

Validation of Chinese Version of Brace Questionnaire from its Original Greek Version

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Abstract

Purpose: A disease specific Brace Questionnaires (BrQ) has been developed for measuring the quality of life of patients with adolescent idiopathic scoliosis (AIS) who were under brace treatment. The aim of this study was to translate and validate the Chinese version of BrQ from its original Greek version.

Methods: Forward and backward translations of BrQ were performed according to the cross-cultural adaptation process. After translation, 120 subjects with AIS were recruited and asked to fill out the Chinese translated BrQ and the Chinese refined 22-item Scoliosis Research Society questionnaire (SRS-22r). Subjects completed the Chinese translated BrQ again in 1-2 weeks. Demographic data as well as other parameters were collected such as brace wearing duration, brace wearing hours per day (self-reported), in-brace Cobb angles and curve patterns. The reliability and validity were checked by internal consistency and test-retest reliability using Cronbach's alpha, Intraclass correlation as well as Pearson correlation coefficient.

Results: The internal consistency and test-retest reproducibility of the translated BrQ were 0.89 and 0.83 respectively. The Chinese translated BrQ demonstrated concurrent validity as reflected by the significant correlation between the BrQ domains and the relevant SRS-22r domains. The Chinese translated BrQ showed its discriminant validity too. Significant differences were found in the BrQ school activity mean score ($p=0.042$) and social functioning mean score ($p=0.047$) between subject groups: age 12 or below and age 13 or above. Significant differences were also detected in the BrQ domain score including physical functioning ($p<0.001$), emotional functioning ($p=0.002$), vitality ($p=0.004$), bodily pain ($p<0.001$) and social functioning ($p=0.018$) between subject groups with different brace wearing hours (0-8 hours, 9-16 hours and 17-23 hours).

Conclusion: The Chinese translated BrQ showed good validity and reliability. It demonstrated its concurrent validity and discriminatory validity in the AIS population studied.

Keywords: Adolescent idiopathic scoliosis; Brace questionnaire; Cross-cultural adaptation process; Chinese validation; Quality of life.

Introduction

Adolescent idiopathic scoliosis (AIS) affects 1-3% of children aged 10-16 years [1]. In Hong Kong, AIS affects mostly girls with a prevalence of 3 to 4% among adolescents [2]. This is comparable to that of Greater China (5.14%) [3]. This condition is characterized by a 3-dimensional deformity with rotation. Curve progression may occur with growth and in serious cases may cause cardiopulmonary complications. To prevent curve progression, bracing is often prescribed. However, brace treatment may cause physical and psychosocial burdens to patients with AIS and issues related to brace compliance have been reported. To reflect the level to which AIS patients consider brace treatment acceptable, it is essential to assess the effect of physical and psychosocial aspects on brace wearing by deploying an objective assessment tool.

In recent years, measures by which outcomes of various treatment regimens have changed in focus. Quality of life (QoL) is stressed as an outcome measure in the guidelines of many medical societies. QoL can be impaired not only by the deformity itself but also by the disease process. Conservative treatment can contribute to a decreased QoL.

A disease-specific QoL instrument is preferred for monitoring braced patients because it focuses on particular characteristics of AIS. More importantly, disease-specific instruments are considered superior for measurements in homogenous populations because they concentrate primarily on the domains most relevant to the disease and are most responsive to measuring clinically important differences [4]. Therefore, appropriate design and use of condition-specific tools to measure all of the related domains is critical in facilitating the study of QoL among AIS patients.

A disease specific questionnaire – Brace Questionnaire (BrQ) developed by Vasiliadis et al. [5] is a specific questionnaire for measuring the QoL of patients in brace. The BrQ has been reported to be user-friendly, reliable, and with satisfactory internal consistency, reproducibility and responsiveness to change in QoL [5]. BrQ is self-administered and developmentally appropriate for ages 9 to 18. However, no Chinese validation of BrQ has been conducted. Hence, the objectives of this study were to culturally adapt the Greek version of the BrQ to Chinese, to assess the internal consistency, test-retest reliability, construct validity and discriminant validity of this translated questionnaire in patients with AIS.

