were approved by a University of Washington Institutional Review Board. All participants were provided an information statement prior to participation.

## Procedure

Magazine advertisements, mailings, internet postings, and flyers in private and institutional clinics across the U.S. directed people with LLA to the study website. Interested individuals either completed an electronic survey or contacted study investigators for a paper survey. Individuals who chose the electronic survey were directed to the Assessment Center (Northwestern University, Chicago).<sup>18</sup> Participants who requested a paper survey were mailed a survey and return envelope. Paper surveys were double-entered to minimize data entry errors.<sup>19</sup> All surveys were assessed for completeness and consistency; participants were contacted to resolve missing data and/or potentially invalid responses.

## Survey

Participants completed a survey of standardized outcome measures and health questions, including measures of pain intensity, pain interference, and pain sites. Pain intensity (1-item) and pain interference (4-item) were measured with the Patient-Reported Outcomes Measurement Information System 29-item profile (PROMIS-29) v1.0 ([www.nihpromis.org](http://www.nihpromis.org)), a valid and reliable measure of health-related quality of life.<sup>20, 21</sup> PROMIS instruments, with the exception of pain intensity, provide scores on the T-score metric with a mean of 50 and SD of 10. Normative scores for PROMIS-29 instruments are based on samples representative of the U.S. general population. A higher score indicates higher levels of the measured trait. Thus, a higher score of pain interference indicates more consequences of pain on participation in desired activities. Pain interference items asked how much pain interfered with day-to-day activities, work around the home, participation in social activities, and household chores over the past seven days. Pain intensity had respondents rate their average pain over the past seven days from 0–10 (i.e., from no pain to the worst imaginable pain). PROMIS depression and anxiety scores were included in the regression model as potential covariates.<sup>22, 23</sup>

Participants also rated the extent to which five different pain sites were a problem using a five-option scale from “not at all” to “very much”. Pain sites (i.e., residual limb, phantom limb, knee, back, and shoulder) were chosen by clinical investigators as most relevant to the health experience of people with LLA. Pain at these sites was characterized as “problematic” if the respondent indicated “somewhat,” “quite a bit,” or “very much.” Sites were characterized as “non-problematic” if the respondent indicated “not at all” or “a little bit.” Participants also answered demographic and clinical questions.

## Analysis

Demographic and clinical characteristics were summarized using descriptive statistics. Mean pain interference T-scores and pain intensity scores were calculated for the sample as a whole, and for subgroups based on amputation etiology and age. A one sample median test was performed to test whether the pain interference T-score for the whole sample was different from the PROMIS norm of 50. Spearman correlations were used to determine the relationship between the number of problematic pain sites and PROMIS pain interference T-scores/pain intensity ratings. Kruskal Wallis tests were used to assess differences in pain interference T-scores and pain ratings grouped by number of problematic pain sites. Two multiple linear regression models were conducted to look at factors related to pain interference and pain intensity scores. Twenty-one independent variables that were hypothesized to have a relationship with pain were selected and entered into each model. Age, years since amputation, hours of prosthetic use, body mass index (BMI), and PROMIS depression and anxiety T-scores were entered as continuous variables. Number of comorbid conditions was entered as an ordinal variable. Sex, income, education, employment disability status, amputation level, amputation etiology, number of affected limbs, and pain sources were entered as binary variables. Tests were conducted to verify that data met assumptions and data were examined for unusual and influential observations. The level of significance was set at  $\alpha=.05$ . All analyses were conducted using SAS software v9.3 (SAS Institute, Cary, NC).

