Key characteristics of upper limb prosthesis users influence Patient Experience Measure scores

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ABSTRACT

The Patient Experience Measure (PEM) was designed to assess psychosocial experiences of upper limb prosthesis users. While the PEM has been validated in a national study, differences in PEM scores based on participant characteristics have not been investigated yet. We present a secondary analysis of survey data demonstrating significant differences in PEM scores by amputation laterality (unilateral vs. bilateral), amputation level, and prosthesis type.

INTRODUCTION

The Patient Experience Measure (PEM) is a validated tool for assessing psychosocial experiences of upper limb prosthesis users consisting of six scales: social interaction, self-efficacy, embodiment, intuitiveness, wellbeing, and self-consciousness. The PEM was initially developed for use for studies of sensory enabled prostheses [1] and was subsequently refined in a large calibration study using contemporary measurement methods [2]. The prior calibration study examined structural validity, the ordering of items within scales, and the presence of differential item functioning by participant characteristics. However, we have not yet reported the summary scores of the PEM scales or analyses of the scores within subgroups of participants. The purpose of this analysis is to quantify and compare the PEM scores of key subgroups of interest. Specifically, we examined whether differences across the PEM subscales existed by prosthesis laterality, amputation level, and prosthesis type.

METHODS

This study presents a secondary analysis of data collected for the PEM calibration study. The sample consisted of U.S. military Veterans and civilians recruited through a variety of sources including VA databases, the Amputee Coalition of America, and a private prosthetics service company. Data was collected through telephone survey.

The PEM subscales query a variety of psychosocial experiences of upper limb prosthesis users (see [2] for full list of items within each subscale). The *social interaction* scale consists of 11 items addressing use of the prosthesis in physical interactions with others, such as shaking hands. The *self-efficacy* scale consists of 12 items addressing confidence in using the prosthesis to perform specific types of activities, such as handling fragile or small objects. The *embodiment* scale consists of 5 items related to self-attribution of the prosthesis and how it interacts with the body image. The 4-item *intuitiveness* scale includes items addressing the naturalness, clumsiness, speed, and concentration involved in using a prosthesis. The *wellbeing* scale consists of 6 items related to one's sense of wholeness, happiness, confidence, relaxation, freedom, and relief when not wearing a prosthesis. Finally, the 4-item *self-consciousness* addresses the user's sense of vulnerability, incompleteness, difference from others, and shyness when not wearing a prosthesis. Higher scores indicate better experience for all scales.

Scores of PEM scales were calculated for subgroups of participants across the following characteristics: amputation laterality (unilateral (UA) versus bilateral amputation (BA)), amputation level for UA only (transradial (TR), transhumeral (TH), shoulder (SH)) and prosthesis type (cosmetic (Cos), body powered (Bod), myoelectric single degree of freedom terminal device (MyoS), myoelectric multi-degree of freedom terminal device (MyoM)) Subgroup scores were compared using ANOVAs and t-tests. Prosthesis type comparisons were limited to the sample with unilateral TR/wrist disarticulation to provide robust estimates.

RESULTS

The sample for this analysis included 459 upper limb prosthesis users. The mean sample age was 61.9 (14.4) years old, 88 (20%) participants were women, and 378 (82%) were white. (Table 1). Of participants with unilateral TR amputation, there were 195 (65.4%), 53 (17.8%), 34 (11.4%) and 16 (5.4%) who used cosmetic, body powered, myoelectric single degree of freedom (DOF) and myoelectric multi-DOF prostheses respectively.

Table 1: Characteristics of Full Analytic Sample (N=459)

Gender	**N (%)**		**Mn (sd)**
Female	88 (19.2)	**Age**	61.9 (14.4)
Male	371 (80.8)	**Race**	**N (%)**
Laterality	**N (%)**	White	378 (82.4)
Unilateral	426 (92.8)	Black	40 (8.7)
Bilateral	33 (7.2)	Unknown	24 (5.2)
Amputation level (UA only)	**N (%)**	Mixed	17 (3.7)
Shoulder	26 (6.1)	**Ethnicity**	**N (%)**
Transhumeral	102 (23.9)	Hispanic	28 (6.1)
Transradial	298 (70.0)	Not Hispanic	421 (91.7)
		Unknown	10 (2.2)

Statistically significant differences were observed in PEM scores of persons with UA and BA (Figure 1). Mean and standard deviations of all measures are shown by subgroup in Table 2. Specifically, social interaction scores were higher among those with BA (p=0.0092), while wellbeing (p=0.04) and self-consciousness (p=0.01) scores were higher (i.e. better) among those with UA.

