The Trinity Amputation and Prosthesis Experience Scales and Quality of Life in People With Lower-Limb Amputation

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ABSTRACT. Gallagher P, MacLachlan M. The Trinity Amputation and Prosthesis Experience Scales and quality of life in people with lower-limb amputation. Arch Phys Med Rehabil 2004;85:730-6.

Objectives: To undertake preliminary research into quality of life (QOL) for a group of people with a lower-limb amputation and to investigate what aspects of the "prosthetic experience" are most strongly associated with QOL using the Trinity Amputation and Prosthesis Experience Scales (TAPES).

Design: Cross-sectional survey.

Setting: Prosthetic limb fitting center.

Participants: Sixty-three people older than 18 years with unilateral lower-limb amputation.

Interventions: Not applicable.

Main Outcome Measures: The TAPES and the World Health Organization Quality of Life Questionnaire—Brief Version.

Results: There were no significant differences in any of the QOL domain scores (physical health, psychological, social relationships, environmental) arising from age, gender, level of amputation, or cause of amputation. However, there were significant differences depending on the length of time living with the prosthesis and the degree of prosthetic use. Stepwise regression identified different significant predictors for each domain of QOL.

Conclusions: These findings support the claim that the TAPES can be used to evaluate QOL for this patient group. Further research is warranted to learn how sensitive the scale and its items are to change in clinical status.

Key Words: Amputation; Quality of life; Rehabilitation.

THE WORLD HEALTH ORGANIZATION defines health as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. It is therefore important that a measure of health includes an estimation of well-being that is not solely related to the individual's physical well-being. The development of the Trinity Amputation and Prosthesis Experience Scales[1] (TAPES) is consistent with this philosophy. It is a brief self-administered inventory designed to be used in the context of a multidimensional assessment of adjustment to a prosthetic limb. The questionnaire comprises psychosocial adjustment, activity restriction, and prosthetic satisfaction domains, each with 3 subscales. It also explores the experience of residual limb pain, phantom limb pain, and other medical problems, thereby incorporating both the physical and psychosocial aspects of adjustment. Its theoretical and empirical foundation and the preliminary demonstration of good reliability and validity argue for its applicability as a supplement to clinical assessment and its contribution as a research tool.[1] Its aim is to enable an examination of the psychosocial processes involved in adjusting to an artificial limb, the specific demands of wearing a prosthesis, and the potential sources of maladjustment. From a research perspective, the TAPES can facilitate the exploration of the relationships between different variables and the identification of those factors, which promote successful rehabilitation and adjustment to wearing a lower-limb prosthesis. The overall aim is to provide a mechanism that may allow the assessment and planning of future care programs to be more efficient, comprehensive, and effective.[1]

The process of adjustment after an amputation is life long and multifaceted, involving psychosocial as well as physical functional adjustment. However, the literature deals primarily with physical aspects of the adjustment process.[2-7] Very recently, there has been an attempt to redress this imbalance, by relating psychosocial variables to the adjustment process[8-19]; however, quality of life (QOL) remains a relatively poorly researched concept within this field. Desmond and MacLachlan[20] assessed the profile of psychology in prosthetic and orthotic research, as evidenced by a thematic analysis of the articles in the journal *Prosthetics and Orthotics International*. The search term *quality of life* yielded only 3 articles; however, none of these focused exclusively on QOL. This trend is apparent across much of the literature relating to prosthetics and lower-limb amputation, despite the fact that there has been an apparent upsurge in the number of QOL studies within the field of health. Furthermore, those studies relating to amputation in which QOL is a predominant theme have mostly been undertaken with specific client groups—for example, vascular patients,[21-23] grade III open tibial fractures,[24] and nonvascular patients.[25] Alternatively, studies[26] have compared amputees with other client groups. However, these studies have used generic health-related QOL (HRQOL) measures (eg, Nottingham Health Profile,[27] Medical Outcomes Study 36-Item Short-Form Health Survey[28] [SF-36]), except for that by Harness and Pinzur,[22] who used the Prosthesis Evaluation Questionnaire[29] (PEQ), which is a prosthesis-related QOL questionnaire, the development of which occurred separately from, but at the same time as, the TAPES.

