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RESEARCH ARTICLE

Body Image in People with Lower-Limb Amputation

A Rasch Analysis of the Amputee Body Image Scale

ABSTRACT

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Objective: The aim of this study was to examine the psychometric properties of the Amputee Body Image Scale (ABIS) through Rasch analysis, investigating the quality of its rating categories and its reliability and validity.

Design: The ABIS (20 items; ratings of 1–5) and Trinity Amputation Prosthesis Experience Scales (TAPES) were administered by post and completed by 145 people with a lower-limb amputation and currently wearing a prosthesis.

Results: According to Rasch analysis and expert review, some response categories were collapsed and six items were deleted. The remaining 14 items created a revised ABIS (ABIS-R) rated with a three-level rating scale. ABIS-R fitted the unidimensional construct that the scale was intended to measure and demonstrated good reliability (Cronbach's alpha and person separation reliability = 0.87), targeting, and internal construct validity. Moreover, the correlations with the nine TAPES subscales (in particular, $r = -0.54$ with the general adjustment, $r = -0.43$ with the social activity restriction, and $r = -0.40$ with social adjustment) supported the convergent validity of ABIS-R.

Conclusions: The 14-item ABIS-R demonstrates good psychometric characteristics for measuring body image disturbances in people with lower-limb amputation. These preliminary results suggest the general adequacy of the new instrument and provide a good foundation on which further validation and psychometric studies of the ABIS-R can be conducted.

Key Words: Amputation, Body Image, Psychometrics, Rasch Analysis

Psychosocial factors have recently been demonstrated to influence the prosthetic rehabilitation of individuals with an amputation.[1–9] Consequently, the psychological impact of amputation and the subsequent fitting of a prosthesis needs to be taken into consideration in conjunction with the physical impact to enhance the prosthetic experience and outcomes for the user and to lead to enhanced health and quality of life. For example, there are a number of images for the person who has experienced an amputation to adjust to: the "complete" or familiar body before the limb loss, the traumatized body, the healing body, and the extended body (i.e., a body supplemented with prosthetic devices and, if necessary, mobility aids). Each of these images may be accompanied by phantom sensations and/or phantom limb pain (i.e., sensations and/or pain in the part of the body that has been amputated). Rybarcyzk et al.[10] proffer that the person has to adapt to an image of him- or herself without the amputated limb while reconciling three images of his or her body: before the limb loss, without a prosthesis, and with a prosthesis. Body image anxiety has been found to be significantly related to depression,[11,12] poorer perceived quality of life,[11,12] lower levels of self-esteem,[12] higher levels of general anxiety,[13] lower levels of prosthesis satisfaction,[12] and lower levels of participation in physical activity.[14] According to Horgan and MacLachlan,[3] adaptation to a changed body image is a potential measure of psychosocial adjustment to amputation. Therefore, it is an important construct that should be included in a clinical assessment.

However, to be adequately able to investigate body image concerns in people with an amputation and to explore its relationship with psychosocial adjustment, it is important to have a psychometrically sound instrument that will facilitate the development of a solid evidence base on which to set up appropriate interventions. The Amputation Body Image Scale (ABIS) developed by Breakey[12] has been proposed as one such instrument. It comprises 20 items that assess how a person with an amputation perceives and feels about his or her body experiences. In the original paper outlining its development, acceptable content validity, internal consistency, and convergent validity were demonstrated using classical test theory, and significant positive correlations were found between the perception of body image (using the ABIS) and psychosocial well-being (more specifically, anxiety, depression, self-esteem, and life satisfaction).[12] In addition, Murray and Fox[15] observed moderate to high negative correlations between body image disturbance as measured by the ABIS and prosthesis satisfaction. The validity of the ABIS was also supported by Wetterhahn et al.,[14] who found a significant correlation between six subscales of the Multidimensional Body–Self Relations Questionnaire[16] and the ABIS. To the best of our knowledge, these are the only published studies using the ABIS. As such, many issues related to the structure and main psychometric properties of the scale still need to be examined.[17,18] In particular, it was considered worthwhile to further investigate (a) content validity (i.e., that it covers all parts of the universe of content and reflects the relative importance of each part, and that it is free from the influence of factors that are irrelevant to the purpose of the measurement), and (b) the rating-scale structure.

Recently, there has been a growing trend in the field of rehabilitation to implement Rasch analysis to facilitate the development and validation of questionnaires.[19–23] Rasch analysis provides psychometric information that is not given by classical test theory,[23–24] examining, among other things, (a) how the rating scale is being used; (b) the validity of a measure by evaluating the fit of individual items to the latent trait: it postulates that if the ability in responding to items on an ordinal scale is explained by an underlying unidimensional construct, the hierarchy of difficulty of the items is expected to match the hierarchy of ability of the subjects (i.e., more able subjects are more likely to pass more difficult items) within a probabilistic model; and (c) whether the pattern of item difficulties is consistent with the expectations of the construct and, hence, provides an adequate description of the range and hierarchical relationship of the variable. Indeed, Andresen[25] recommends Rasch analysis as a method for assessing scaling properties in addition to traditional psychometric criteria for reviewing and assessing surveys and questionnaires for disability outcomes research.