Distributions of PEM scores by amputation level are shown in Figure 2. There were significant differences in 4 PEM scales by amputation level: Social Interaction (p=0.002), Self-efficacy (p<0.0001), Embodiment (p<0.0001), and Intuitiveness (p=0.01). In all 4 scales, those with TR amputation had the highest scores while those with amputation at the SH level had the lowest scores. Participants with TH amputation tended to have intermediate scores.

Finally, distributions of PEM scores for those with TR unilateral amputation are shown by prosthesis type in Figure 3. Only social interaction (p=0.02) and self-efficacy (p<0.0001) scores differed significantly by prosthesis type. Those using cosmetic devices had the lowest scores on these two scales, myoelectric multi-DOF users had the highest social interaction scores, and body-powered users had the highest self-efficacy scores.

DISCUSSION

This study found statistically significant differences in PEM scores by amputation laterality, amputation level, and prosthesis type. Our analyses were bivariate only, and further multivariate analyses are needed to identify independent predictors of PEM scores to control for potential confounding.

Table 2 PEM scores by subgroups

		Social Interaction (N=390)	**Self-efficacy (N=405)**	**Embodiment (N=406)**	**Intuitiveness (N=406)**	**Wellbeing (N=454)**	**Self-consciousness (N=454)**
	N	**Mn (sd)**	**Mn (sd)**	**Mn (sd)**	**Mn (sd)**	**Mn (sd)**	**Mn (sd)**
Amputation Laterality							
Unilateral	426	49.6 (9.9)	50.0 (9.,9)	50.0 (9.9)	50.1 (10.2)	49.4 (9.7)	50.2 (10.0)
Bilateral	33	56.5 (8.3)	53.1 (9.9)	52.7 (10.2)	49.6 (7.7)	45.7(12.0)	45.6 (8.5)
Amputation level							
Shoulder	26	44.4 (11.5)	44.7 (12.8)	45.6 (11.6)	45.9 (9.6)	49.6 (11.8)	51.6 (10.2)
Transhumeral	102	47.6 (10.7)	46.9 (9.8)	46.7 (9.6)	48.4 (8.7)	49.9 (8.4)	50.0 (9.6)
Transradial	298	50.7 (9.3)	51.4 (9.3)	51.4 (9.5)	51.0 (10.6)	49.2 (9.9)	50.2 (10.1)
Prosthesis type							
Body-powered	195	50.3 (9.6)	52.4 (9.2)	51.0 (10.0)	51.3 (10.3)	49.1 (10.2)	50.5 (10.0)
Myoelectric single DOF	53	52.1 (8.7)	51.6 (9.6)	52.5 (8.5)	50.6 (11.1)	49.2 (9.5)	49.3 (10.7)
Myoelectric multi-DOF	34	53.6 (8.8)	51.0 (6.2)	50.8 (8.0)	48.1 (9.8)	49.2 (9.6)	52.0 (9.8)

