

Original research

Psychometric properties of the Glaucoma Quality of Life-15 questionnaire: Use of explanatory factor analysis

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Abstract

Purpose: The purposes of this study were to validate the Persian translation of the Glaucoma Quality of Life-15 (GQL-15) questionnaire, evaluate its psychometric properties, and identify new composite items and item numbers.

Methods: This cross-sectional study was conducted from August to November 2016, at the Glaucoma Clinic of the Ophthalmology Department at Shiraz University of Medical Sciences, Iran. One hundred ninety patients with glaucoma were enrolled. Habitual-corrected visual acuity (HCVA), intraocular pressure (IOP), slit-lamp biomicroscopy, fundus exam, and mean deviation (MD) of the visual field were recorded in the course of clinical examination by glaucoma professional. Psychometric properties, i.e. test–retest reliability, internal consistency, content validity, and construct validity were evaluated with factor analysis. Based on the Disc Damage Likelihood Scale (DDLS), patients were stratified to mild, moderate, and severe disc damage. The association between the GQL-15 scores and disease severity (mild, moderate and severe) were evaluated by the analysis of variance (ANOVA).

Results: Of 190 eligible glaucoma patients, reliable clinical data were available for 140 participants. Mean age [standard deviation (SD)] of the patients was 58.7 (13.3) years. Cronbach's α coefficient ranged from 0.74 to 0.91, and the correlation coefficient for total score was 0.53. The content validity ratio (CVR) was 0.91 based on evaluations in expert panel. Exploratory factor analysis (EFA) based on eigenvalue higher than one identified two factors after varimax rotation for the GQL-15 which explained 66.5% of the total variance. Discriminant validity analysis disclosed statistically significant differences in mean quality of life scores between levels of disease severity.

Conclusion: The Persian version of the GQL-15 is a reliable and valid questionnaire for use in glaucoma clinics as a complementary tool for evidence-based decision-making.

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Keywords: Glaucoma; Linguistic validation; Persian; Psychometric properties; Quality of life

Introduction

Glaucoma is a chronic, progressive disease with loss of optic nerve fibers which can lead to permanent visual field damage and blindness.^{1–3} Glaucoma is the second most frequent cause of blindness after cataract. The worldwide prevalence of glaucoma is about 1%–4%, and it affects about 68 million people.^{4–7}

Declaration of interest: None of the authors has any proprietary interests or conflicts of interest related to this submission.

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Important advances have been made in the diagnosis and treatment of glaucoma.⁸ However, the use of multiple drugs and surgical procedures to lower the intraocular pressure (IOP) and long-term follow-up can decrease patients' quality of life and disability-adjusted life-years.^{1,6,8–11} Knowledge about the patient's perceptions and a focus on patient-centered care is crucial because they can lead to more specific care, changes in patients' lifestyle, increased adherence to treatment, and improved doctor–patient communication.^{5,8,9,12–15} Moreover, the US Food and Drug Administration have recently placed emphasis on patient-reported outcome (PRO) measures in clinical studies.¹⁶

In earlier studies, many generic and vision-specific PRO instruments have been used with glaucoma patients.¹⁷ Among these, the Glaucoma Quality of Life-15 (GQL-15) questionnaire is specific, brief, and easy to use, and studies have reported a strong correlation between GQL-15 scores and objective visual indices.^{14,18} It has already been translated and validated in different languages,^{6,14,18} but this instrument (like similar questionnaires about patients' experiences) has elements that are culturally dependent, and to the best of our knowledge, there is no Persian version of the GQL-15. The primary aim of this study was the translation and linguistic validation of the GQL-15; the secondary aim was to evaluate the psychometric properties of the Persian version of this instrument. If its psychometric properties were found to be suboptimal, a provisional third aim was to use exploratory factor analysis (EFA) to identify new composite items and item numbers in the Persian version of the GQL-15.

Methods

Patients and sample size

This cross-sectional study was conducted from August to November 2016. One hundred ninety eligible patients with glaucoma, who were being routinely followed at the Glaucoma Clinic of the Ophthalmology Department at Shiraz University of Medical Sciences, Iran, were enrolled. Sample size was calculated based on empirical rules widely used by experts in this field and on earlier methods which have been mentioned in the literature.^{19,20} Based on a rule of thumb (10-fold number of questionnaire items), a minimum sample of 150 subjects was required. To achieve the required sample size we used a convenience sampling method.