Despite the increase in the number of generic and disease-specific instruments developed to assess QOL,[30] to date only 1 QOL measure specific to amputation, the PEQ, has emerged. It was developed on a conceptual framework of HRQOL and consists of 4 prosthesis function scales, 2 mobility scales, 3 psychosocial scales, and 1 well-being scale. Part of the validation of this questionnaire involved correlating the scales against criterion measures; the SF-36,[28] a well-established generic HRQOL instrument; the social interaction subscale of the Sickness Impact Profile[31] (SIP); and the Profile of Mood States–Short Form[32]

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(POSM-SF). As expected, the ambulation scale of the PEQ correlated strongly with the physical subscale of the SF-36.[29] The social burden scale of the PEQ showed a strong negative correlation with the SIP social interaction score; that is, experiencing lower social burden on the PEQ was associated with fewer social interaction problems on the SIP.[29] Finally, a feeling of well-being on the PEQ was associated with lower mental distress on the POMS-SF.[29]

Some studies have examined the correlates of QOL. For example, Matsen et al[33] explored the correlates of QOL in people with a lower-extremity amputation and found that QOL correlated with the comfort of the residual limb; the condition of the contralateral limb; the comfort, function, and appearance of the prosthesis; social factors; and the ability to exercise recreationally. However, their QOL measure was a single item. Furthermore, few studies have examined the predictors of QOL. Van der Schans et al[34] explored HRQOL in people with a lower-limb amputation and found that, although people with phantom limb pain had a poorer HRQOL than people without phantom limb pain, the most important amputation-specific determinants of HRQOL, using the Dutch version of the SF-36, were walking distance and stump pain. Importantly, Rybarcyzk and colleagues[35,36] have undertaken the only research that investigates psychosocial factors as statistical predictors of QOL in people with a lower-limb amputation. Rybarcyzk[35] found body image, perceived social support, self-rated health, and time since amputation to be the best set of predictors for QOL. Behel[36] found that a feeling of vulnerability accounted for a significant portion of the variance in QOL ratings: more specifically, higher levels of vulnerability were associated with lower QOL. However, both of these studies only used a 3-item measure, and given the widely recognized multidimensional nature of QOL, it is important to investigate QOL more comprehensively.

QOL has been defined by the World Health Organization Quality of Life (WHOQOL) Group as individuals' perceptions of their position in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns.[37] Recognition of this breadth of QOL is important for meaningful rehabilitation of people with amputations. Another study[1] using the TAPES reported a cursory exploration of QOL, but only as a means of establishing construct validity of TAPES subscales. That study did not seek to investigate the TAPES' multivariate ability to predict QOL. Given that previous research shows the relationship among activity, adjustment, pain, and satisfaction and that these facets and others are all assessed by the TAPES, it may be that the TAPES could play an important role in predicting the breadth of QOL domains, described above. The purpose of our study was therefore to investigate whether multivariate combinations of TAPES subscales are important in predicting different domains in QOL.

METHODS

Participants

Of 169 potential respondents, 63 people (37% response rate) returned completed questionnaires and were included in this study. The characteristics of the sample are outlined in table 1. As can be seen, the sample was predominantly male, with the prevalent cause of amputation being trauma or accident. In addition, the most common level of amputation was below knee.

Table 1: Sample Characteristics

Variable	n	%
Gender		
Men	44	69.8
Women	19	30.2
Cause of amputation		
Congenital	7	11.1
Cancer	14	22.2
Trauma	27	42.9
Other	15	23.8
Level of amputation		
Below knee	36	57.1
Above knee	25	39.7
Not specified	2	3.2

Variable	Mean ± SD	Range
Age (y)	47.45±18.4	19–84
Length of time living with prosthesis	9.9±9.2y	2 mo–47.25y
Degree of prosthetic use (h)	13.2±3.9	0–19

Abbreviation: SD, standard deviation.