## Results

### Participants

1250 electronic surveys were started and 200 paper surveys were mailed. Of those, 1134 electronic surveys and 162 paper surveys were completed for a total sample of 1296 people with unilateral (n=1090) or bilateral (n=206) LLA (Table 1). The majority of the sample was male (70.1%), non-Hispanic white (79.8%), and reported a mean age of 54.4 (SD=13.7) years. Approximately two-thirds of the sample (64.7%) had amputation(s) at the transtibial level and just under half (42.3%) had amputation(s) as a result of dysvascular causes. Participants in the sample were an average of 12.2 (SD=14.1) years post-amputation and used their prosthesis an average of 12.3 (SD=4.1) hours a day. 61.7% of the sample had one or more co-morbid health conditions, with 35.3% reporting diagnosis of diabetes. Average PROMIS depression and anxiety T-scores for the sample (49.2 and 49.3, respectively) were similar to the U.S. general population.

## Self-reported pain

Nearly three-quarters (72.1%) of the sample reported problematic pain in one or more sites (Table 2). Almost half (48.1%) of the sample reported problematic PLP, and over one-third reported problematic back pain (39.2%) or RLP (35.1%). Knee pain (27.9%) and shoulder pain (21.7%) were less commonly problematic. As a group, study participants reported significantly ( $p<.0001$ ) higher pain interference (T score=54.7, SD=9.0) than the U.S. normative sample. Average pain intensity was 3.3 (SD=2.4) on a 0–10 scale. Tables 3 and 4 present pain data by amputation level and etiology. Data on pain sites was missing for <9% of participants, resulting in a smaller sample ( $n=1174$ ) in regression models compared to the total sample. Pain interference ( $\rho=.564$ ,  $p<.0001$ ) and intensity ( $\rho=.603$ ,  $p<.0001$ ) were positively and significantly correlated with number of pain sites reported. As the number of pain sites increased, mean pain interference scores increased from 48.1 for no sites reported up to 64.3 for those who endorsed all sites as problematic (chi-square=416.3,  $p<.0001$ ; see Figure 1). Average pain intensity likewise increased from 1.6 for zero problematic pain sites to 6.2 for those who reported pain from all sites (chi-square=473.9,  $p<.0001$ ).

## Unusual and influential data

Data for four participants in the pain interference model and six participants in the pain intensity model were flagged as unusual and potentially influential based on leverage, Cook's Distance,<sup>24</sup> studentized residuals, and DFITS criteria<sup>24–26</sup> and were removed from analysis.

## Association between pain interference and pain sites

The full model accounted for 48% of the variance in pain interference scores (Table 5; adjusted  $R^2=.48$ ,  $p<.0001$ ). After adjusting for covariates, four of the five pain sites (back, residual limb, knee, and phantom limb) were significantly associated with pain interference. The strongest relationship with pain interference was back pain ( $\beta=0.18$ ,  $p<.0001$ ), followed by depression ( $\beta=0.18$ ,  $p<.0001$ ), and RLP ( $\beta=0.16$ ,  $p<.0001$ ). More anxiety ( $\beta=0.10$ ,  $p=.0034$ ) was also associated with more pain interference. Fewer hours of prosthetic use were also significantly associated with more pain interference ( $\beta=-0.14$ ,  $p<.0001$ ).

## Association between pain intensity and potential pain sites

The full model accounted for 49% of the variance in pain intensity scores (Table 6; adjusted  $R^2=.49$ ,  $p<.0001$ ). Pain intensity was significantly associated with all five pain sites (residual limb, back, phantom limb, knee, and shoulder). The strongest relationship with pain intensity was RLP ( $\beta=0.22$ ,  $p<.0001$ ), followed by back pain ( $\beta=0.18$ ,  $p<.0001$ ) and fewer hours of prosthetic use ( $\beta=-0.12$ ,  $p<.0001$ ). More depression ( $\beta=0.10$ ,  $p=.0026$ ) and anxiety ( $\beta=0.10$ ,  $p=.0033$ ) were also associated with more pain interference.