The eligibility criteria were ability to speak and understand Persian, an age older than 18 years, and being followed more than 6 months in the glaucoma clinic prior to enrollment. All patients were re-evaluated again on the day of the study by a glaucoma specialist for confirmation of the diagnosis and staging the glaucoma severity. Patients with primary open-angle glaucoma (POAG), primary angle-closure glaucoma (PACG), and secondary glaucoma were included.

The exclusion criteria were severe psychiatric problems, cognitive impairments (Dementia and Alzheimer), and other eye diseases with vision impairment secondary to other causes (cataract, corneal opacities, and age-related macular degeneration).

The study protocol complied with the tenets of the Declaration of Helsinki, and was approved by the local Ethics Committee at Shiraz University of Medical Sciences. Written informed consent was obtained from all eligible patients after they were informed about the study objectives.

Participant enrollment and ocular examination

Sociodemographic characteristics of the patients were recorded on a data-gathering form and included age, gender, marital status, living situation, educational level, occupation, comorbidities, family history of glaucoma, type of glaucoma, laterality of disease, and disease duration. Before each ophthalmic examination, the main questionnaire (Persian version of the GQL-15) was administered during a face-to-face interview. In the eye clinic, complete ocular examination was done including habitual-corrected visual acuity (HCVA) measurement with the Snellen visual acuity chart, slit-lamp biomicroscopy (Haag-Streit, Bern, Switzerland), IOP with Goldmann applanation tonometry, and fundus exam with a 90-diopter non-contact lens. Visual field examinations with a Humphrey visual field analyzer (Carl Zeiss Meditec Inc., Dublin, CA, USA) (24-2 pattern Swedish Interactive Threshold Algorithm standard) were done for all participants within 4 months of recruitment. Only “reliable” visual field mean deviations were recorded. The severity of glaucoma was graded based on the amount of disc damage estimated with the Disc Damage Likelihood Scale (DDLS). The DDLS is a user-friendly method which correlates accurately with visual field changes, and shows high intra-observer and inter-observer reproducibility.^{21–23} Optic disc damage was graded in three levels: mild (DDLS 1–4), moderate (DDLS 5–7), or severe (DDLS 8–10).

Linguistic validation

The GQL-15 is a 15-item questionnaire divided into four subscales: central and near vision (two items), peripheral vision (six items), glare and dark adaptation (six items), and outdoor mobility (one item). An original version of this questionnaire was formed from 36 questions related to visual disability in daily-life activities. All questions (15 items) were significant predictors of visual field loss in factor analysis.¹² Response categories for each item are ordered from 1 (no difficulty) to 5 (severe difficulty), and 0 represents “abstinence from activity due to non-visual reasons”. Summary scores are reported as the sum of item-level response scores, with higher scores indicating poorer quality of life. Linguistic validation of the Persian GQL-15 was done in three stages based on standardized rules.^{24,25}

For parallel forward translation and reconciliation, two independent professional translators, both of whom were aware of the purposes of the study, translated the GQL-15 from English into Persian. A panel (two translators and two glaucoma experts) compared and discussed both translations. Whenever necessary, changes were made until a consensus was reached regarding the primary translation (Persian version

no. 1). For back translation, a native English-speaking (American) translator who was unaware of the purposes of the study translated Persian version no. 1 back into English. The panel accommodated this version with the original version and prepared Persian version no. 2.

Cognitive debriefing and finalization

A group of 20 patients with glaucoma was selected, and Persian version no. 2 of the questionnaire was administered. To assess the comprehension level of the items for the reference population, the alternative choice “difficult to understand” was added to the response categories for each item. If more than 10% of the patients chose this response, the item was regarded as “difficult to understand” and retranslated or rewritten until it was found acceptable by 90% of the professionals in the review panel.

Statistical analysis

Descriptive statistics including means \pm standard deviation (SD) or proportions (%) were used to determine the distribution of sociodemographic and clinical characteristics according to different stages of glaucoma. Visual field presented based on mean defect of visual field (MD), eyes with greater absolute value were defined as the better eye. HCVA was converted to the logarithm of the minimum angle of resolution (logMAR). Eyes with lesser logMAR value were defined as the better eye.