Methods

Translation of BrQ

BrQ consists of 34 Likert scale items associated with eight domains: general health perception, physical functioning, emotional functioning, self-esteem and aesthetics, vitality, school activity, bodily pain and social

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functioning. According to Vasiliadis et al. [5], all the items chosen were consistent with the need-based theory of QoL. The subscales of these eight dimensions are combined to produce a total score. The items were formulated so that they could be meaningfully answered with the five response categories: "Always", "Most of the time", "Sometimes", "Almost never", "Never". Higher score means better QoL.

The validation was conducted in two phases. In phase I, the questionnaire was translated into traditional Chinese according to the guidelines for a cross-cultural adaptation process [6]. This is the method currently used by the AAOS Outcomes Committee. To do this, forward translation was done by two translators who were bilingual in Greek and Chinese independently without prior knowledge of the questionnaire. They both graduated from a local university in Greece and one of them had worked in the medical field. The translator was chosen to provide equivalence from a clinical perspective [6]. After the translation, they prepared their own translated versions (T1 & T2), and highlighted and resolved any discrepancies. Finally, a written report documenting the reconciliation process together with the synthesized Chinese version (T12) was completed.

To confirm that the translated version reflected the item contents of the original version, a back-translation was required [6]. For this, another two translators were involved. They were graduates of a translation program at a local university in Greece. They were without prior knowledge of the original Greek version of the BrQ, and they were asked to translate T12 back into Greek. Again, they produced their own back translations (BT1 & BT2) and reconciled the differences before submitting a final report. All of the BrQ-related written reports were reviewed by an expert committee. The committee included orthopaedic surgeons, orthotists and nursing professionals. The committee gathered together to reach consensus over any discrepancies. A pre-final version was then produced for pre-testing. In the pre-testing stage, 20 Chinese speaking patients with AIS who attended brace treatment follow-up in a local hospital were asked by convenience to fill out the questionnaires. They were also interviewed about the appropriateness of the contents by Likert scale. This was to ensure the equivalence of the adapted versions. It took less than 10 minutes for each patient to complete the questionnaire. Review of the completed questionnaire confirmed no missing items, and the contents and wordings of the questionnaire were clear and easy to understand.

Validation of BrQ

In phase II, subjects who attended brace treatment follow-up in a local hospital were recruited according to the following inclusion criteria:

- All subjects with diagnosis of AIS
- Aged between 9-18 years
- Patients were prescribed brace treatment (underarm brace) for more than 3 months with 23 hours of brace wearing time per day (self-reported). The Chinese translated BrQ (Appendix I) was administered consecutively to a sample of 120 subjects.

The Chinese version of SRS-22r was also administered to the subjects as the reference questionnaire. The questionnaire consists of 22 questions. It is separated into five domains: function/activity (5 items); pain (5 items), self-perceived image (5 items); mental health (5 items) and satisfaction with treatment (2 items) [7].

The purpose of the study was clearly explained before informed consent was obtained from the subjects and their parents/guardians.

The same group of subjects was asked to fill out the same set of questionnaire again 1-2 weeks later and to return them in pre-addressed envelopes. The demographic information of subjects such as age and sex were collected. Other parameters including brace wearing duration, brace wearing hours per day (self-reported), curve patterns (single thoracic, single thoracolumbar, single lumbar, double thoracic, double thoracic and lumbar, double thoracic and thoracolumbar, triple or more) and in-brace Cobb angles were also collected to detect any correlation between these data and the adapted questionnaire.

Ethical approval

Ethical approval for the study was obtained from the local institutional review board.

Statistical Analysis

Floor and ceiling effects were calculated as the percentage of patients having a maximum, or minimum score, respectively. As highlighted by Asher et al. [7], to provide maximum information about a construct, item difficulty should match the population level and avoid floor and ceiling effects that limit the value of an instrument in measuring change over time or discriminating between different degrees of severity of the conditions being measured. Normality of the BrQ mean scores was also checked in terms of skewness and kurtosis. According to West et al. [8], a reference of substantial departure from normality as an absolute skew value is >2 and as an absolute kurtosis value is >7 .

The Chinese translated BrQ was analyzed for internal consistency of domains by means of Cronbach's alpha. The Cronbach's alpha was used to assess the homogeneity of the items on the questionnaires. It was to check whether the items included were measured the same latent variable and scored it in the same direction. A Cronbach's alpha equal to or greater than 0.9 is considered excellent, 0.80 to 0.89 very good, 0.50 to 0.79 good, and less than 0.5 poor [9].