To facilitate the availability of a psychometrically robust measure of body image in people with an amputation, the aim of this study was to perform an in-depth validation of the basic measurement properties of ABIS[12] through Rasch analysis, investigating the quality of their rating categories and the validity (unidimensionality and internal construct validity) and reliability of the instrument.

METHODS

Procedure and Sample

After ethical approval from two national limb-fitting centers in Ireland, hospital charts of potential participants were reviewed. A preselection criterion included a requirement that the participants with loss/absence of a limb be at least 18 yrs old. A cover letter, the questionnaire, and a stamped, addressed envelope were sent to all participants. A

TABLE 1 Sample characteristics

	Frequency	Percentage
Gender		
Male	99	68.3
Female	46	31.7
Type of amputation		
Below knee	73	50.3
Through knee	3	2.1
Above knee	52	35.9
Bilateral	17	11.7
Cause of amputation		
PVD	40	27.6
Diabetes/PVD	38	26.2
Accident/trauma	37	25.5
Infection	8	5.5
Cancer	7	4.8
Clot	4	2.8
Other	11	7.6
	Mean	SD
Age, yrs	60.5	17.4
Length of time since amputation, mos	81.4	143.4

PVD, peripheral vascular disorder.

short reminder card was sent 2 wks after the initial mailing to nonrespondents. There was no incentive or reimbursement for participation.

One hundred ninety-one people returned completed questionnaires. Of these 191 respondents, 145 indicated that they had had a lower-limb amputation and were currently using a prosthesis. These respondents were included in the study. The characteristics of the sample (n = 145) are outlined in Table 1. As can be seen, the sample was predominantly male, with the prevalent cause of amputation being peripheral vascular disorder, diabetes/peripheral vascular disorder, or accident/trauma. In addition, the most common level of amputation was below the knee. These characteristics are consistent with the general population of people with lower-limb amputations in the Western world.

Measures

ABIS

The ABIS[12] comprises 20 items (see Appendix) that assess how an amputee perceives and feels about his or her body experiences. Participants are asked to indicate their responses to the questions using a rating scale of 1 (none of the time) to 5 (all of the time). Three questions (3, 12, and 16) are reverse scored. The scale produces scores that range from 20 to 100, with high scores indicating high body image disturbance.

Trinity Amputation and Prosthesis 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 Trinity Amputation and Prosthesis Experience Scales (TAPES) consist of nine subscales.[7] There are three psychosocial subscales: general adjustment (e.g., I have adjusted to having an artificial limb), social adjustment (e.g., I don't mind people asking about my artificial limb), and adjustment to limitation (e.g., Being an amputee means that I can't do what I want to do). Each of these subscales contains five items, which are measured along a five-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 contains three activity-restriction subscales: functional activity restriction (e.g., walking 100 yards), social activity restriction (e.g., visiting friends), and athletic activity restriction (e.g., sport and recreation). Each of these activity-restriction subscales contains four items, which are measured along a three-point scale (not at all limited, limited a little, limited a lot). Scores range from 3 to 12, with higher scores being indicative of greater activity restriction. There are three additional subscales assessing satisfaction with the prosthesis, measured along a five-point scale (very dissatisfied, dissatisfied, neither dissatisfied nor satisfied, satisfied, very satisfied). The functional satisfaction subscale contains five items (e.g., reliability), with a potential score range of 5–25. There are four items in the aesthetic satisfaction subscale (e.g., color), with a potential score range of 4–20. Because weight satisfaction contains only one item, scores in this subscale range from 1 to 5. Higher scores in each of the satisfaction subscales are indicative of greater satisfaction with the prosthesis. Each of the psychosocial, activity-restriction, and satisfaction scales demonstrate high internal reliability using Cronbach's alpha (range, 0.75–0.89) and good face, content, construct, and predictive validity.[7]

The TAPES also looks 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 their daily lives. This section of the TAPES also incorporates two items requesting respondents to rate their general health and phys-

ical capabilities, using a five-point scale (very poor [1] to very good [5]).

Statistical Analysis

A three-stage process was used to investigate the basic psychometric properties of the ABIS:

1) Using SPSS version 11 (SPSS 11 for Windows, SPSS Inc., Chicago IL), internal consistency and homogeneity of the original 20 items were examined by calculating:

a) Cronbach's coefficient alpha. It has been suggested that this should be above 0.70 but not higher than 0.90,[26–27] because it is important to strike a balance between satisfactory internal consistency and an instrument that is too homogenous and thus measures a very restricted aspect of a phenomenon.[17,28]

b) Item–total correlations. Spearman rank correlation coefficients (r_s) were used to examine the degree to which each item was correlated with the total score, omitting that item from the total. The usual rule of thumb is that an item should correlate with the total score with a $r > 0.20$[27];

c) Kaiser Meyer Olkin measure of sampling adequacy (both global and for each item). The level of homogeneity of the matrix of item scores was investigated through comparison of the magnitudes of the correlation coefficients observed with those of the partial correlation coefficients. Kaiser Meyer Olkin values greater than 0.6 are sought because values less than this indicate that one or more items should not be included in the factor analysis, because they do not belong to the same universe shared by the other variables.[29]

d) Principal-component analysis. To test the unidimensionality of the measure, the amount of variance explained by the first principal component and the extent to which the first eigenvalue was larger than the second and third ones is examined. It has been suggested that when the first component accounts for 40% of the total variance, it can be said that a set of items is measuring a single dimension.[30,31]