Reliability

To examine test–retest reliability of the Persian version of the GQL-15, 30 patients who had not switched to new medication or any other procedures were selected randomly and interviewed again 2 weeks after the first visit. We used Spearman's rank correlation coefficient to compare the two sets responses. Correlation coefficients greater than 0.6, between 0.3 and 0.6, and lower than 0.3 indicate high, moderate, and low correlation, respectively.²⁶ Internal consistency of the subscales was evaluated with Cronbach's α coefficient, and values higher than 0.70 were considered optimal.²⁷

Validity

To assess content validity, five experts (two glaucoma specialists and three statisticians) evaluated the relevance of each item, and a content validity ratio (CVR) \geq 0.9 was considered an optimal value.²⁸ Construct validity was evaluated with a confirmatory factor analysis (CFA) method. Based on the results, we used EFA after varimax rotation to identify new composite items and item numbers in the questionnaire. The association between the GQL-15 scores and disease severity (mild, moderate, and severe) was evaluated by the analysis of variance (ANOVA).

All data were entered in the Statistical Package for the Social Sciences version 15.0 (SPSS Inc. Chicago, IL, USA) by a trained operator and double-checked by an investigator.

Values of P less than 0.05 were considered statistically significant. All factor analyses were conducted with version 6.2 of the Mplus software package.

Results

Of 190 eligible patients with glaucoma, reliable clinical data were available for 140 (73%). The mean age (SD) of the patients was 58.7 (13.3) years with a range of 18–85 years, and 64.3% of them were female. Mean duration of the disease was 3.85 ± 4.58 years (range, 0.08 to 30.0 years), and the most prevalent type of glaucoma was PACG (37.4%). The socio-demographic and clinical characteristics of patients with different stages of glaucoma are shown in [Table 1](#).

During the cultural adaptation of the Persian GQL-15 instrument, based on the results of cognitive debriefing, three items (4, 9 and 13) of the glare and dark and peripheral vision subscales needed some modifications. The remaining items were easy to understand for most patients in the pilot study. The final Persian version of the GQL-15 was established with minor revisions to the initial translation.

Cronbach's α coefficient was optimal for all subscales, ranging from 0.74 to 0.91. This test was not applied to the outdoor mobility subscale because it consists of only one item. The correlation coefficients were calculated for the total score (0.53) and each subscale of GQL-15 ([Table 2](#)).

The CVR was 0.91 for five experts in the field. The results of the goodness-of-fit of CFA methods were X^2/df 3.06, root mean square error of approximation (RMSEA) 0.103, comparative fit index 0.761, and Tucker-Lewis Index 0.743. In the EFA, based on eigenvalues greater than one, two factors were extracted after varimax rotation for the GQL-15 which explained 66.5% of the total variance. Factor 1 containing ten questions ($q_1, q_2, q_3, q_5, q_6, q_7, q_9, q_{13}, q_{14}, q_{15}$) and five other questions formed factor 2 ($q_4, q_8, q_{10}, q_{11}, q_{12}$). The Kaiser–Meyer–Olkin statistic (0.93) and Bartlett's test of sphericity ($P < 0.001$) showed that sample size was adequate for the analysis. [Table 3](#) shows the results for the Persian GQL-15 based on EFA.

[Fig. 1](#) shows mean scores of glaucoma quality of life according to stage of glaucoma. Total mean (SD) scores of GQL-15 were 17.2 ± 4.51 for mild, 23.1 ± 12.08 for moderate, and 26.8 ± 12.87 for severe glaucoma. Based on One-way ANOVA, there were statistically significant differences in quality of life scores between the mild and moderate and severe levels of disease severity ($P < 0.001$). Multiple comparisons was done using least significant difference (LSD) post hoc test. We found statistically significant differences in quality of life scores between the mild and moderate (0.008), and between the mild and severe levels (<0.001) of disease severity; however, there was no statistically significant differences between quality of life score in patients with moderate and severe (0.09) glaucoma.

Discussion

Glaucoma has a substantial impact on patients' quality of life because of its nature and life-long treatment. The use of

Table 1

Sociodemographic and visual characteristics of the 140 glaucoma patients according to stage of disease severity.