Measures

World Health Organization Quality of Life Questionnaire. The World Health Organization Quality of Life Questionnaire (Brief Version)[37] (WHOQOL-BREF) considers QOL as a broad-ranging concept affected in a complex way by the person's physical health, psychologic state, social relationships, and relationship to salient features of the environment. Therefore, it produces scores for 4 domains related to QOL: physical, psychological, social relationships, and environment. The instrument consists of 28 items with 5-point Likert scales for all items. The WHOQOL-BREF domain scores show good internal consistency and test-retest reliability, content validity, and discriminant validity. The WHOQOL-BREF significantly discriminated between ill and well respondents.[37] These statistics were based on 3 samples (N=4802, N=3882, N=2369) from 33 field centers in 18 countries. With respect to people with disease or impairment, this group included patients from primary care settings, hospitals, and community care settings, and it included data from a number of specific populations (eg, people with schizophrenia, cataracts, diabetes, cancer). The WHOQOL Group[37] envisaged the WHOQOL-BREF to be of use in studies that require a brief assessment of QOL and to health professionals in the assessment and evaluation of treatment efficacy. The WHOQOL-BREF places primary importance on the perception of the individual. By focusing on individuals' own views of their well-being, the instruments inquire not only about the functioning of people with certain diseases and disorders but also about how satisfied the patients are with their functioning and with effects of treatment.

Trinity Amputation and Prosthetic Experience Scales. As well as requesting demographic and disability-related data regarding gender, age, cause and type of amputation, length of time living with the prosthesis, and degree of prosthetic use, the TAPES[1] consist of 9 subscales. There are 3 psychosocial subscales: general adjustment (eg, I have adjusted to having an artificial limb), social adjustment (eg, I don't mind people asking about my artificial limb), and adjustment to limitation (eg, being an amputee means that I can't do what I want to do). Each of these subscales contains 5 items, which are measured along a 5-point rating scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree). Scores range from 5 to 25, with higher scores indicating greater levels of adjustment. The TAPES also contain 3 activity restriction subscales: functional activity

restriction (eg, walking 100yd [90m]), social activity restriction (eg, visiting friends), and athletic activity restriction (eg, sport and recreation). Each of these activity restriction subscales contains 4 items, which are measured along a 3-point scale (not at all limited, limited a little, limited a lot). Scores range from 3 to 12, with higher scores indicating greater activity restriction. There are 3 additional subscales that assess satisfaction with the prosthesis, measured along a 5-point scale (very dissatisfied, dissatisfied, neither dissatisfied nor satisfied, satisfied, very satisfied). The functional satisfaction subscale contains 5 items (eg, reliability), with a potential score range from 5 to 25. There are 5 items in the aesthetic satisfaction subscale (eg, color), with a potential score range from 4 to 20. Because weight satisfaction contains only 1 item, scores in this subscale range from 1 to 5. Higher scores in each of the satisfaction subscales indicate greater satisfaction with the prosthesis. Each of the psychosocial, activity restriction, and satisfaction scales shows high internal reliability using the Cronbach α (range, .75–.89) and good face, content, construct, and predictive validity.[1]

The TAPES also look at the experience of phantom limb pain, residual limb pain, and other medical problems not related to the amputation. Each of the aforementioned is subdivided into questions relating to (1) whether that type of pain is experienced, (2) how often it is experienced, (3) how long each episode lasts, (4) how the level of pain can be described, and (5) the extent to which it interferes with daily life. This section of the TAPES also incorporate 2 items requesting respondents to rate their general health and physical capabilities measured, along a 5-point scale (very poor, 1; very good, 5).

Procedure

After ethics approval from the management of the Limb Fitting Centre was received, hospital charts of potential participants attending the Limb Fitting Clinic in Cappagh National Orthopaedic Hospital, Dublin, Ireland were reviewed. The preselection criteria included a requirement that the participants be at least 18 years old and have had a unilateral lower-limb amputation. A covering letter, the questionnaire, and a stamped, addressed envelope were posted to 169 people. A short reminder card was sent 2 weeks after the initial mailing.