2) Rasch analysis: The matrix of single raw scores for each subject was subjected to the rating-scale model through the WINSTEPS software (WINSTEPS, Chicago, IL) to estimate the following issues:

a) Rating-scale diagnostics. To investigate whether the rating scales of the questionnaire were being used in the expected manner, the following criteria (suggested by Linacre[32]) have been adopted to judge this parameter: (1) at least ten cases per category; (2) regular distribution of category use; and (3) monotonic increase in both average measures across rating-scale categories and thresholds. Thresholds (sometimes also called step calibrations) are the points at which the probability of a response of either the category below and the next category are equally likely; that is, they represent the transition from the category below to the next category; (4) category outfit mean square values less than 2; and (5) thresholds differences greater than 1.4 and less than 5.

Until all these criteria were met, categories were combined according to specific guidelines, and several categorizations have been compared, looking not only at above indicators of category diagnostics but also at various reliability and validity indices.[24] Only the final solution is reported on in the results.

b) Validity. After the check and revision of the rating scale, validity was analyzed by evaluating the fit of the individual items to the latent trait (unidimensionality), as well as by examining whether the pattern of item difficulties was consistent with the expectation of the construct. Depending on the string of responses provided by a particular sample of subjects on a particular sample of items, the Rasch model estimates (1) goodness of fit of the model (fit statistics). Information-weighted (infit) and outlier-sensitive (outfit) mean-square statistics (MnSq) for each item were calculated (similarly to a χ^2 analysis) to test whether there were items that did not fit with the model expectancies. According to the literature, items are deemed to have an acceptable fit to the model when the MnSq is greater than 0.6 and less than 1.4.[24,33] Items outside this range were considered misfitting (MnSq $>$ 1.4) or overfitting (MnSq $<$ 0.6) (see also below); (2) the level of difficulty achieved by each item on an interval scale (item difficulty) and where each individual subject fits along the continuum (subject ability). Item difficulty and patient ability are expressed (on a common interval scale) in logits, the natural logarithm of the odds of mutually exclusive alternatives (e.g., pass *vs.* fail, or higher response *vs.* lower response).[24,34,35] It is reported that a sample size of about 100 persons will estimate item difficulty with an alpha of 0.05 to within 0.5 logits.[36]

c) Reliability. The final set of items satisfying both the model fit requirements and an expert review were evaluated in terms of "separation" (G), defined as the ratio of the true spread of the measures with their measurement error.[24] The item separation index indicates an estimate (in standard error units) of the spread or separation of items along the measurement construct; the person separation index provides the same for persons (describing the number of performance levels the test measures in a particular sample). A separation of 2.0 is considered good and enables the distinction of three groups or strata (high, average, low) (number of distinct strata = (4G + 1)/3), defined as segments whose centers are separated by distances

greater than can be accounted for by measurement error alone.[34,35] A related index is the reliability of these separation indices, indicating the degree of confidence we can place in the consistency of our estimates (range = 0–1; coefficients >0.80 are considered good, and coefficients >0.90 are excellent).[24]

3) Construct validity: Both the original 20-item ABIS and the new Rasch-refined version of the scale (known as ABIS-R) were correlated with the TAPES using Spearman's correlation coefficient to assess their convergence issues.[27,28] It is expected that the ABIS and ABIS-R will correlate positively with each of the activity-restriction subscales on the TAPES—that is, body image disturbance will be associated with higher levels of restriction in athletic, social, and functional activity restriction. It is expected that the ABIS and ABIS-R will correlate negatively with each of the satisfaction and adjustment subscales of the TAPES—that is, body image disturbance will be associated with lower levels of functional, weight, and aesthetic satisfaction and lower levels of general, social, and limitation adjustment. Aside from the significance level of the correlations, $r < 0.25$ indicates little relationship, and r from 0.25 to 0.50 suggests a fair degree of relationship.[28]

RESULTS

Internal Consistency/Homogeneity

The Cronbach's coefficient alpha of the original ABIS was 0.90. The item-to-total correlation coefficients (r_s) ranged from 0.30 (item 7) to 0.74 (item 11). The overall Kaiser Meyer Olkin measure of sampling adequacy was 0.87. The Kaiser Meyer Olkin statistics for each individual item found on the diagonal of the antiimage correlation matrix were all greater than 0.6, as required[29]: they ranged from 0.94 (item 8) to 0.73 (item 15). Principal-component analysis showed that four factors had eigenvalues greater than 1.0, and the first factor (eigenvalue = 7.40) explained 37% of variance, whereas the second (eigenvalue = 1.61) and third (eigenvalue = 1.28) factors explained only small additional amounts of variance (9 and 6%, respectively). The scree test identified only the first factor before the "break." The internal consistency indices and the large amount of variance accounted for by the first principal factor indicated that the test was sufficiently unidimensional[30] to be submitted to Rasch analysis.

