The Impact of the Severity of Vision Loss on Vision-Related Quality of Life in India: An Evaluation of the IND-VFQ-33

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PURPOSE. To validate the 33-item Indian Vision Functioning Questionnaire (IND-VFQ-33), a vision-specific scale, and determine the relationship between the severity of vision impairment (VI) and vision-related quality of life (VRQoL).

METHODS. In this cross-sectional, observational study 273 participants with VI from cataract were recruited from a South Indian eye hospital. Participants underwent a clinical examination and completed the IND-VFQ-33 scale. The psychometric properties of the IND-VFQ-33 and its subscales were assessed using Rasch analysis, exploring key indices such as instrument unidimensionality, discriminant ability, and targeting of item difficulty to patient ability.

RESULTS. Rasch analysis demonstrated the validity of the IND-VFQ-33 to assess VRQoL through four subscales (i.e., vision-specific mobility, activity limitation, psychosocial impact, and visual symptoms), but not as an overall measure. In adjusted multivariate analysis models, those with severe VI and blindness led to a clinically meaningful decline in vision-specific mobility and activity limitation. This finding remained significant in a direct comparison between impaired vision and VRQoL has been well documented in developed countries, but little information is available for developing countries. Visual acuity (VA) and other clinical measures do not adequately reflect the impact of vision impairment on patients’ lives, which is why the use of patient reported outcomes (PROs) such as vision-specific functioning or VRQoL alongside clinical evaluation has increasingly been recognized as an integral part of patients’ health assessment and evaluation of medical interventions.

Few PRO measures have been developed specifically for use in developing countries. It is important to use a culturally valid questionnaire in such settings, which contains items that are relevant for people who may be illiterate and whose visual requirements to perform activities of daily living are very different from those of people in developed countries. One instrument that is available to measure VRQoL in developing countries is the 33-item Indian Vision Function Questionnaire (IND-VFQ-33). This scale has been developed from focus group discussions with Indian patients; has a concise format; is easy to administer; and has been validated using traditional validation techniques such as classical test theory (CTT), which has shown it to possess adequate psychometric properties. However, CTT has several limitations compared with modern psychometric methods such as Rasch analysis, a form of item response theory that is the current gold standard in assessing psychometric instruments. To date, Rasch validation of the IND-VFQ-33 or any other VRQoL questionnaires for use in developing countries has not been performed.

In this study, we first determined the validity, reliability, and measurement characteristics of the IND-VFQ-33 for use in an Indian patient sample with vision impairment using Rasch analysis. Second, we investigated the relationship between the severity of vision impairment and VRQoL in that sample.

METHODS

This cross-sectional, and observational study took place from March until July 2009 at the Sankara Eye Care Institutions, Coimbatore, India.

Recruitment

Participants were recruited from cataract outreach eye clinics and from the general hospital before undergoing cataract surgery. All participants had their distance VA tested using a logarithm of minimum angle of resolution (logMAR) numbers or tumbling E chart at 6 m without correction and with pinhole, and had a basic eye examination to determine the cause of visual loss. Patients were subjected to a more
The IND-VFQ-33

The IND-VFQ-33 contains 33 questions (items) related to the degree of difficulty in performing vision-dependent activities (e.g., reading, climbing stairs), psychosocial impact (e.g., fear, anxiety), and visual symptoms (e.g., glare, pain), which form three subscales (general functioning scale, psychosocial impact scale, and visual symptoms scale) (Table 1).11,12 Each item has four to five active response options targeting difficulty or frequency using Likert scaling ranging from no problems at all to cannot do this because of your vision (five response categories) or from no problems at all to a lot (four response categories). One additional response option represents "nonapplicable." Responses were coded as recommended by the developers. "Not applicable" responses were treated as missing data in the analysis. Higher scores represent poorer visual functioning (i.e., more difficulty) and, therefore, less ability in performing the activity. The original IND-VFQ-33 questionnaire was developed in the same state (Tamil Nadu) in which this study was conducted, in the local language (Tamil) spoken in the region, with a sample of patients visually impaired by cataract.11 Thus, no cultural or linguistic adaptation of the scale was necessary for this study. Approval to use the copyrighted IND-VFQ-33 was obtained from the Lions Aravind Institute of Community Ophthalmology.