Variables	Mild (n = 54)	Moderate (n = 36)	Severe (n = 50)	Total (n = 140)
Age (years)	55.63 ± 12.16	56.56 ± 13.55	63.64 ± 13.32	58.73 ± 13.37
Gender, female	45 (83.3)	23 (63.9)	22 (44.0)	90 (64.3)
Marital status, married	49 (84.5)	29 (80.6)	47 (82.5)	118 (84.3)
Living situation, with family	51 (94.4)	34 (94.4)	45 (90.0)	130 (92.9)
Education, secondary	32 (59.3)	23 (63.9)	29 (58.0)	84 (60)
Occupation, retired	33 (61.1)	19 (52.8)	25 (50.0)	77 (55)
Chronic disease, yes	27 (50)	20 (55.6)	24 (48.0)	71 (50.7)
Family history of glaucoma, yes	16 (29.6)	10 (27.8%)	11 (22.0)	37 (26.4)
<i>Type of glaucoma</i>				
POAG	24 (41.4)	16 (44.4)	10 (20.0)	50 (35.7)
PACG	27 (50.0)	11 (30.6)	13 (26.0)	51 (36.4)
Secondary	3 (5.6)	9 (25.0)	27 (54.0)	39 (27.9)
<i>Laterality of disease</i>				
Unilateral	3 (5.6)	6 (16.7)	9 (18.0)	18 (12.9)
Bilateral	51 (94.4)	30 (83.3)	41 (82.0)	122 (87.1)
Glaucoma duration (years)	2.87 ± 4.01	4.25 ± 5.76	4.61 ± 4.05	3.85 ± 4.58
<i>Visual field</i>				
MD better eye (dB)	-0.71 ± 2.10	-2.56 ± 6.57	-12.29 ± 10.93	-4.16 ± 8.11
MD worse eye (dB)	-2.58 ± 5.17	-6.03 ± 7.64	-19.45 ± 10.57	-7.84 ± 10.15
logMAR VA better eye	0.17 ± 0.17	0.17 ± 0.18	0.29 ± 0.28	0.22 ± 0.23
logMAR VA worse eye	0.28 ± 0.25	0.30 ± 0.22	0.59 ± 0.31	0.40 ± 0.30
Higher IOP of both eyes	16.72 ± 3.63	16.17 ± 5.99	18.56 ± 9.13	17.21 ± 6.64
CDR better eye	32.97 ± 11.02	58.00 ± 13.24	74.10 ± 25.15	55.19 ± 25.30
CDR worse eye	35.74 ± 10.58	70.57 ± 9.37	97.60 ± 4.31	68.41 ± 27.90

Data are presented as mean ± standard deviation (SD) or n (%).

POAG: Primary open-angle glaucoma; PACG: Primary angle-closure glaucoma; MD: Mean defect of visual field; IOP: Intraocular pressure; VA: Visual acuity; CDR: Cup-to-disk ratio.

Table 2

Test-retest reliability and internal consistency of the Persian version of Glaucoma Quality of Life-15 (GQL-15).

Subscales	Test-retest reliability (Spearman's rho)	Cronbach's α
Central and near vision	0.50	0.74
Peripheral vision	0.53	0.88
Glare and dark adaptation	0.60	0.91
Outdoor mobility	0.51	—
Total score	0.53	—

Spearman's rho: Spearman's rank correlation coefficient.

subjective measures as a complementary tool that provides objective values can help clinicians reduce the burden of this disease.^{1,17} In this study, we translated and validated a Persian version of the GQL-15. To the best of our knowledge, ours is the first validation study of the GQL-15 in Iran.

Our findings confirmed that the Persian version of the GQL-15 has good homogeneity. The results for internal consistency were in line with Cronbach's α coefficients reported for the original version of the questionnaire and the Chinese GQL-15.^{12,14} Reliability coefficients (Spearman's rho) for the total score and subscale scores were within an acceptable range, but lower than the correlation coefficients reported in other studies.^{12,14,18} The precise time intervals and modes of administration of the questionnaire were not reported in previous studies, but differences in these factors may affect reliability measures.

In terms of content validity, our CVR >0.91 indicated optimal relevance of each item in the questionnaire. Zhou

Table 3

Exploratory factor analysis (EFA) statistics and composite scores for factors in the Persian version of Glaucoma Quality of Life-15 (GQL-15).