Rasch Analysis

Regarding rating-scale diagnostics, the rating categories of 2 (rarely), 3 (some of the time), and 4 (most of the time) did not comply with the set criteria for category functioning (average measures, thresholds, etc.) (Fig. 1A).

The model meeting all the established criteria and with the best person separation and reliability was the one that collapsed into a unique category level 2 with 3, and level 4 with 5 of the ABIS, thus producing a new three-level rating scale (0 = none of the time, 1 = sometimes, and 2 = most/all of the time). Figure 1B shows category probability curves after collapsing the categories.

After the phase of rating-scale modification, the Rasch analysis showed that 15 ABIS items fitted the unidimensional construct that the scale was intended to measure (Table 2). Items 2, 19, 17, and 16 were misfitting (MnSq > 1.4), and item 11 was overfitting (MnSq < 0.6).

Regarding the hierarchic ordering of items, Figure 2A shows the distribution map of subject ability and item difficulty of the items, according to the Rasch model. In the original 20-item scale (Fig. 2A), item measures ranged from –1.63 (item 19) to +1.33 logits (item 5), and person-ability measures ranged from –3.00 to +4.19 logits. In the shortened 14-item version without misfitting and overfitting items or item 7 (which was deleted for content reasons; see Discussion) (ABIS-R), item measures ranged from –1.47 (item 12) to +1.23 logits (item 5) (Fig. 2B), and person-ability measures ranged from –3.21 to +3.99 logits.

In the 14-item ABIS-R, the item separation index was 4.59 (item separation reliability = 0.95), the person separation index was 2.33, and the person separation reliability (which is analogous to Cronbach's alpha) was 0.84.

Correlations of ABIS (20 Items) and ABIS-R (14 Items) with TAPES

As can be seen in Table 3, there is a significant negative correlation between both ABIS and ABIS-R and each of the following TAPES subscales: aesthetic, weight, and functional satisfaction; and general, social, and limitation adjustment. There is also a significant positive correlation between the ABIS, ABIS-R, and functional and social activity restriction.

DISCUSSION

Being cognizant of the person's body image after amputation is an important aspect of ongoing postamputation care, and its inclusion as part of a comprehensive outcome measurement merits consideration. However, because such measurements need to demonstrate robust psychometric properties, this study used Rasch analysis to improve the value of the ABIS by refining its rating scale, distinguishing items belonging to the same construct (unidimensionality), verifying the expected difficulty hierarchy of its items, examining the extent to which the items are of appropriate difficulty for