Psychometric Validation of the IND-VFQ-33

Rasch analysis is a modern psychometric method that mathematically describes the interaction between respondents and test items. The Rasch model states that the probability of a correct response is a logistic function of the difference between person ability (person measure) and item difficulty (item measure) and applies a strict model that the pattern of participants' responses should satisfy.19–22 Estimates from matrices of response data based on the model are obtained, and raw ordinal scores are thus transformed into data that approximate interval-level measurement (expressed in log of the odds units, or logits). A high person measure (in logits) indicates that a person possesses a high level of the assessed latent trait (e.g., VRQoL).21,23–24 To ease interpretation, the rating scale of the IND-VFQ-33 was reversed for Rasch analysis so that patients with a high level of VRQoL were given the highest scores. Rasch analysis also provides insight into the psychometric properties of a scale, such as how well items fit the underlying latent trait being measured, how well items discriminate between the respondents, how well item difficulty targets person ability, and the appropriateness of the response scale used.25

Rasch analysis was undertaken to validate the IND-VFQ-33 questionnaire using appropriate software (Winsteps, version 3.68; Chicago, IL).26 The Andrich rating scale model27 was used and two rating scales were applied, the first to items 1 to 21 and the second to items 22 to 33 because these groups of items shared the same item and response
option characteristics. Several key indicators assessing the psychometric properties of the IND-VFQ-33 were examined. We assessed the response category threshold ordering by visually checking for disordered thresholds. Disordered thresholds can result when certain response options are underutilized by participants. Disordered thresholds can cause significant item and model misfit, and thus collapsing response categories may be necessary to improve model fit. The scale’s ability to discriminate different strata of person ability was then assessed using the Person Separation Index (PSI) and Person Reliability (PR) coefficient. A PSI value of 2.0 and PR coefficient of 0.8 indicate that the scale can successfully distinguish three levels of person ability, which is the minimum level for a satisfactory scale. A major requirement of the Rasch model is unidimensionality, that is to say that a scale measures a single underlying latent trait and that the items “fit” the underlying trait. The two parameters of unidimensionality are item fit statistics and testing the assumption of local independence. The key statistic assessing item fit is the mean square standardized residuals (MNSQ), and items with an MNSQ value of 0.7–1.3 are considered acceptable. Values < 0.7 may indicate redundancy and values > 1.3 indicate an unacceptable level of “noise” in the responses. To test for local independence, the principal components analysis (PCA) of the residuals was examined. The first factor should explain at least 50% of the variance and the first contrast of the residuals (i.e., the second dimension) should be <2.0 eigenvalues. A value of >2.0 is considered greater than that observed in random data and may suggest the existence of another dimension. In the case of multidimensionality, the conventional approach is to identify the largest positive PCA standardized residual loadings (i.e., loading value >0.4) on the first contrast to determine whether certain items are loading substantially. The content of any positively loading items was examined to assess whether there was evidence to split the scale and form a conceptually relevant second dimension to be analyzed separately.

How well item difficulty targets person ability is assessed through visual inspection of the person-item map and the difference between person and item mean logits. In a perfectly targeted instrument, the difference in means would be 0; a difference of >1.0 logits indicates notable mistargeting. Poor targeting occurs when persons generally have a higher or lower ability than the most or least item difficulty threshold, or when items are clustered at particular levels of difficulty, leaving large gaps.

Finally, we assessed for differential item functioning (DIF), which occurs when sample subgroups, such as sex or age group, systematically respond differently to an item despite having similar underlying ability. A DIF contrast of >1.0 logits is notable and suggests that the interpretation of the scale differs by group and may be biased.