The test and retest reproducibility was analyzed by means of Intraclass Correlation Coefficient (ICCs). The ICC was used to measure stability. An ICC of 0.75 or greater indicates excellent reproducibility, an ICC between 0.40 and 0.75 indicates fair to good reproducibility, and an ICC <0.4 is considered poor [10].

The concurrent validity was assessed by means of the Pearson correlation coefficient (r). A correlation coefficient of 0.9 or higher indicates very strong correlation, that between 0.7 and 0.9 indicates strong correlation, that between 0.4 and 0.7 indicates moderate correlation, that between 0.2 and 0.4 indicates weak correlation, and that less than 0.2 (very weak) is an indication of lack of correlation [11].

The discriminant validity was analyzed by means of an independent sample t-test and General Linear Model (GLM).

Results

One hundred and twenty subjects filled out the BrQ and SRS-22r questionnaires, of which 4 filled questionnaires were found to be incomplete. Finally, the data of 116 subjects were valid for analysis. There were 93 female and 23 male subjects and their mean age was 13 years (± 1 SD, 1.48 years; range, 9-18 years). Majority (83%) of brace wearing duration was between 3 months and 2 years. The mean brace wearing time per day (self-reported) was 16.2 hours (± 1 SD, 5.06 hours; range 5-23 hours). The mean in-brace Cobb angle was 19° (± 1 SD, 7.9° ; range, $3-40.8^\circ$). There were 5 single thoracic curves, 18 single thoracolumbar curves, 3 single lumbar curves, 4 double thoracic curves, 7 double thoracic and lumbar curves, 53 double thoracic and thoracolumbar

Variables	Mean (± 1 SD)	Minimum value	Maximum value	25 th percentile	50 th percentile	75 th percentile
BrQ total score (20-100)	75.9 (9.67)	51.2	96.5	69.6	77.6	82.9
BrQ general health perception mean score (1-5)	3.4 (0.95)	1.0	5.0	3.0	3.5	4.0
BrQ physical functioning mean score (1-5)	3.5 (0.60)	2.3	4.9	3.1	3.6	4.0
BrQ emotion functioning mean score (1-5)	3.2 (0.74)	1.4	5.0	2.8	3.3	3.8
BrQ self-esteem and aesthetics mean score (1-5)	2.5 (0.91)	1.0	5.0	2.0	2.8	3.0
BrQ vitality mean score (1-5)	3.2 (0.80)	1.0	5.0	2.5	3.0	4.0
BrQ school activity mean score (1-5)	4.3 (0.58)	2.0	5.0	4.0	4.3	4.7
BrQ bodily pain mean score (1-5)	4.6 (0.55)	2.8	5.0	4.3	4.8	5.0
BrQ social functioning mean score (1-5)	4.2 (0.69)	2.0	5.0	3.9	4.3	4.7
SRS-22r mean score (20-100)	81.9 (8.99)	57.3	99.1	77.3	82.7	88.2
SRS-22r function/activity mean score (1-5)	4.4 (0.53)	2.8	5.0	4.2	4.4	4.8
SRS-22r pain mean score (1-5)	4.5 (0.45)	3.0	5.0	4.2	4.4	4.8
SRS-22r self-image/appearance mean score (1-5)	3.5 (0.59)	1.8	5.0	3.2	3.6	4.0
SRS-22r mental health mean score (1-5)	4.1 (0.64)	2.4	5.0	3.6	4.0	4.6
SRS-22r satisfaction with management mean score (1-5)	3.9 (0.78)	2.0	5.0	3.5	4.0	4.5

Table 1: Mean, standard deviations and range of BrQ total score and domain scores, SRS-22r total score and domain scores (N =116).

BrQ Domain	Number of Items	Floor Effect [#]	Ceiling Effect ^{##}
General health perception	2	1 (0.9%)	7 (6.0%)
Physical functioning	7	0 (0.0%)	0 (0.0%)
Emotional functioning	5	0 (0.0%)	1 (0.9%)
Self-esteem and aesthetics	2	14 (12.1%)	1 (0.9%)
Vitality	2	1 (0.9%)	1 (0.9%)
School activity	3	0 (0.0%)	20 (17.2%)
Bodily pain	6	0 (0.0%)	48 (41.4%)
Social functioning	7	0 (0.0%)	15 (12.9%)

[#]Percentage of subjects with lowest scale scores
^{##}Percentage of subjects with highest scale scores

Table 2: Floor effects and ceiling effects of BrQ domains.