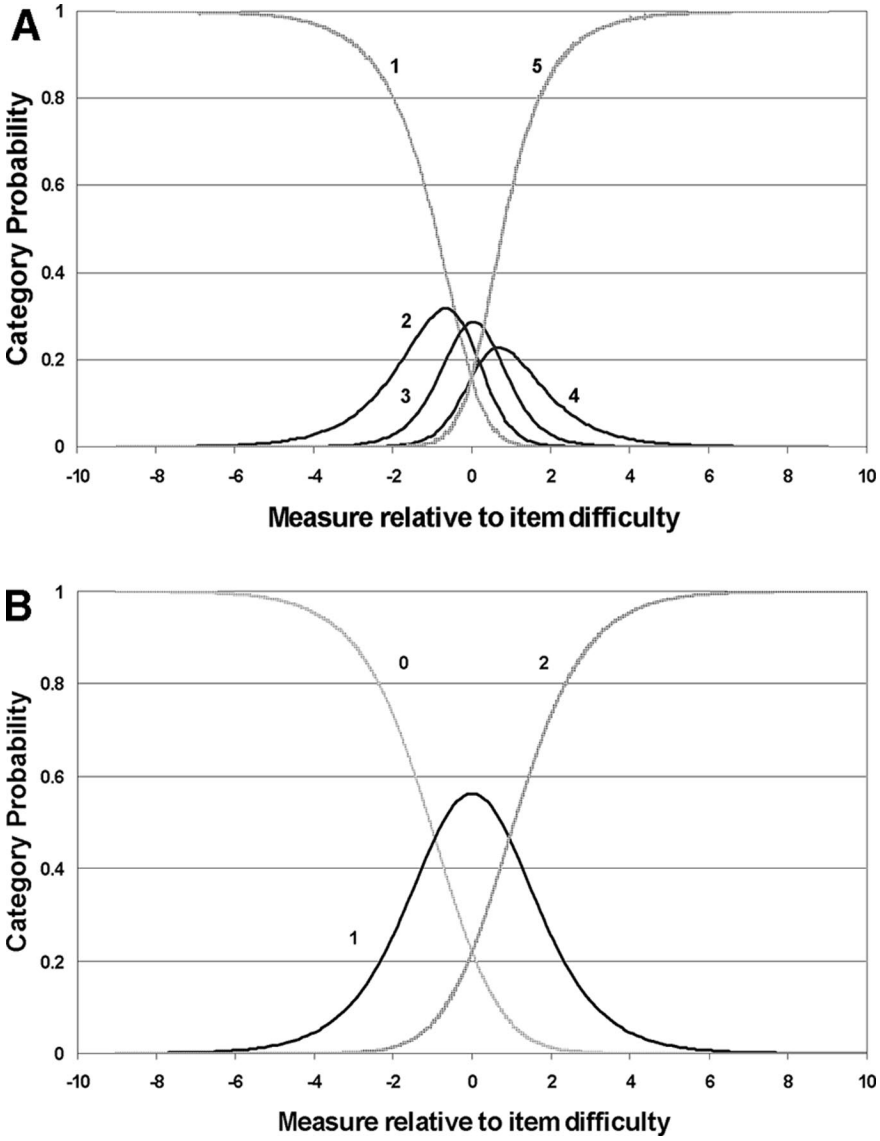

FIGURE 1 *Category probability curves of ABIS. The y-axis represents the probability (0–1) of responding to one of the rating categories, and the x-axis represents the different performance values (person measure minus the item measure) in logits. The 0 curve declines as the subject's ability increases; the crossing point (where 0 and 1 are equally probable) is the first threshold. The same applies for the other curves. The plot should look (as in* panel B*) like a range of hills.* A, *Original scale with five categories (1 = none of the time, 2 = rarely, 3 = some of the time, 4 = most of the time, and 5 = all of the time).* B, *Revised scale after collapsing some categories (1→ 0 = none of the time; 2 + 3 → 1 = sometimes; and 4 + 5 → 2 = most/all of the time).*

Apparent from Figure 1A is that the probability of using the central categories 2–4 is never higher than receiving other ratings. Conversely, in Figure 1B, it can be seen that the probability of selecting one of the three revised rating categories is now a clear function of the level of body image disturbance expressed by the individual in x-axis.

the sample (targeting), and analyzing reliability in terms of both internal consistency and separation.

Internal Consistency

The internal consistency of ABIS was found to be satisfactory according to multiple tests from classical test theory.[27,28] Furthermore, despite the reduction of six items, the ABIS-R showed an acceptable value (0.84) of person separation reliability, which is analogous to Cronbach's alpha.[24]

Rasch Analysis

Regarding the rating-scale diagnostics, the ABIS showed some disordered thresholds. This contradicts the usual interpretation of categories (i.e., that they represent the sequence of the most

TABLE 2 Item calibrations (measure) with standard errors (SE) and infit and outfit mean-square statistics (MnSq) for the 20 items of Amputee Body Image Scale, in order of misfit

Item Number	Measure	SE	Infit MnSq	Outfit MnSq
2	−1.29	0.17	1.57*	1.33
19	−1.63	0.18	1.48*	1.33
16	−0.92	0.16	1.39	1.46*
17	0.86	0.15	1.41*	1.25
15	0.21	0.15	1.08	1.32
7	0.11	0.15	1.06	1.24
5	1.33	0.16	1.21	1.21
12	−1.13	0.16	1.14	1.19
13	−0.52	0.15	1.01	1.18
20	1.16	0.15	1.12	1.18
3	0.57	0.15	1.00	1.12
10	−0.17	0.15	1.04	0.95
14	−0.09	0.15	1.03	0.99
8	0.97	0.15	0.81	0.85
18	0.73	0.15	0.75	0.76
6	0.86	0.15	0.71	0.67
9	−0.17	0.15	0.70	0.67
4	−0.59	0.15	0.66	0.64
1	0.09	0.15	0.65	0.61
11	−0.37	0.15	0.57*	0.57*

Each item estimate can be regarded as the balance point for the response distribution across that item's categories. The higher the item estimate, the more difficult that item was for the group to endorse (higher scores). Items 3, 12, and 16 are reverse scored. Misfitting and overfitting values are marked by asterisks.

likely outcomes) and suggests that respondents were not able to distinguish their abilities as finely as envisaged by the five response categories (i.e., more categories existed in the scale than were needed to describe the construct).[19,22] In particular, category diagnostics evidenced the inability of respondents to appreciably discern between categories 2 (rarely) and 3 (some of the time) and between categories 4 (most of the time) and 5 (all of the time) and later confirmed the appropriateness of collapsing them into two single categories indicating "sometimes" and "most/all of the time." This modification makes sense, eliminates the redundancy of underused rating categories, and ensures that each rating category is distinct from the others.[24,32] Similar problems and solutions with scales using adjectival descriptions of frequency and discrete responses have been illustrated by Bond and Fox[24 (p 166)] and Zhu.[37]

Four ABIS items proved to be "misfitting": their values suggested erratic response patterns. The misfitting could have been attributable—among other reasons—to their being part of another construct, being poorly written, or being too sensitive to confounding factors.[23,24] We used a careful approach to item deletion that was based not only on the criterion of Rasch fit statistics but also on expert analysis of the item content and presentation, to guarantee the face, content, and clinical validity of the shortened scale.[38] That stated, we suggest the elimination of the four misfitting items (because of their major threat to validity) for both statistical and content reasons. They are:

- Item 2: "I avoid wearing shorts in public because my prosthesis would be seen"; and item 17: "I wear baggy clothing in an attempt to hide my prosthesis." The wearing of clothes may be influenced by factors other than body image. This task is also sensitive to cultural and environmental (including geographical) factors.
- Item 16: "I like the appearance of my stump anatomy." It is possible that the way in which this item is phrased may render it sensitive to confounding factors; for instance, a significant proportion of people experience stump pain.[39] However, the shape and appearance of the residual limb is a potentially important aspect of body image, and this element is retained in item 20, which remains in the ABIS-R.
- Item 19: "It is important that my prosthesis and remaining anatomy of my affected limb are the same size as the other limb." We do not think that the element of "body size distortion" is as relevant to people with an amputation, nor is it a significant part of their concept of body image.