Statistical Analysis

In terms of investigating the relationship between each of the QOL domains and demographic and disability-related variables, Pearson *r* correlations and 1-way analyses of variance (ANOVAs) were undertaken. Pearson *r* correlations were used to investigate whether there were relationships between each of the QOL domains and age, length of time with the prosthesis, and degree of prosthetic use. ANOVAs were used to investigate whether there were differences in each of the QOL domains depending on gender, level of amputation, and cause of amputation. Only significant results are reported here.

Multiple regression was used to investigate what aspects of the TAPES, if any, were predictive of each of the QOL domains. A stepwise approach was used to determine the best combination of variables for predicting each domain of QOL, because it is considered the best method for exploratory purposes.[38] Table 2 provides information on the predictor variables.

As part of the regression analysis, the assumptions underpinning the use of regression were checked for any violations. The assumption of normality, linearity, homoscedasticity, and independence of residuals was tested using residual scatterplots. The possible presence of multivariate outliers was detected using Mahalanobis distance and residual scatterplots. Multicolinearity, referring to high correlations among the independent variables, which can affect the interpretation of any relationships between the independent and dependent variables, was detected by examining the correlation matrix, tolerances, and variance inflation factor.

RESULTS

There were no significant relationships between age and each of the QOL domain scores. There was a significant relationship between length of time living with the prosthesis and each of physical health ($r=.26$, $P<.05$), social relationships ($r=.29$, $P<.05$), and the environment ($r=.33$, $P<.01$) scales on the WHOQOL. There was also a significant relationship between degree of prosthetic use and both the psychological domain ($r=.29$, $P<.05$) and the social relationships domain ($r=.50$, $P<.001$). There were no significant differences in any of the QOL domains arising from gender, level of amputation, and cause of amputation.

Assumption Testing for Regression Analysis

No univariate outliers were found for any of the regressions undertaken. The normal plot of regression-standardized residuals for each of the dependent variables (ie, physical domain, psychological domain, social relations domain, and environmental domain of WHOQOL) indicated a relatively normal distribution. From the scatterplot of residuals against predicted values, it was evident that there was no clear relationship between the residuals and the predicted values, which is consistent with the assumption of linearity. This also applied to each of the dependent variables. In terms of the Mahalanobis distance values, no distance was greater than the critical value of the chi-square analysis at an α level of .001 (ie, 42.3), so it was concluded that there were no multivariate outliers among the independent variables.

The first step in the assessment of multicolinearity was an examination of the bivariate correlations (see table 3). According to Hair et al,[39] the presence of high bivariate correlations (generally those ≥ 0.9) is the first indication of substantial colinearity. There were no bivariate correlations above 0.9. The tolerance values are a measure of the correlation between the predictor variables and can vary between 0 and 1. The closer to zero the tolerance value is for a variable, the stronger the relationship between this and the other predictor variables. Because there were no variables that had a very low tolerance (ie, $<.01$), there was little evidence of multicolinearity in any of the regression equations.[40] Variance inflation factor is an alternative measure of colinearity in which a large value (>10)[41] indicates a strong relationship between predictor variables. No variance inflation factor value for any of the regression equations exceeded 10. Based on the above analysis, it appeared that none of the multivariate assumptions for regression would be violated by our data set.

QOL: Physical Health Domain

The general adjustment subscale, functional restriction subscale, physical capabilities rating, experience of residual limb pain, health rating, and the adjustment to limitation subscale predicted a significant proportion of the variance (84%) in the physical health domain of QOL (see table 4). On the TAPES, higher scores on general adjustment and adjustment to limitation, a more favorable physical capabilities and health rating, a lower score on functional restriction, and an absence of residual limb pain were related to higher levels of QOL associated with physical health.