## Discussion

The purpose of this study was to evaluate pain interference and pain intensity in people with LLA who use prosthetic limbs. Results demonstrate that, on average, people with LLA experience pain that interferes with life activities to a greater extent than people without amputation. This finding is likely because people with amputation commonly report pain in

the years following amputation.<sup>1-3, 6-8</sup> In addition, most people with LLA experience pain from at least one source that can be directly (e.g., RLP) or indirectly (e.g., back pain) related to their amputation. Consistent with our hypotheses, most pain sites directly contributed to pain interference and pain intensity, with back and residual limb pain exhibiting the strongest relationships. These results reinforce findings from previous work assessing pain in people with amputation<sup>1-3, 6</sup> and add to prior research by focusing exclusively on prosthesis users, who may have different experiences with pain than non-users. Results from our study indicate that pain is a problem for a high percentage (72.1%) of prosthesis users.

Additionally, this study examined relationships between sites of problematic pain (e.g., back pain, PLP) and measures of pain interference and intensity. Problematic pain most frequently experienced by prosthesis users was derived from the phantom limb (48.1%), back (39.2%), and residual limb (35.1%). Current study results suggest that pain was less common in our sample than in previous studies, where phantom limb, back, and residual limb pain were present in 67–76%, 52–71%, and 63–79% of the samples, respectively.<sup>1-3, 6</sup> Discrepancies in the prevalence of pain between this study sample and those in prior studies could be due to variations in the questions used to solicit pain experiences from participants. For example, Ephraim and colleagues assessed the frequency of painful sensations.<sup>3</sup> In contrast, the current study assessed how problematic painful sensations were. Further, differences in how investigators chose to categorize pain may affect each study's results. Borsje and colleagues described the effect of cut off points on phantom limb pain prevalence, which ranged between 7–72% depending on their definition of “absent” and “present” phantom limb pain. Results from this work suggested that the wide range of numbers presented in the literature may be due, in part, to cut offs used by study investigators.<sup>27</sup> In the current study, we chose to report “problematic pain,” which we defined as pain that was “somewhat”, “quite a bit”, or “very much” a problem. Another approach to reporting painful sensations would have been to dichotomize pain as “present” for those that identified their pain as “a little bit” problematic or higher and “not present” for those choosing “not at all” problematic. With this approach, experiences of phantom limb pain increased from 48.1% to 81.7%, back pain increased from 39.2% to 70%, and residual limb pain increased from 35.1% to 74.8%. Thus, it is likely that questions used to assess painful experiences and/or the cut-points used by investigators to classify experiences as “painful,” affected the results presented across studies.

Another consideration when examining discrepancies in reported pain in people with LLA is differences in samples. In the current study, we assessed pain in people who regularly use a prosthesis to walk whereas other studies<sup>1,3,6</sup> recruited samples with LLA who were both prosthesis users and non-users. Given the relatively small proportion of non-users in previous samples (~20%),<sup>1,3,6</sup> it is unlikely that their inclusion in other studies is the sole reason for the large discrepancy in pain experiences across studies. However, it is possible that people who regularly use prostheses to walk are able to do so, in part, because they do not experience pain to the same degree as non-users.

Problematic back pain and RLP were main factors that positively correlated with pain interference and intensity scores. The finding is unsurprising given that back pain and RLP were common, both in the current study and in previous studies.<sup>1-3,6</sup> However, even though

a high percentage of the sample experienced problematic PLP, it was not a main factor in either pain interference or intensity scores. Marshall and colleagues found that while back, residual limb, and phantom limb pain together accounted for 20% of the variation in pain-related disability, PLP alone had uniquely accounted for only 2% of the variation.<sup>16</sup> Similarly, Ehde and colleagues found that many people with PLP did not find it to be as disabling as other types of pain, including RLP.<sup>1</sup>

Because our sample was limited to prosthesis users, it was important to evaluate the relationship between prosthesis use and pain. On average, people in our sample used prosthetic limb(s) 12.3 hours per day. While some pain, especially RLP and back pain, may be a result of prosthesis use, the current study found that higher prosthesis use correlated with lower pain intensity and interference scores. This negative relationship may indicate that experiences of pain limit individuals' use of their prostheses. Thus, addressing the root cause of pain is paramount to increasing daily prosthesis use. Another interpretation of this data is that use of a prosthesis reduces pain in people with LLA. A study of people with upper limb amputation found that use of functional myoelectric prostheses reduced PLP.<sup>28</sup> Although the exact mechanisms of pain reduction may differ between upper and lower limb prosthesis users, it is possible that overall increased physical activity, fitness, or residual limb muscle activity reduce pain experienced by the user.