To facilitate the interpretation of the person measure scores, they were recalibrated from a negative–positive scale (in logits) to range between 0 and 100 for all subscales, with a higher score indicating better VRQoL.

Statistical Analysis

Statistical software (SPSS, version 16.0; SPSS Science, Chicago, IL) was used to analyze the data. Descriptive statistical analyses were performed to characterize the participants’ sociodemographic, clinical, and IND-VFQ-33 data. The overall and subscale scores of the IND-VFQ-33, as suggested by the developers and then modified guided by Rasch analysis, were the main outcomes examined. Linear regression models were conducted to determine the independent factors associated with vision-specific functioning (mobility and activity limitation), emotional well-being, and symptoms. Cases with missing data were excluded from analyses pertaining to these missing variables. Only cases with complete data for all necessary variables were included in multivariate analyses. The covariates adjusted for in multivariate analyses were those found to be univariately associated with the subscale scores (i.e., age, sex, education, work status, and visual impairment). VA was categorized into four categories: normal presenting vision in the better eye (≤0.3 logMAR), mild visual impairment (0.3 < logMAR < 0.5), moderate visual impairment (1.0 > logMAR ≥ 0.5), and severe visual impairment and blindness (logMAR ≥ 1.0). Factors independently associated with VRQoL were considered to be clinically meaningful if the confidence interval (CI) limits of their beta coefficients were approximately half the SD of the overall mean. This is generally considered a useful estimate of clinical significance.

RESULTS

Sociodemographics and Clinical Characteristics of the Participants

Of the 273 participants, approximately half were female (47%) and older than 60 years (59%) (Table 2). Most participants had no or just primary school education (77%), and just under half were currently working (45%). The mean ± SD age and best-corrected VA in the better eye were 59 ± 9 years and 0.74 ± 0.45 logMAR (20/100 Snellen), respectively. All participants had cataracts and most were at least moderately visually impaired (65%).

Psychometric Validation of the IND-VFQ-33 Questionnaire

The data of the IND-VFQ-33 were fitted to the Rasch model and the main validation indices were explored (Table 3). The 33-item IND-VFQ scale had disordered thresholds in its first rating scale, suggesting that the clarity and/or number of response categories was suboptimal. Consequently, categories 2 and 3 (a little and quite a bit) were collapsed, resulting in four final response options for each rating scale. The capacity for the scale to function as an overall measure was then explored, although its psychometric properties were suboptimal (Table 3). Consequently, the three subscales as proposed by the developers were separately assessed.

For the general functioning scale, the PSI and PR scores were 4.24 and 0.95, respectively, indicating that the scale was able to distinguish between four or more strata of vision-specific functioning. However, although the PCA for the first factor explained >60% of the variance, the unexplained variance in the first contrast of the residuals was 3.0, suggesting evidence of multidimensionality, and two items (items 5 and 9) demonstrated substantial misfit (MNSQ > 1.3). Analysis of the standardized residual loadings for items in the PCA revealed a set of items loading together (>0.4) pertaining to mobility. Thus, the overall general functioning scale was split into a mobility and an activity limitation scale (Table 1). Both new scales demonstrated unidimensionality, the activity limitation scale only after removal of several misfitting items (eigenvalue first contrast 1.9 and variance by first factor > 60% for both scales; Table 3), and good discriminant ability. However, although the mobility scale did not have any misfitting items, several others were identified in the activity limitation scale (5, 6, 9, 15, 16; infit MNSQ values > 1.3) and these were iteratively deleted until no misfitting items remained. The targeting of both the mobility and activity limitation scales was suboptimal (person mean, 2.94 and 1.93, respectively; Table 3), but this is most likely due to the considerable proportion of patients with no or only mild visual impairment.