GQL-15 Items	Item number in new factors	Items	Factor 1	Factor 2
1	1	Reading newspaper	0.761	0.280
2	2	Walking after dark	0.690	0.484
3	3	Seeing at night	0.811	0.322
4	5	Adjusting to bright lights	0.708	0.263
5	6	Adjusting to dim lights	0.867	0.146
6	7	Going from light to dark room or vice versa	0.732	0.375
7	9	Seeing objects coming from the side	0.626	0.400
8	13	Judging distance of foot to step/curb	0.609	0.554
9	14	Finding dropped objects	0.615	0.577
10	15	Recognizing faces	0.599	0.432
11	4	Walking on uneven ground	0.482	0.646
12	8	Tripping over objects	0.455	0.619
13	10	Crossing the road	0.323	0.738
14	11	Walking on steps/stairs	0.131	0.885
15	12	Bumping into objects	0.305	0.751
Eigenvalue	—	—	8.82	1.16
Variance (%)	—	—	37.72	28.83

GQL-15: Glaucoma Quality of Life-15.

et al. noted the face validity of the final version of GQL-15-CHI¹⁴ but the CVR was not reported in their study.

Regarding construct validity, the CFA method did not confirm the presence of four factors and their item distributions according to the original version of the GQL-15. Based

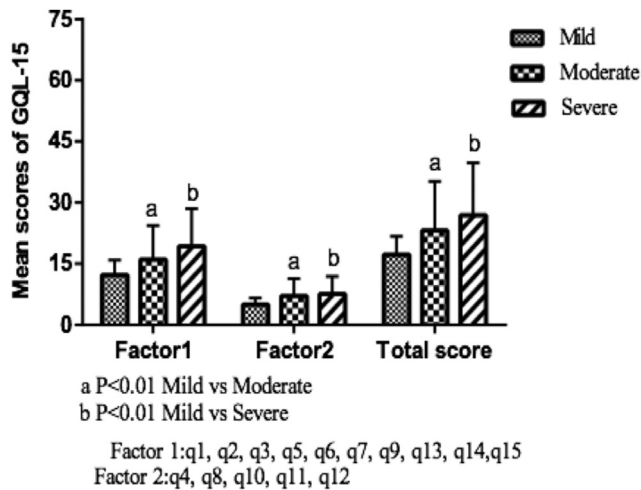


Fig. 1. Mean scores of Glaucoma Quality of Life-15 (GQL-15) according to stage of disease.

on our EFA results approximately, items for the central and near vision subscale merged with items in the glare and dark vision subscale in factor 1, while factor 2 integrated the peripheral vision and outdoor mobility subscales. The results of factor analysis in the validation study of the GQL-15-CHI conformed to the same four dimensions as in the original version, albeit with some differences in item distribution.¹⁴ Khadka et al. optimized the German version of the GQL-15 with Rasch analysis, and proposed a short version named the Glaucoma Activity Limitation (GAL-9) questionnaire.⁶ The explanations for these discrepancies may lie in difference in the sociocultural background of our population, despite questionnaire revision during the cultural adaptation process.

The results of our discriminant validity analysis showed that the Persian version of the GQL-15 discriminated well between patients with two different levels of disease severity: mild vs. moderate and mild vs. severe glaucoma ($P < 0.05$). The discriminatory power of the Persian GQL-15 was similar to the versions developed by Onakoya et al. and Nelson et al.^{5,12} The difference between total mean score in patients with moderate vs. severe glaucoma yielded a P value of 0.09. This borderline result may be related to the lower number of patients with moderate-stage glaucoma (36 patients) than mild (54 patients) or severe disease (50 patients).

Our study had some potential limitations. First, few studies have evaluated the psychometric properties of the GQL-15 in different populations, and this made desirable comparisons difficult. Second, due to the subjective nature of the instrument and the influence of personality factors, information bias cannot be entirely ruled out. Third, we did not compare the results between glaucoma patients and healthy population. Fourth, the sample size was not equal in three categories of disease severity: the number of patients was lower in moderate-stage of glaucoma than the two other categories.

In conclusion, the Persian version of the GQL-15 is a reliable and valid questionnaire for use in ophthalmology clinics as an appropriate complementary tool for evidence-based decision-

making by glaucoma specialists. This simple and immediate measure is also potentially applicable in further clinical research on glaucoma in Persian-speaking populations.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.joco.2017.12.005>.

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