Finally, there appears to be a cumulative effect of pain sites on overall measures of pain interference and intensity. Pain interference and intensity significantly and positively correlated with number of problematic pain sites. Furthermore, those who indicated problematic pain at two or more sites reported clinically significant<sup>29</sup> pain interference scores that were 0.63 to 1.43 SDs higher than the U.S. general population norm. This finding indicates that multiple pain sites need to be evaluated and treated by clinicians working with people who have LLA. While the treatment of some types of pain may require medication, other pain sites may require modifications to the prosthesis. Addressing pain at each individual site may reduce the overall intensity of painful experiences and decrease the extent to which pain interferes in prosthesis users' lives.

## Limitations

This study was cross-sectional, which precludes the ability to draw causal links between pain interference/intensity and pain sites. In addition, participants were not randomly sampled, and the sample had a smaller proportion of people with amputation from dysvascular causes (42.3%) than is estimated in the U.S. LLA population (about 80%).<sup>30</sup> Thus, results from this study may not be generalizable to all people with amputation.

Items used to assess pain sites asked respondents to rate the extent to which different types of pain were a problem, a term that has not been used to assess pain in people with amputation.

The ad hoc questions included in the survey were not subjected to cognitive interviews,<sup>31</sup> and may have been interpreted differently among participants. Future work is needed to assess how people with amputation interpret the question of "how much of a problem" they have with pain sites. We also did not ask about the frequency or intensity of individual pain

experiences, which provides information about the nature of a person's pain experience and limits comparison to previous research.<sup>1,2,6,16</sup> Finally, the survey did not include questions pertaining to pain medication. Use of pain medications may affect pain intensity, interference, or the extent to which participants perceive their pain as problematic. Future research should inquire about pain medication when assessing pain in people with amputation.

## Conclusions

Problematic pain is common in prosthetic limb users and has the potential to impact participation in life activities. The number of pain sites appears to have a cumulative effect on pain intensity and interference. Health providers working with people with LLA should assess and manage pain from multiple sites to improve clinical outcomes.

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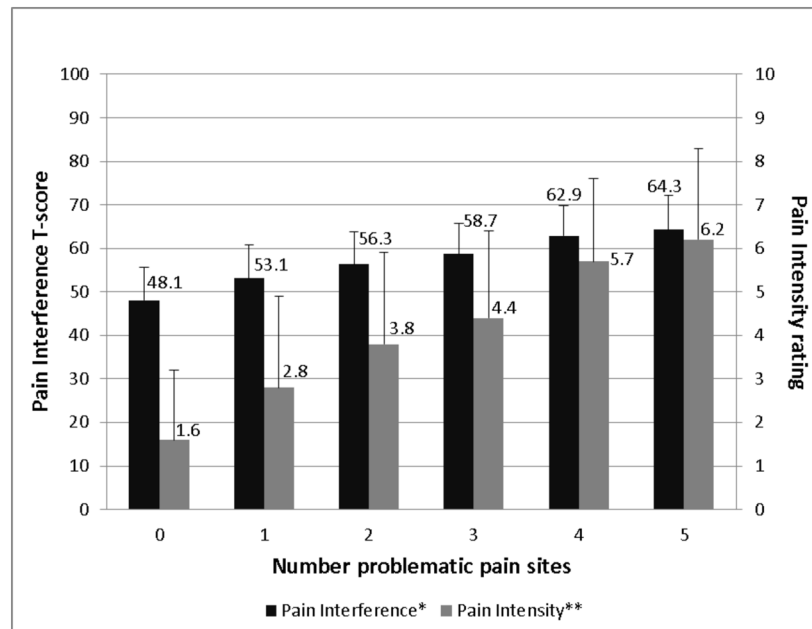
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**Figure 1.** Mean pain interference and pain intensity scores by number of problematic pain sites (\*chi-square=416.3,  $p<.0001$ ; \*\*chi-square=473.9,  $p<.0001$ ).