For the psychosocial impact and the visual symptoms scales, the PSI and PR scores were 2.00 and 0.80, and 2.24 and 0.83, respectively, indicating that these two scales were able to distinguish between three strata of patients’ vision-specific functioning (Table 3). Visual inspection of the person–item map for the psychosocial impact scale indicated suboptimal targeting because perceived participant ability was higher than the visual ability required to undertake the items. Therefore, persons with extreme scores at the high spectrum of ability
level were deleted from the analysis, which improved the overall target; however, since this did not improve other fit statistics, these highly able participants were retained in the final analysis. Targeting of the symptoms scale was adequate. No misfitting items were detected for either the psychosocial or symptoms scales. Finally, there was no evidence of multidimensionality for the psychosocial and visual symptoms scales.

No misfitting items were detected for either the psychosocial or visual symptoms scales. In this sample (Table 3), no significant DIF factors for factors such as age, sex, and visual impairment was found for any item. Taken together, these fit parameters indicate that the four subcales of the IND-VFQ are valid, reliable, and unidimensional and can be used to assess the impact of visual impairment on VRQoL.

The participants’ mean ± SD scores for the IND-VFQ mobility, activity limitation, psychosocial impact, and visual symptoms subscales were, respectively, 51.92 ± 23.51, 61.88 ± 23.78, 60.82 ± 18.81, and 64.30 ± 17.79. Factors independently associated with VRQoL were therefore considered to be clinically meaningful if the CI limits of their beta coefficients were >12 or <−12, >12 or <−12, >9.5 or <−9.5, and >9 or <−9 for the mobility, activity limitation, psychosocial impact, and visual symptoms subscales, respectively, which is approximately half the SD of the overall mean.

**Relationship between Vision Impairment and Vision-Related Quality of Life**

The mean score of vision-specific mobility (mean, 51.92) was lower than that of vision-specific activity limitation (mean, 61.88).
61.88), emotional well-being (mean, 60.82), and visual symptoms (mean, 64.50) scores. Those with normal vision \( (n = 31) \) reported significantly better vision-specific mobility and emotional well-being as well as fewer visual symptoms than those of visually impaired participants \( (n = 242) \) (all \( P < 0.004; \) Table 2). In addition, working participants reported a higher mean vision-specific mobility, vision-specific emotional well-being, and fewer visual symptoms compared with those reported by nonworking participants (all \( P < 0.005; \) Table 2). A lack of formal education (no schooling) was also associated with poorer vision-specific mobility (trend at \( P = 0.058; \) Table 2).

In adjusted multivariate analysis models controlling for all variables listed in Table 4, only severe vision impairment and blindness remained independently associated with the vision-specific mobility and activity limitation subscales (all \( P < 0.05; \) Table 4). Those with severe visual impairment and blindness had significant, clinically meaningful reductions in vision-specific mobility and activity limitation (mean change, \(-18.82, P = 0.007 \) and \(-29.48, P < 0.001\), respectively). Additionally, a lack of formal education (no schooling) was associated with poorer vision-specific mobility, and schooling up to the completion of primary school was associated with worse visual symptoms (Table 4). No variables were associated with the psychosocial impact subscale scores.

**DISCUSSION**

We investigated the relationship between the severity of visual impairment and VRQoL in a sample of cataract patients awaiting cataract surgery in South India. Using four Rasch-validated subscales of the IND-VFQ questionnaire (vision-specific mobility, activity limitation, psychosocial impact, and visual symptoms) we found that severe vision impairment and blindness (but not mild or moderate VI) were independently associated with poorer vision-specific mobility and activity limitation. Similar to no or limited schooling was associated with worse vision-specific mobility and visual symptoms scores. This finding reflects the present protocol for cataract surgery referral in developing or transitional countries, where priority is given to patients with at least moderate to severe VI.