BrQ Domain	Cronbach's alpha	SRS-22r Domain	Cronbach's alpha
General health perception	0.70	Function / activity	0.71
Physical functioning	0.52	Pain	0.71
Emotional functioning	0.66	Self-image / appearance	0.71
Self-esteem and aesthetics	0.87	Mental health	0.75
Vitality	0.42	Satisfaction with management	0.63
School activity	0.56		
Bodily pain	0.83		
Social functioning	0.79		

Table 3: Internal consistency of the BrQ domains and SRS-22r domains.

Variables	General health perception	Physical functioning	Emotional functioning	Self-esteem and aesthetics	Vitality	School activity	Bodily pain	Social functioning
Function / activity	0.30 ^{**}	0.44 ^{**}	0.38 ^{**}	0.24 ^{**}	0.42 ^{**}	0.45 ^{**}	0.50 ^{**}	0.49 ^{**}
Pain	0.23 [*]	0.41 ^{**}	0.31 ^{**}	0.06 [#]	0.36 ^{**}	0.37 ^{**}	0.57 ^{**}	0.30 ^{**}
Self-image / appearance	0.33 ^{**}	0.33 ^{**}	0.44 ^{**}	0.30 ^{**}	0.38 ^{**}	0.44 ^{**}	0.37 ^{**}	0.46 ^{**}
Mental health	0.46 ^{**}	0.49 ^{**}	0.55 ^{**}	0.32 ^{**}	0.58 ^{**}	0.40 ^{**}	0.50 ^{**}	0.56 ^{**}
Satisfaction with management	0.23 [*]	0.10 [#]	0.51 ^{**}	0.14 [#]	0.27 ^{**}	0.17 [#]	0.18 [#]	0.43 ^{**}
In-brace Cobb angle	-0.04 [#]	-0.003 [#]	-0.07 [#]	-0.07 [#]	-0.10 [#]	-0.04 [#]	-0.05 [#]	-0.13 [#]

^{**}Correlation is significant at the 0.01 level (2-tailed)
^{*}Correlation is significant at the 0.05 level (2-tailed)
[#] No significant correlation

Table 4: Correlation between BrQ domains and SRS-22r domains & in-brace Cobb angle.

Variables	Age ≤ 12	Age ≥ 13	p-value
	(n=73)	(n=43)	
School activity score	4.19 ± 0.64	4.43 ± 0.43	0.030
Social functioning score	4.33 ± 0.63	3.98 ± 0.73	0.007

Table 5: BrQ domain score between different age groups.

Predictors	Regression Coefficient	p-value	95% C.I.
Brace wearing hours			
Group 1: 0-8	-0.958	<0.001	(-1.321, -0.594)
Group 2: 9-16	-0.297	0.043	(-0.585, -0.10)
Group 3: 17-23	0		
Age	0.102	0.026	(0.12, 0.192)

Table 6: Analysis of BrQ physical functioning score among subjects with different brace wearing hours, adjusted for age

Predictors	Regression Coefficient	p-value	95% C.I.
Brace wearing hours			
Group 1: 0-8	-0.636	0.014	(-1.139, -0.134)
Group 2: 9-16	-0.212	0.290	(-0.609, 0.185)
Group 3: 17-23	0		
Age	-0.017	0.790	(-0.141, 0.108)

Table 7: Analysis of BrQ emotional functioning score among subjects with different brace wearing hours, adjusted for age

Predictors	Regression Coefficient	p-value	95% C.I.
Brace wearing hours			
Group 1: 0-8	-0.721	0.001	(-1.135, -0.306)
Group 2: 9-16	-0.123	0.456	(-0.451, 0.205)
Group 3: 17-23	0		
Age	0.077	0.141	(-0.026, 0.179)

Table 8: Analysis of BrQ school activity score among subjects with different brace wearing hours, adjusted for age.