Table 1

## Participant demographic and clinical characteristics

	Unilateral n=1090		Bilateral n=206		Total Sample n=1296	
	N	%	N	%	N	%
Gender						
Male	767	70.4	141	68.4	908	70.1
Female	320	29.4	65	31.6	385	29.7
Not reported	3	0.3	0	0.0	3	0.2
Race/Ethnicity						
Non-Hispanic White	871	79.9	163	79.1	1034	79.8
Other race/ethnicity	213	19.5	41	19.9	254	19.6
Not reported	6	0.6	2	1.0	8	0.6
Disability Status						
On disability	349	32.0	80	38.8	429	33.1
Not on disability	738	67.7	126	61.2	864	66.7
Not reported	3	0.3	0	0.0	3	0.2
Individual Income						
<\$40,000	729	66.9	129	62.6	858	66.2
\$40,000	336	30.8	69	33.5	405	31.3
Not reported	25	2.3	8	3.9	33	2.5
Veteran Status						
Active Military/Veteran	218	20.0	37	18.0	255	19.7
Non-Veteran	860	78.9	168	81.6	1028	79.3
Not reported	12	1.1	1	0.5	13	1.0
Education						
Some college or less	734	67.3	131	63.6	865	66.7
College degree or more	351	32.2	75	36.4	426	32.9
Not reported	5	0.5	0	0.0	5	0.4
Amputation level <sup>a</sup>						
Transfemoral (below knee)	704	64.6	135	65.5	839	64.7

	Unilateral n=1090		Bilateral n=206		Total Sample n=1296	
	N	%	N	%	N	%
Transfemoral (above knee)	386	35.4	71	34.5	457	35.3
Amputation etiology						
Dysvascular	486	44.6	62	30.1	548	42.3
Non-dysvascular	604	55.4	144	69.9	748	57.7
Number co-morbid health conditions						
0	404	37.1	92	44.7	496	38.3
1	371	34.0	53	25.7	424	32.7
2	315	28.9	61	29.6	376	29.0
Diagnosis of diabetes	387	35.5	71	34.5	458	35.3
Problems with residual limb						
Sores on residual limb	268	24.6	49	23.8	317	24.5
Loss of feeling on residual limb	180	16.8	34	16.7	214	16.8
	Mean	SD	Mean	SD	Mean	SD
Age at survey (yrs)	55.0	13.4	51.2	14.6	54.4	13.7
Age at amputation (yrs) <sup>b</sup>	43.1	17.6	37.2	19.1	42.2	18.0
Time since amputation (yrs) <sup>b</sup>	11.8	14.0	14.0	14.9	12.2	14.1
Prosthetic use (hrs/day)	12.4	4.1	11.7	4.4	12.3	4.1
Body mass index (kg/m <sup>2</sup> )	28.9	6.1	27.1	6.5	28.6	6.2
PROMIS depression T-score	49.3	9.3	48.8	8.7	49.2	9.2
PROMIS anxiety T-score	49.4	9.5	49.0	8.6	49.3	9.4

<sup>a</sup>For bilateral amputees, this is the highest level of amputation in either leg.