Our finding that severe visual impairment and blindness from cataract impacts on vision-specific mobility and activity limitation are supported by a number of studies, both in developed and in developing countries. In India, Nirmalan and colleagues found worse presenting vision in the better eye to be associated with poorer quality of life and vision-specific functioning in an elderly, rural population in South India using a VRQoL instrument validated for use in that population. In addition, participants with glaucoma and age-related cataract had an associated decrease in quality of life and vision-specific functioning, independent of VA. Another study in a neighboring state of India using a 16-item vision functioning questionnaire found that worse VA in the better seeing eye was independently associated with poorer vision-specific functioning, as was the presence of glaucoma, corneal, or retinal disease. Similar results were also found using an adaptation of the WHO health-related QoL instrument. Unlike in our study, moderate VI was also associated with poorer vision-specific functioning in all studies. However, as in our study, mild VI was not associated with a decline in reported vision-specific functioning. This differs from findings from developed countries where even mild VI has been found to be associated with poor vision-specific functioning and VRQoL.

This finding reflects the present protocol for cataract surgery referral in developing or transitional countries such as India, where priority is given to patients with at least moderate to severe VI. The decision of patients to accept recommended cataract surgery is based on a complex set of factors, including individually perceived levels of vision-specific functioning and quality of life, which may not be affected until VI has progressed to the more severe stages. Therefore, it is important that individual evaluations for cataract surgery referrals include both an assessment of presenting VA and a subjective assessment of each patient’s level of restriction in daily functioning.

Educational deprivation has been shown to be an integral part of human poverty. Our finding that no or lower levels of formal education were independently associated with poorer vision-specific mobility and more visual symptoms reflect findings from similar studies in India, emphasizing the need to focus on those at the lowest level of socioeconomic standing within present cataract surgery programs.

The fact that we did not find an association between vision impairment and emotional well-being is contrary to many studies in low-vision samples in developed countries and developing or transitional countries such as India. One plausible explanation for this discrepancy in our findings is that the original IND-VFQ was designed to be used with visually impaired cataract patients only, whereas in our study there were a number of patients who were not or only mildly visually impaired. At only five items, the vision-specific emotional well-being subscale of the IND-VFQ may simply be too short and lacking enough content to be able to detect vision-related impact in this sample. Similarly, this subscale may not function adequately in other sample populations and should be applied with caution. Future research could reassess the psychosocial impact scale of the IND-VFQ and produce a more sensitive vision-related emotional well-being subscale for use in cataract patients in India. Another reason may be that a large proportion of this sample had previous experience with cataract surgery and knowledge of its potential to improve vision, which may have mitigated the impact of vision impairment caused by cataract on vision-specific emotional well-being in this sample.

We found that the IND-VFQ scale did not conform to the strict requirements of the Rasch model and it was subsequently assessed as four unidimensional subscales. The original General Functioning subscale of the IND-VFQ was split into a set of activity limitation and mobility items, which is not uncommon in other studies assessing vision-specific functioning in cataract patients. Although most of the Rasch indices were satisfactory, three of the four subscales displayed suboptimal targeting, suggesting that participants had a higher ability than that required by the average item difficulty. This is most likely because a third of our sample was normally sighted or only mildly visually impaired and, as evident in the person-item map, there were not enough questions targeting very able participants. The original IND-VFQ was designed for use with visually impaired cataract patients only, and thus the targeting would likely improve in a more visually impaired sample. Overall, the Rasch-validated IND-VFQ was a valid instrument to assess the impact of visual impairment from cataract on vision-specific mobility, activity limitation, emotional well-being, and visual symptoms in this Indian population. The authors recommend using the modified, Rasch-validated IND-VFQ to provide four psychometrically valid measurements of VRQoL in future studies.