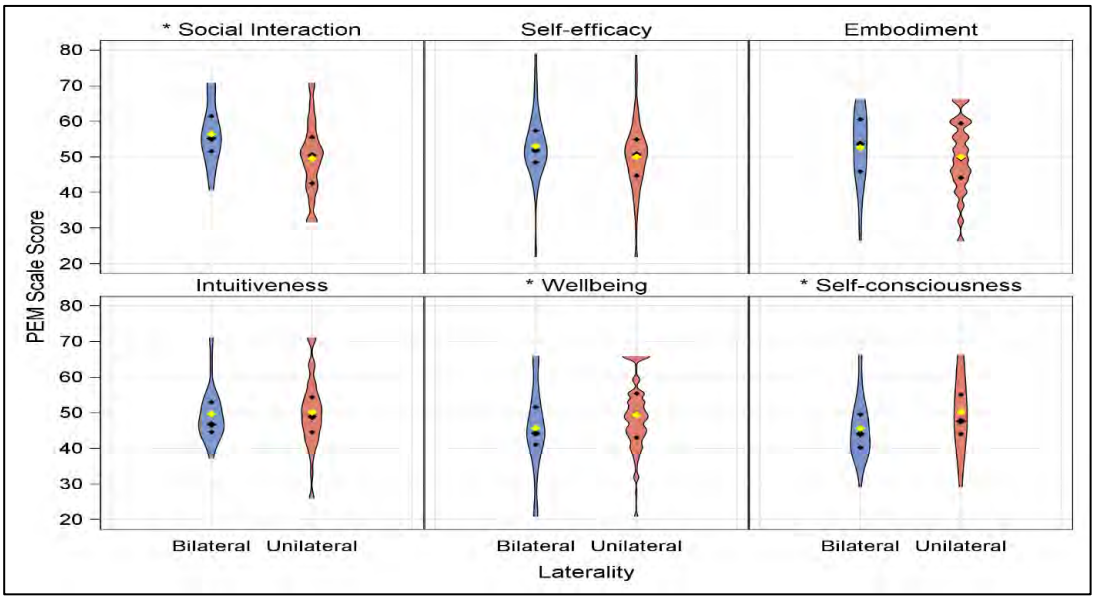

Figure 1. Violin plots showing PEM scores by laterality

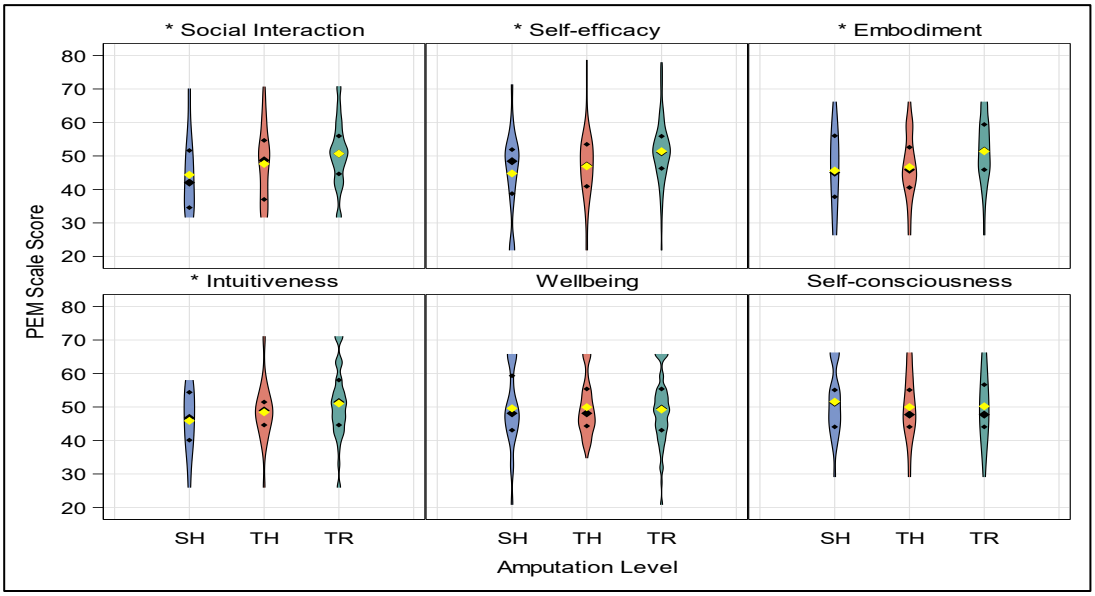

Figure 2. Violin plots showing PEM scores by unilateral amputation level.