<sup>b</sup>For bilateral amputees, this is age at unilateral amputation and years since unilateral amputation

**Table 2**  
Participant outcomes on problematic pain sites and PROMIS pain interference and pain intensity scores

	Unilateral n=1090		Bilateral n=206		Total Sample n=1296	
	N	%	N	%	N	%
Problematic pain sites						
Residual limb pain	386	35.6	67	32.7	453	35.1
Phantom limb pain	531	49.3	85	41.7	616	48.1
Non-amputated knee pain (if applicable)	319	29.4	32	18.5	351	27.9
Back pain	433	39.9	73	35.4	506	39.2
Shoulder pain	236	21.7	45	22.0	281	21.7
Number problematic pain sites						
0	289	26.5	73	35.4	362	27.9
1	231	21.2	46	22.3	277	21.4
2	570	52.3	87	42.2	657	50.7
Mean SD Mean SD Mean SD						
PROMIS pain interference T-score	54.8	8.9	53.9	9.5	54.7	9.0
PROMIS pain intensity (0–10 scale)	3.4	2.4	3.0	2.5	3.3	2.4

Table 3

Pain data for participants with UNILATERAL amputation

	Transfemoral dysvascular n=120		Transfemoral trauma n=266		Transfemoral dysvascular n=366		Transfemoral trauma n=338	
	N	%	N	%	N	%	N	%
Problematic pain sites								
Residual limb pain	36	30.0	89	33.7	125	34.4	136	40.4
Phantom limb pain	71	60.7	135	51.1	186	51.4	139	41.6
Knee pain on non-amputated side	31	26.1	96	36.1	74	20.3	118	35.1
Back pain	41	34.5	114	43.0	134	36.7	144	42.7
Shoulder pain	28	23.3	62	23.4	69	18.9	77	22.8
Number problematic pain sites								
0	31	25.8	60	22.6	97	26.5	101	29.9
1	32	26.7	59	22.2	84	23.0	56	16.6
2	57	47.5	147	55.3	185	50.5	181	53.6
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PROMIS pain interference T-score	55.3	8.9	53.5	8.7	55.9	8.7	54.5	9.2
PROMIS pain intensity (0–10 scale)	3.6	2.3	3.1	2.3	3.6	2.4	3.3	2.5

**Table 4**

Pain data for participants with BILATERAL amputation

	Bilateral transfemoral dysvascular n=4		Bilateral transfemoral other n=39		Transfemoral/transfibial dysvascular n=8		Transfemoral/transfibial other n=20		Bilateral transfemoral/transfibial dysvascular n=50		Bilateral transfemoral/transfibial other n=85	
	N	%	N	%	N	%	N	%	N	%	N	%
Problematic pain sites												
Residual limb pain	1	25.0	6	15.4	4	50.0	13	65.0	18	36.0	25	29.8
Phantom limb pain	4	100.0	15	38.5	5	62.5	6	30.0	26	54.2	29	34.1
Knee pain (if applicable)*	0	0.0	1	11.1	3	37.5	4	20.0	11	22.0	13	15.5
Back pain	3	75.0	15	38.5	3	37.5	8	40.0	17	34.0	27	31.8
Shoulder pain	2	50.0	8	21.1	4	50.0	4	20.0	11	22.0	16	18.8
Number problematic pain sites												
0	0	0.0	14	35.9	2	25.0	6	30.0	13	26.0	38	44.7
1	1	25.0	14	35.9	1	12.5	2	10.0	12	24.0	16	18.8
2	3	75.0	11	28.2	5	62.5	12	60.0	25	50.0	31	36.5
Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
PROMIS pain interference T-score	58.9	4.7	51.8	8.2	54.9	14.6	55.4	8.7	54.5	9.0	53.7	10.2
PROMIS pain intensity (0–10 scale)	4.5	2.1	2.5	2.1	3.8	3.8	2.8	2.5	3.3	2.4	3.1	2.5



**Table 5**  
Regression model results examining factors associated with pain interference in individuals with lower limb amputation