The use of Rasch analysis, an important step in modern scale validation to assess the measurement properties of the IND-VFQ, and four parameters of VRQoL, constitute a major strength of this study. Other strengths include the continuum of VA present in this sample, from mild to severe, and the linguistic and cultural relevance of the IND-VFQ to the participants in this study. Moreover, the IND-VFQ was developed using input primarily from cataract patients, and therefore...
Table 4. Differences in the IND-VFQ Subscale Scores by Age, Sex, Education Level, Work Status, and Categories of Vision Impairment in Regression Models

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mobility</th>
<th>Activity Limitation</th>
<th>Psychosocial Impact</th>
<th>Visual Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (95% CI)</td>
<td>P</td>
<td>Mean (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;60 (Reference)</td>
<td>51.40 (46.11, 56.70)</td>
<td>0.365</td>
<td>62.26 (56.49, 68.03)</td>
<td>0.136</td>
</tr>
<tr>
<td>≥60</td>
<td>60 (Reference)</td>
<td></td>
<td>64.7 (-2.04, 14.98)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (Reference)</td>
<td>50.32 (45.58, 55.05)</td>
<td>0.249</td>
<td>61.19 (56.04, 66.34)</td>
<td>0.159</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to completion of high school/</td>
<td>-1.11 (-11.54, 9.31)</td>
<td>0.833</td>
<td>1.79 (-9.57, 13.14)</td>
<td>0.757</td>
</tr>
<tr>
<td>school/university (Reference)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No schooling</td>
<td>-11.30 (-21.43, -1.17)</td>
<td>0.029</td>
<td>-7.06 (-18.09, 3.97)</td>
<td>0.208</td>
</tr>
<tr>
<td>Work status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working (Reference)</td>
<td>54.49 (49.30, 59.68)</td>
<td>0.522</td>
<td>63.69 (58.04, 69.34)</td>
<td>0.748</td>
</tr>
<tr>
<td>Not working</td>
<td>-2.70 (-10.98, 5.59)</td>
<td></td>
<td>-1.47 (-10.50, 7.56)</td>
<td></td>
</tr>
<tr>
<td>Presenting categories of VI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (Reference)</td>
<td>57.96 (49.21, 66.71)</td>
<td></td>
<td>70.20 (60.67, 79.74)</td>
<td></td>
</tr>
<tr>
<td>Mild VI</td>
<td>4.22 (-11.37, 16.20)</td>
<td>0.730</td>
<td>-10.97 (-25.98, 4.04)</td>
<td>0.151</td>
</tr>
<tr>
<td>Moderate VI</td>
<td>3.04 (-10.27, 16.36)</td>
<td>0.652</td>
<td>-8.06 (-22.56, 6.44)</td>
<td>0.274</td>
</tr>
<tr>
<td>Severe VI and blindness</td>
<td>-18.82 (-32.54, -5.11)</td>
<td><strong>0.007</strong></td>
<td>-29.48 (-44.41, -14.54)</td>
<td><strong>&lt;0.001</strong></td>
</tr>
</tbody>
</table>

Coefficients in bold type represent independent variables found to be statistically associated with visual functioning at the 0.05 level.

Coefficients in bold type and underlined represent independent variables found to be statistically associated with visual functioning and clinically meaningful. VI, vision impairment.
the item content is also likely to be very appropriate for this sample. Conversely, our study is limited by its cross-sectional design, which limits our ability to apply causality to our findings, and a moderate sample size that included a number of patients with no significant vision impairment. Thus, future studies would benefit from a longitudinal study design and a greater proportion of patients with low vision. In addition, clinical measures other than VA and/or VA measurements obtained in a more standardized way than at outreach sites or during routine outpatient clinics may better reflect actual levels of functional vision and VRQoL. Because all patients were visually impaired from cataracts, our findings may not be generalizable to other ocular diseases and sample populations.

In conclusion, our study showed that the IND-VFQ is a valid psychometric tool to assess the impact of differing levels of vision impairment on vision-specific mobility, activity limitation, emotional well-being, and visual symptoms. We found a clinically meaningful decline in vision-specific mobility and activity limitation as a result of severe visual impairment and blindness, but not mild or moderate visual impairment. This study reflects the present practice of cataract surgery programs prioritizing surgery for the severely visually impaired and blind.

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Validation of the IND-VFQ-33 6087


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