Table 2: Variables in Multivariate Analysis

Variable	Response Format	n (N=63)	Potential Range	Min	Max	Mean ± SD
Physical health (QOL)	5-point scale	62	7–35	9	35	25.48±5.81
Psychological (QOL)	5-point scale	62	8–40	15	40	29.21±5.79
Social relations (QOL)	5-point scale	62	3–15	3	15	11.08±2.92
Environmental (QOL)	5-point scale	62	8–40	13	38	28.05±5.72
Gender	Men/women	63	1–2	1	2	1.30±.46
Age	Year	62	NA	19	84	47.45±18.44
Length of time living with prosthesis	Months	63	NA	2	567	118.86±109.89
Level of amputation	Below knee/above knee	61	1–2	1	2	1.41±0.50
General adjustment	5-point scale (strongly agree–strongly disagree)	62	5–25	5	25	19.11±5.03
Social adjustment	5-point scale (strongly agree–strongly disagree)	62	5–25	9	25	19.00±4.45
Adjustment to limitation	5-point scale (strongly agree–strongly disagree)	62	5–25	6	25	13.13±5.45
Athletic activity restriction	3-point scale (not at all limited–limited a lot)	62	0–8	0	8	6.37±1.94
Functional restriction	3-point scale (not at all limited–limited a lot)	62	0–8	0	8	3.65±2.81
Social restriction	3-point scale (not at all limited–limited a lot)	62	0–8	0	8	2.27±2.49
Weight satisfaction	5-point scale (very dissatisfied–very satisfied)	62	1–5	1	5	3.52±1.21
Aesthetic satisfaction	5-point scale (very dissatisfied–very satisfied)	62	4–20	4	20	14.47±3.71
Functional satisfaction	5-point scale (very dissatisfied–very satisfied)	62	5–25	5	25	17.23±5.61
Degree of prosthetic use	Hours (daily use)	60	0–24	0	19	13.15±3.90
Health rating	5-point scale (very poor–very good)	63	1–5	1	5	3.83±0.89
Physical capabilities rating	5-point scale (very poor–very good)	62	1–5	1	5	3.45±1.14
Residual limb (stump) pain	Yes/No	63	0–1	0	1	0.51±0.50
Phantom limb pain	Yes/No	63	0–1	0	1	0.71±0.46
Other medical problems	Yes/No	62	0–1	0	1	0.29±0.46

Abbreviations: max, maximum; min, minimum; NA, not available.

QOL: Psychological Domain

General adjustment and social adjustment subscales, level of amputation, aesthetic satisfaction with prosthesis, and physical capabilities rating, as measured by the TAPES, predicted a significant proportion of the variance (72%) in the psychological domain of QOL (see table 4). Specifically, higher scores on general and social adjustment and aesthetic satisfaction with prosthesis, a more favorable rating of physical capabilities, and above-knee limb loss were associated with a more positive score on the psychological domain of the WHOQOL.

QOL: Social Domain

TAPES ratings of social adjustment, degree of prosthetic use, and length of time with prosthesis predicted 63% of the variance in the social relationships domain of QOL (see table 4). The results indicate that higher scores on social adjustment, more hours of prosthetic use, and a longer time living with the prosthesis were associated with more positive scores on the social relationships domain of the WHOQOL.

QOL: Environment Domain

Finally, the general adjustment subscale of the TAPES predicted a significant proportion of the variance (44%) in the environment domain of the WHOQOL (see table 4). Again, higher scores on the TAPES general adjustment subscale were associated with more positive ratings on the WHOQOL environment domain.

DISCUSSION

The ability of the TAPES to predict a significant amount of variance for each of the 4 domains of QOL identified by the WHOQOL highlights the potential usefulness of the TAPES as a disorder-specific index of QOL for amputees. In particular, the ability of the TAPES to account for 84% of the variance in the physical domain of QOL is indicative of the usefulness of the general adjustment subscale, functional restriction subscale, physical capabilities rating, experience of residual limb pain, health rating, and the adjustment to limitation subscale when exploring this aspect of QOL. Interestingly, phantom limb pain, unlike residual limb pain, was not a significant predictor of the physical health domain of QOL. However, residual limb pain can entirely prevent the use of a prosthesis, thereby impeding activities. Furthermore, a study by Gallagher et al[42] showed that, although fewer people experienced residual limb pain, those who did experienced it for longer periods, at a greater level of intensity, and with a greater amount of inter-

Table 3: Bivariate Correlations Between Predictor Variables (TAPES) and Dependent Variable (WHOQOL-BREF subscales) and Intercorrelations Between Predictor Variables