Variable	Full model adjusted R <sup>2</sup> =0.48; n=1174					
	Unstandardized Beta	Coefficient	Standard Error	Standardized Beta	t	p-value
Depression (T-score) *	0.18		0.03	0.18	5.35	<.0001
Prosthetic use (hrs/day) *	-0.32		0.06	-0.14	-5.70	<.0001
Anxiety (T-score) *	0.10		0.03	0.10	2.94	0.0034
Amputation level: above knee *	-1.29		0.44	-0.07	-2.94	0.0033
Number of comorbid conditions *	0.46		0.21	0.06	2.21	0.0273
Education: some college or more *	-1.08		0.43	-0.06	-2.48	0.0131
Disability status: on disability *	1.02		0.48	0.05	2.14	0.0323
Body mass index (Kg/m <sup>2</sup> ) *	-0.07		0.03	-0.05	-2.14	0.0329
Sex: Female	0.64		0.44	0.03	1.46	0.1457
Age at survey (yrs)	-0.02		0.02	-0.03	-1.13	0.2608
Income: \$40,000	0.51		0.48	0.03	1.06	0.2883
Time since amputation (yrs)	-0.01		0.02	-0.02	-0.65	0.5189
# of amputations: bilateral	-0.42		0.57	-0.02	-0.73	0.4673
Amputation etiology: dysvascular	0.03		0.54	0.00	0.06	0.9538
Problematic back pain: yes *	3.41		0.45	0.18	7.61	<.0001
Problematic residual limb pain: yes *	3.04		0.49	0.16	6.21	<.0001
Problematic sores on residual limb: yes *	2.34		0.49	0.11	4.75	<.0001
Problematic knee pain: yes *	2.16		0.47	0.11	4.57	<.0001
Problematic phantom limb pain: yes *	1.57		0.46	0.09	3.45	0.0006
Problematic shoulder pain: yes	0.73		0.50	0.03	1.44	0.1494
Problematic loss of feeling on residual limb: yes	0.77		0.55	0.03	1.40	0.1628

\* p<0.05

Table 6

Regression model results examining factors associated with pain intensity in individuals with lower limb amputation

Variable	Full model adjusted R <sup>2</sup> =0.49; n=1174					
	Unstandardized Beta	Coefficient	Standard Error	Standardized Beta	t	p-value
Prosthetic use (hrs/day) *	-0.07		0.01	-0.12	-4.62	<.0001
Depression (T-score) *	0.03		0.01	0.10	3.01	0.0026
Anxiety (T-score) *	0.03		0.01	0.10	2.94	0.0033
Number of comorbid conditions *	0.19		0.06	0.09	3.44	0.0006
Disability status: on disability *	0.43		0.13	0.08	3.39	0.0007
Body mass index (Kg/m <sup>2</sup> ) *	-0.02		0.01	-0.05	-2.16	0.0311
Education: some college or more *	-0.24		0.11	-0.05	-2.11	0.0348
Amputation level: above knee *	-0.24		0.12	-0.05	-2.07	0.0391
# of amputations: bilateral	-0.24		0.15	-0.03	-1.59	0.1132
Sex: Female	0.18		0.12	0.03	1.56	0.1195
Age at survey (yrs)	0.00		0.00	-0.03	-1.12	0.2615
Time since amputation (yrs)	0.00		0.00	0.01	0.44	0.6604
Income: \$40,000	0.04		0.13	0.01	0.28	0.7811
Amputation etiology: dysvascular	0.01		0.14	0.00	0.04	0.9664
Problematic residual limb pain: yes *	1.09		0.13	0.22	8.45	<.0001
Problematic back pain: yes *	0.87		0.12	0.18	7.36	<.0001
Problematic phantom limb pain: yes *	0.54		0.12	0.11	4.48	<.0001
Problematic knee pain: yes *	0.56		0.13	0.11	4.51	<.0001
Problematic sores on residual limb: yes *	0.43		0.13	0.08	3.25	0.0012
Problematic shoulder pain: yes *	0.37		0.13	0.06	2.78	0.0055
Problematic loss of feeling on residual limb: yes	0.23		0.15	0.04	1.60	0.1096

\* p<0.05