One item was "overfitting" (MnSq < 0.60)—that is, open to interpretation as redundant or failing to discriminate persons with different levels of ability.[23,24] Overfitting items contribute little extra information beyond that provided by other items in the scale.[22] However, the decision to remove, retain, or substitute overfitting items should be made on the basis of clinical reasoning. In our opinion, because the aspects covered in the overfitting item (item 11: "The loss of my limb makes me think of myself as disabled") are also covered by remaining items, we would suggest removing it from the scale. Indeed, concerns about the reduction of functional capabilities are also found in items 4, 9, 13, and 15 (see Appendix). Furthermore, we suggest the removal of item 7 ("I experience a phantom limb") on conceptual grounds. Because the majority of people with an amputation experience phantom limb pain, this item is unlikely to distinguish between people who are and are not experiencing body image disturbance. Moreover, this item was that with the lowest item–total correlation ($r = 0.30$), and some authors consider as satisfactory only a correlation of 0.40 or higher.[40]

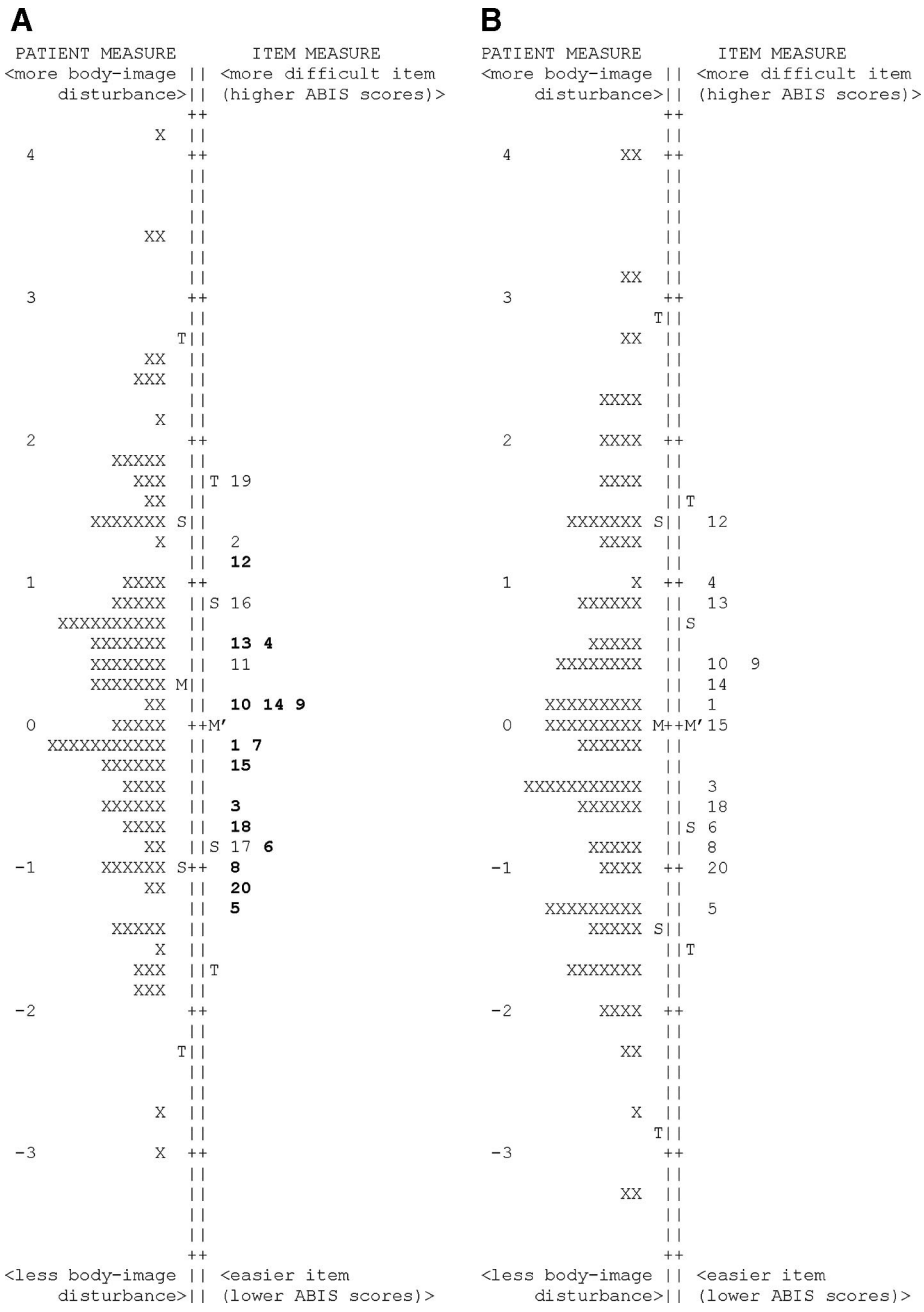

FIGURE 2 *Person-ability and item-difficulty maps of the ABIS (*A*) and ABIS-R (*B*). In each map, the* double vertical line *represents the measure of the variable, with the units of measurement on the scale (logits, the natural logarithm of the odds of mutually exclusive alternatives; e.g., pass* vs. *fail, or higher response* vs. *lower response). The lefthand column locates the individual person's performance along the variable: each person is indicated by an "X." The righthand column locates the item difficulty measures along the variable (the difficulty estimate represents the mean calibration of the threshold parameters according to the rating-scale model, with values opposite those from Table 2). Each item is indicated by its number (see Appendix); fitting items are in bold. The top of the scale represents greater body image disturbance (patient measure) and greater item difficulty (higher item raw score). By convention, the average difficulty of items in the test is set at 0 logits (and indicated with M'); items with negative signs are easier than average, and those with positive signs are harder than average. Accordingly, a candidate with average ability is indicated with M.*

Despite the considerable item reduction from ABIS, the ABIS-R showed a large logit range in person ability (7.20 logits, from –3.21 to +3.99) and a reasonable logit range of item difficulty (2.70 logits, from –1.47 to +1.23) (Fig. 2B); this indicates a great spread of both person measures (as defined by the selected items) and item difficulties (as characterized by the sample under study). Av-

TABLE 3 Correlation between the original Amputee Body Image Scale (ABIS) and revised Amputee Body Image Scale (ABIS-R) and each of the Trinity Amputation Prosthesis Experience Scales (TAPES) subscales

	ABIS 20	ABIS-R
Aesthetic satisfaction subscale ($n = 119$)	$r = -0.27$ $P < 0.005$*	$R = -0.22$ $P < 0.05$*
Weight satisfaction subscale ($n = 121$)	$r = -0.23$, $P < 0.01$*	$R = -0.23$, $P < 0.01$*
Functional satisfaction subscale ($n = 120$)	$r = -0.41$, $P < 0.0001$*	$R = -0.37$, $P < 0.0001$*
Athletic activity-restriction subscale ($n = 114$)	$r = 0.17$, $P = 0.07$	$R = 0.19$, $P < 0.05$*