	WHOQOL Physical Health	WHOQOL Psychological	WHOQOL Social Relations	WHOQOL Environmental	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Gender (1)	–0.09	–0.02	0.13	–0.11	1.00																		
	0.51	*0.85*	*0.33*	*0.39*	—																		
Age (2)	–0.22	0.08	0.10	0.00	0.20	1.00																	
	0.09	*0.54*	*0.44*	*0.98*	*0.12*	—																	
Length of time living with prosthesis (3)	0.26	0.19	0.28	0.33	–0.03	–0.04	1.00																
	0.05	*0.13*	*0.02*	*0.01*	*0.79*	*0.75*	—																
Level of amputation (4)	–0.14	0.17	0.07	–0.05	0.23	0.12	–0.20	1.00															
	0.30	*0.20*	*0.62*	*0.72*	*0.08*	*0.37*	*0.11*	—															
General adjustment (5)	0.79	0.72	0.49	0.66	–0.08	–0.06	0.22	–0.11	1.00														
	0.00	*0.00*	*0.00*	*0.00*	*0.54*	*0.67*	*0.09*	*0.40*	—														
Social adjustment (6)	0.39	0.64	0.69	0.33	0.01	0.05	0.00	0.03	0.46	1.00													
	0.00	*0.00*	*0.00*	*0.01*	*0.95*	*0.71*	*0.97*	*0.82*	*0.00*	—													
Adjustment to limitation (7)	0.62	0.43	0.14	0.37	–0.11	–0.18	0.14	0.01	0.45	0.22	1.00												
	0.00	*0.00*	*0.29*	*0.00*	*0.38*	*0.16*	*0.29*	*0.92*	*0.00*	*0.09*	—												
Athletic activity restriction (8)	–0.63	–0.34	–0.18	–0.44	0.04	0.39	–0.34	0.30	–0.42	–0.09	–0.55	1.00											
	0.00	*0.01*	*0.16*	*0.00*	*0.74*	*0.00*	*0.01*	*0.02*	*0.00*	*0.49*	*0.00*	—											
Functional restriction (9)	–0.64	–0.39	–0.24	–0.34	0.07	0.45	–0.23	0.19	–0.42	–0.32	–0.54	0.65	1.00										
	0.00	*0.00*	*0.06*	*0.01*	*0.60*	*0.00*	*0.08*	*0.14*	*0.00*	*0.01*	*0.00*	*0.00*	—										
Social restriction (10)	–0.65	–0.56	–0.39	–0.52	–0.03	0.21	–0.31	–0.07	–0.57	–0.39	–0.60	0.53	0.69	1.00									
	0.00	*0.00*	*0.00*	*0.00*	*0.83*	*0.11*	*0.02*	*0.57*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	—									
Weight satisfaction (11)	0.40	0.44	0.26	0.29	–0.16	–0.33	0.26	–0.07	0.46	0.17	0.29	–0.27	–0.36	–0.25	1.00								
	0.00	*0.00*	*0.04*	*0.02*	*0.22*	*0.01*	*0.04*	*0.58*	*0.00*	*0.19*	*0.02*	*0.03*	*0.00*	*0.05*	—								
Aesthetic satisfaction (12)	0.45	0.47	0.38	0.44	–0.11	0.06	0.26	–0.22	0.32	0.36	0.14	–0.21	–0.20	–0.23	0.49	1.00							
	0.00	*0.00*	*0.00*	*0.00*	*0.39*	*0.65*	*0.04*	*0.09*	*0.01*	*0.00*	*0.27*	*0.10*	*0.11*	*0.08*	*0.00*	—							
Functional satisfaction (13)	0.58	0.53	0.38	0.43	–0.12	–0.30	0.28	–0.11	0.62	0.34	0.37	–0.41	–0.44	–0.44	0.75	0.58	1.00						
	0.00	*0.00*	*0.00*	*0.00*	*0.35*	*0.02*	*0.03*	*0.39*	*0.00*	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	—						
Prosthetic use (14)	0.25	0.29	0.50	0.21	–0.01	–0.07	0.11	–0.16	0.37	0.24	0.14	–0.30	–0.27	–0.31	0.22	0.19	0.39	1.00					
	0.06	*0.03*	*0.00*	*0.12*	*0.97*	*0.58*	*0.40*	*0.24*	*0.00*	*0.07*	*0.28*	*0.02*	*0.04*	*0.02*	*0.09*	*0.14*	*0.00*	—					
Health rating (15)	0.67	0.53	0.35	0.50	0.17	–0.08	0.20	–0.03	0.54	0.17	0.37	–0.47	–0.38	–0.50	0.29	0.29	0.45	0.16	1.00				
	0.00	*0.00*	*0.01*	*0.00*	*0.19*	*0.52*	*0.11*	*0.84*	*0.00*	*0.18*	*0.00*	*0.00*	*0.00*	*0.00*	*0.02*	*0.02*	*0.00*	*0.23*	—				
Physical capabilities rating (16)	0.69	0.52	0.33	0.47	0.00	–0.07	0.29	–0.17	0.58	0.20	0.49	–0.58	–0.47	–0.54	0.36	0.26	0.53	0.23	0.75	1.00			
	0.00	*0.00*	*0.01*	*0.00*	*0.98*	*0.58*	*0.02*	*0.19*	*0.00*	*0.12*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.05*	*0.00*	*0.08*	*0.00*	—			
Residual limb (stump) pain (17)	–0.25	–0.11	–0.14	–0.18	–0.18	0.03	0.04	0.02	–0.19	–0.09	–0.18	0.20	0.11	0.08	–0.07	–0.09	–0.11	–0.19	–0.01	0.02	1.00		
	0.05	*0.40*	*0.28*	*0.15*	*0.15*	*0.83*	*0.74*	*0.88*	*0.15*	*0.50*	*0.16*	*0.11*	*0.40*	*0.53*	*0.60*	*0.50*	*0.39*	*0.15*	*0.91*	*0.90*	—		
Phantom limb pain (18)	0.07	0.08	0.07	0.07	0.11	0.03	–0.27	0.44	0.10	0.06	0.17	0.14	0.01	–0.10	–0.02	–0.17	–0.02	–0.15	0.11	0.00	0.15	1.00	
	0.61	*0.54*	*0.60*	*0.57*	*0.39*	*0.85*	*0.03*	*0.00*	*0.44*	*0.62*	*0.20*	*0.27*	*0.95*	*0.43*	*0.87*	*0.19*	*0.88*	*0.24*	*0.37*	*0.98*	*0.24*	—	
Other medical problems (19)	–0.28	–0.33	–0.15	–0.29	0.11	–0.04	–0.15	0.07	–0.24	–0.09	–0.13	0.18	0.17	0.17	–0.24	–0.30	–0.33	–0.04	–0.31	–0.20	–0.14	–0.08	1.00
	0.03	*0.01*	*0.24*	*0.02*	*0.38*	*0.78*	*0.24*	*0.60*	*0.06*	*0.48*	*0.32*	*0.17*	*0.18*	*0.18*	*0.06*	*0.02*	*0.01*	*0.77*	*0.01*	*0.13*	*0.27*	*0.51*	—