Higher self-consciousness scores (i.e. less self-consciousness) in those with UA (as compared to BA) may be because persons with UA can perform tasks in public with their intact hand, limiting the attention drawn to their prosthesis. Similarly, higher scores in wellbeing may be because those with UA feel less impacted by their amputation. However, persons with BA had higher social interaction scores than those with UA, indicating that they feel more comfortable using their prosthesis in social greetings and to communicate emotion through touch. This may be explained by the increased experience and practice they have acquired with these tasks, given that they must perform them with their prosthesis, whereas persons with UA may predominantly perform them with their intact arm/hand, and thus do them infrequently.

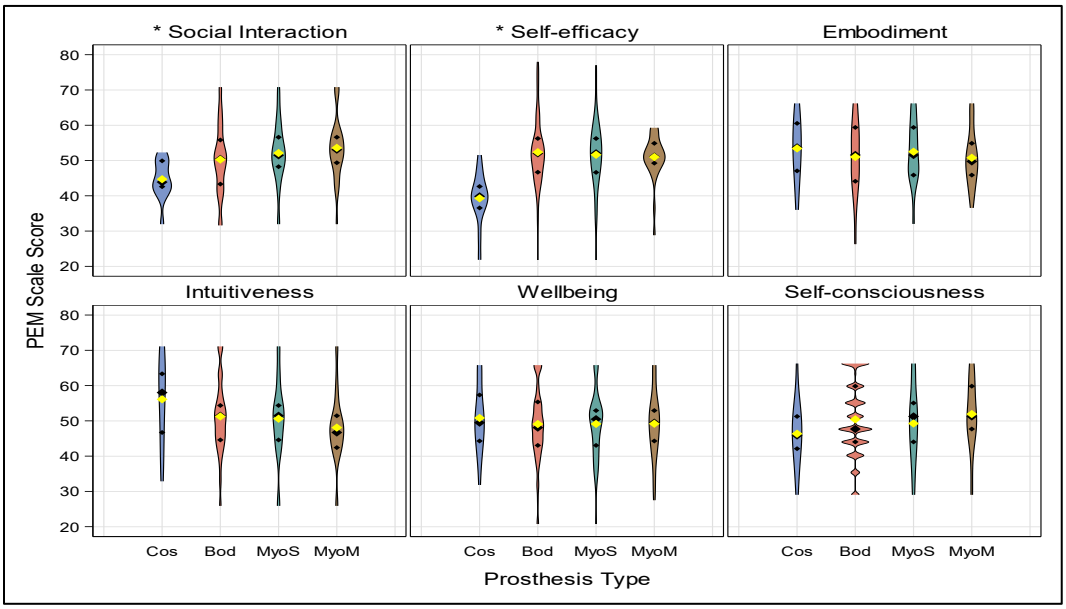

Figure 3. Violin plots showing PEM scores by prosthesis type.

The finding that persons with TR amputation had higher scores in self-efficacy, embodiment, social interaction, and intuitiveness is consistent with prior studies[3]. These scales reflect, to some degree, participants' experiences using the prosthesis and the ways in which they engage the prosthesis to accomplish tasks.

Persons with SH level amputation have limited means of control, which may contribute to lower overall perceived usefulness and functionality of the prosthesis. In contrast, scores on the wellbeing and self-consciousness scales, which address experiences when not wearing a prosthesis, did not differ by amputation level.

Comparisons by prosthesis type yielded significant differences in the social interaction and self-efficacy scales. These scales primarily ask about active prosthesis use in various tasks. Cosmetic prostheses are typically only used for supporting or stabilizing, which would explain their lower scores on these scales. There was no measurable difference in embodiment, intuitiveness, wellbeing, and self-consciousness subscales for people with unilateral TR amputation across prosthesis types, perhaps due to lack of sensitivity or potential confounding by user-relevant factors determining prosthesis choice. A variety of factors might explain why a person with TR amputation would be prescribed or choose to use a given prosthesis type, such as cost, durability, aesthetic factors, or reliability. Future analyses may identify other PEM score predictors or confounders.

SUMMARY & CONCLUSIONS

This study compared PEM by laterality, amputation level and prosthesis type. Findings suggest differences in psychosocial experiences that can be further explored in future research.

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