Functional activity-restriction subscale ($n = 113$)	$r = 0.30$, $P < 0.001$*	$R = 0.31$, $P < 0.001$*
Social activity-restriction subscale score less work ($n = 120$)	$r = 0.40$, $P < 0.0001$*	$R = 0.43$, $P < 0.0001$*
General adjustment subscale ($n = 126$)	$r = -0.57$, $P < 0.0001$*	$R = -0.54$, $P < 0.0001$*
Social adjustment subscale ($n = 123$)	$r = -0.44$, $P < 0.0001$*	$R = -0.40$, $P < 0.0001$*
Adjustment to limitations subscale ($n = 116$)	$r = -0.30$ $P < 0.001$*	$R = -0.26$ $P < 0.005$*

erage person ability (M) was also at the same level as average item difficulty (M′), which denotes that the instrument was well matched to the sample under study. Moreover, person abilities are normally distributed along the continuum, and items tap well into a range of levels of body image disturbances, without significant redundancy or considerable gap in their difficulty estimates (Fig. 2B). Finally, no floor or ceiling effects have been found. In addition, the reliability values indicate that ABIS-R has an acceptable internal consistency (particularly for making group comparison) and a high ability to define a distinction hierarchy of items and persons along the measured construct. Items were distributed into more than six difficulty strata, and their high separation reliability (0.95) indicates that high confidence can be placed in the replicability of item placement across other samples. Furthermore, items of ABIS-R were able to distinguish three levels of body image disturbances (absent, low, high) in this sample of people with a lower-limb amputation. Overall, these findings show that ABIS-R presents a series of sound psychometric properties.

The pattern of the item difficulty estimates in the righthand columns of Figure 2B also provides a description of some characteristics of feelings and concerns about body image in this population, as defined by the ABIS-R questions. For example, items in the upper part of the column (e.g., item 13: "When I am walking, people notice my limp"; item 4: "It concerns me that the loss of my limb impairs my body's functional capabilities in various activities of daily living"; and items 10 and 14: ". . . I avoid situations where my physical appearance can be evaluated by others") are more likely to obtain higher ratings (i.e., answers in category 1 [sometimes] and 2 [more/all of the time]) than items in the lower part of the column (e.g., items 5 and 20: "I avoid looking into a full-length mirror . . .") or in the upper part but reverse scored (e.g., item 12: "I like my physical appearance when not wearing my prosthesis). Several characteristics of this ordering are consistent with clinical experience and support the face validity of the item hierarchy. For example, the physical appearance when not wearing a prosthesis (item 12), the concerns about the impairment of body's functional capabilities in various activities of daily living produced by a limb loss (item 4), and the worries that "people notice my limp, when I'm walking" (item 13) are expected to be potential sources of distress for people with lower-limb amputations. On the contrary, the avoidance of looking into a full-length mirror in order *not* to see one's own prosthesis (item 5) or stump anatomy (item 20) is expected to be infrequent in most people with a lower-limb amputation. In addition, the two pairs of similar items (items 5 and 20; items 10 and 14) occurred in the expected order of difficulty (Fig. 2B).