NOTE. Values are listed for each variable as *r* (top) and significance (bottom). Values for significance are in italics for readability.

Table 4: Predictors of WHOQOL Domains

Dependent Variable QOL Domains	Predictor Variables from TAPES	Standardized Coefficients	*t*	Adj R^2	F
1. Physical health				.842	47.98§
	General adjustment (subscale)	.42	6.12§		
	Functional restriction (subscale)	–.22	–3.37†		
	Physical capabilities rating (item)	.18	2.00*		
	Residual limb pain (item)	–.16	–2.86†		
	Health rating (item)	.19	2.27*		
	Adjustment to limitation (subscale)	.16	2.26*		
2. Psychological				.72	28.34§
	General adjustment (subscale)	.39	3.97§		
	Social adjustment (subscale)	.33	3.81§		
	Level of amputation (item)	.29	3.80§		
	Aesthetic satisfaction with prosthesis (subscale)	.22	2.50*		
	Physical capabilities rating (item)	.20	2.35*		
3. Social relationships				.63	31.37§
	Social adjustment (subscale)	.60	7.00§		
	Degree of prosthetic use (item)	.32	3.65‡		
	Length of time with prosthesis (item)	.25	2.99†		
4. Environment				.44	42.18§
	General adjustment (subscale)	.67	6.49§		

Abbreviation: Adj, adjusted.
*$P<.05$; †$P<.01$; ‡$P<.001$; §$P<.0001$.

ference in their daily lifestyle than people who were experiencing phantom limb pain.