Construct Validity

The revised scale still contains items that relate to affective (e.g., item 1), cognitive (e.g., item 18), and behavioral (e.g., item 10) components of body image as outlined by Breakey[12] (See Appendix). The validity of the ABIS-R was also affirmed in

that similar relationships between the original ABIS and the ABIS-R with the TAPES subscales emerged despite the reduction in items. The relationships between the ABIS-R and each of the TAPES subscales were also in the hypothesized direction.

The moderate correlations between the ABIS-R and the "prosthesis satisfaction" subscales of the TAPES are not surprising and are consistent with the findings of Murray and Fox.[15] As the prosthesis plays an important cosmetic and social role, in addition to a functional role, it is expected that a greater level of satisfaction with the prosthesis is associated with lower levels of body image disturbance. This association can be better appreciated if client satisfaction is considered as a concept related to the extent to which the features of prosthetic care received meet the client's expectations, and if body image is considered as the portion of one's self-concept that involves attitudes and experiences pertaining to the body that influence the individual's subjective well-being. Thus, the personal background expectations and their perceived degree of fulfillment might be the shared underlying variable.

The association between ABIS-R and the activity-restriction subscales of TAPES was also in the expected direction; that is, lower levels of body image disturbance were associated with lower levels of activity restriction. This finding is consistent with Wetterhahn et al.,[14] who identified a positive relationship between regular participation in physical activity and body image among people with lower-limb amputations. Furthermore, Fisher and Hanspal[41] recorded a significant correlation between body image and mobility in younger people with traumatic amputations. Indeed, Van Deusen[42] postulated that body image distortion interferes with body movements that are necessary for daily activities to be performed. Finally, the correlation between the ABIS-R and the psychosocial adjustment subscales of the TAPES confirms the relationship between the body images of people with amputations and psychosocial adjustments to leg amputations found by Rybarcyzk et al.,[11] Breakey,[12] and Murray and Fox.[15]

CONCLUSION

The 14-item ABIS-R demonstrates good psychometric characteristics for measuring body image disturbances in people with lower-limb amputations. Although these preliminary results suggest the adequacy of the new instrument, further studies are needed to analyze the actual performance of the new response structures and to confirm its measurement properties in other samples, thereby adding clinical validity to the instrument. Furthermore, a reasonable next step would be to assess whether ABIS-R items have different levels of difficulty (differential item functioning) on the basis of a sample characteristic such as gender or amputation level.

APPENDIX

Amputation Body Image Scale (ABIS). The 20-item questionnaire that, in the original version, was scored by a five-level ordinal scale (1 = none of the time, 2 = rarely, 3 = some of the time, 4 = most of the time, 5 = all of the time). Three of the questions (3, 12, and 16) are reverse scored. The 14 items of the shortened version (ABIS-R) are in bold, and their new scoring is 0 = none of the time, 1 = sometimes, and 2 = most/all of the time.

1. **Because I am an amputee, I feel more anxious about my physical appearance in social situations than when I am alone.**
2. I avoid wearing shorts in public because my prosthesis would be seen.
3. **I like my overall physical appearance when wearing my prosthesis.**
4. **It concerns me that the loss of my limb impairs my body's functional capabilities in various activities of daily living.**
5. **I avoid looking into a full-length mirror in order *not* to see my prosthesis.**
6. **Because I am an amputee, I feel anxious about my physical appearance on a daily basis.**
7. I experience a phantom limb.
8. **Since losing my limb, it bothers me that I no longer conform to society's idea of normal appearance.**
9. **It concerns me that the loss of my limb impairs my ability to protect myself from harm.**
10. **When I am *not* wearing my prosthesis, I avoid situations where my physical appearance can be evaluated by others (e.g., I avoid social situations, swimming pool or beach activities, etc.).**
11. The loss of my limb makes me think of myself as *disabled*.
12. **I like my physical appearance when *not* wearing my prosthesis.**
13. **When I am walking, people notice my limp.**
14. **When I am wearing my prosthesis, I avoid situations where my physical appearance can be evaluated by others (e.g., I avoid any social situations, and/or I avoid swimming pool or beach activities etc.).**
15. **People treat me as disabled.**
16. I like the appearance of my stump anatomy.
17. I wear baggy clothing in an attempt to hide my prosthesis.

18. I feel I must have four normal limbs to be physically attractive.
19. It is important that my prosthesis and remaining anatomy of my affected limb are the same size as the other limb.
20. I avoid looking into a full-length mirror in order *not* to see my stump anatomy.

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