In relation to the psychological domain of QOL, general adjustment and social adjustment subscales, level of amputation, aesthetic satisfaction with the prosthesis, and the physical capabilities rating were predictive of 72% of the variance. Counterintuitively, above-knee limb loss was predictive of better scores on the psychological domain of QOL. Studies exploring psychosocial adjustment, although not specifically QOL, have not reported such a relationship. Indeed, Hagberg and Branemark[25] concluded that transfemoral amputation due to nonvascular causes had an evident impact on QOL, with considerable problems related to the amputation and to the prosthesis. Further research is required to identify additional factors that may be influencing our own findings (eg, whether the amputation was sudden or planned, what the level of expectation was). It is also important to note that, although previous research has predominantly indicated that adjustment is better in transtibial amputations than in transfemoral amputations, people do differ in what they consider to be salutary outcomes.[12] Finally, the differences arising from level of amputation may diminish as prosthetic technology improves and the loss of the knee joint becomes less challenging. In relation to predicting the psychological domain of QOL, it is also noteworthy that greater aesthetic satisfaction with the prosthesis was predictive of higher scores. This highlights the importance of being able to isolate the different components of the prosthetic limb and to explore their relationship with subsequent adjustment. The importance of the aesthetics of the artificial limb has also emerged in qualitative studies.[11,16]

In predicting the social relationship domain of QOL, the social adjustment subscale, the degree of prosthetic use, and the length of time with a prosthesis accounted for 63% of the variance. Rybarcyzk et al[35] also found that time since amputation was a significant predictor of their single-item measure of QOL. Finally, the general adjustment subscale also appears to be salient to the environment domain of QOL, because it accounted for 44% of the variance. Overall, the general adjustment subscale of the TAPES is a significant predictor in 3 of the dimensions of QOL (physical health, psychological, environment) and thus seems to be the TAPES subscale related to the greatest number of QOL dimensions.

There are some methodologic issues that need to be addressed in future studies and should be acknowledged in the context of interpreting the results of our study. Although our results in this study are clearly statistically significant, how clinically meaningful they are has not been investigated through more detailed interviews with respondents. Moreover, although we have established cross-sectional associations between the TAPES and the WHOQOL-BREF, longitudinal studies to explore possible causal relationships would be desirable. Related to this, we believe that further research is warranted to learn how sensitive the scales and items in the TAPES are to changes in clinical status.

Although the participants in our study were from a national limb fitting clinic, it is also important to note that the participants came from a single facility. Further research is required with larger samples, to validate the findings and to see if they can be replicated and generalized. This is particularly pertinent given the relatively high ratio of cases to independent variables, which theoretically increases the risk of overfitting the variate to the sample and of limiting generalizability.[39] In addition, it would have been desirable to compare respondents with nonrespondents. Unfortunately, we have no further demographic or clinical data concerning the nonrespondents; in compliance with the clinic's ethical requirements, the research was conducted under the condition that only names and addresses (with no other demographic or clinical information being taken from patients' records) would be used, to invite participation in the study.

CONCLUSIONS

We have undertaken an important analysis for the further validation of a recently developed disability-specific instrument and have shown its salience to a highly generic, multidimensional QOL assessment. These findings provide preliminary evidence that the TAPES can be used to evaluate changes in QOL during the rehabilitation process and to provide insights into the nature of

the disability experienced, by assessing how it impairs the subjective well-being of the person across a series of domains. This is particularly important when the assertion of Garratt et al[30] is taken into consideration: that for complete assessment of the benefits of an intervention, it is essential to provide evidence of the impact on the patient in terms of health status and HRQOL. Given the dearth of research in QOL in people with lower-limb amputations, this research is timely, and we hope it will encourage further research in this area.

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