Predictors	Regression Coefficient	p-value	95% C.I.
Brace wearing hours			
Group 1: 0-8	-1.123	<0.001	(-1.479, -0.767)
Group 2: 9-16	-0.258	0.072	(-0.539, 0.023)
Group 3: 17-23	0		
Age	0.006	0.893	(-0.82, 0.094)

Table 9: Analysis of BrQ bodily pain score among subjects with different brace wearing hours, adjusted for age.

Predictors	Regression Coefficient	p-value	95% C.I.
Brace wearing hours			
Group 1: 0-8	-0.68	0.007	(-1.171, -0.189)
Group 2: 9-16	-0.264	0.179	(-0.652, 0.124)
Group 3: 17-23	0		
Age	-0.035	0.563	(-0.157, 0.086)

Table 10: Analysis of BrQ social functioning score among subjects with different brace wearing hours, adjusted for age.

curves and 11 triple or more curve patterns, with data on the remaining 15 curve patterns found missing in the medical record. Normality of the BrQ mean score was checked with skewness=-0.39 and kurtosis=-0.19. Seventy two subjects (60%) returned the same set of questionnaire within 1-2 weeks.

The mean, ± 1 SD and range of BrQ total score and its domain score, SRS-22r total score and its domain score are shown in Table 1. The BrQ overall score ranged between a minimum of 51.3 to a maximum of 96.5 with a 25th percentile of 69.6, a 50th percentile of 77.6 and a 75th percentile of 82.9. The floor and ceiling effects of the BrQ domain score were highlighted (1 as the lowest scale score and 5 as the highest scale score) in Table 2. Most of the BrQ domain score showed no floor effect,

but the BrQ bodily pain score did show a ceiling effect of 41.4%.

The Cronbach's alpha coefficient was 0.89 and Intraclass Correlation was 0.83 for the Chinese translated BrQ. The Cronbach's alpha coefficients for all BrQ domains were between 0.42 and 0.87, while the Cronbach's alpha coefficients for all SRS-22r domains were between 0.63 and 0.75, as shown in Table 3.

A total of 35 relevant BrQ and SRS-22r domains were observed to have significant correlation (Pearson correlation coefficient r) at 0.05 level or above. However, the correlation coefficient between BrQ self-esteem and aesthetics, and SRS-22r pain was 0.06. In addition, the correlation coefficient between BrQ physical functioning, self-esteem and aesthetics, school

activity, bodily pain and that of SRS-22r satisfaction with management were 0.10, 0.14, 0.17 and 0.18 respectively. Moreover, no correlation was detected between all BrQ domains and in-brace Cobb angle (Table 4).

There were significant differences in the BrQ school activity mean score ($p=0.042$) and social functioning mean score ($p=0.047$) between the subjects of different age groups: age 12 or below and age 13 or above as shown in (Table 5). Significant differences were also detected in the BrQ domain score including physical functioning ($p<0.001$), emotional functioning ($p=0.002$), vitality ($p=0.004$), bodily pain ($p<0.001$) and social functioning ($p=0.018$) between the subjects with different brace wearing hours (0-8 hours, 9-16 hours and 17-23 hours). It was observed that those subjects with shorter brace wearing hours (0-8 hours) would have a lower domain score when compared to those with longer bracing hours (Tables 6-10).

Discussion

The translated BrQ showed good reliability and validity in terms of its very good internal consistency (Cronbach's $\alpha=0.89$) and excellent test-retest reproducibility (ICC=0.83). The internal consistencies reported by Vasiliadis et al. [5], Aulisa et al. [12], Deceuninck et al. [13], Kinel et al. [14] and Gur et al. [15] were 0.82, 0.86, 0.85, 0.94 and 0.94, respectively. In addition, most of the BrQ domains had satisfactory internal consistencies that were comparable to those reported by Vasiliadis et al. [5] and Kinel et al. [14].

There was no obvious floor or ceiling effect for the BrQ overall score. This was consistent with the findings of Vasiliadis et al. [5], Aulisa et al. [12] and Kinel et al. [14]. On the other hand, a relatively high ceiling effect (41.4%) was noted in the BrQ bodily pain score. As highlighted by Cheung et al. [16], ceiling effects in the SRS-22r pain domain had been previously demonstrated, and it was suggested that this might be a consequence of lack of pain in the patients with AIS.

The translated BrQ demonstrated concurrent validity as reflected by the satisfactory Pearson correlation coefficients (r) between the BrQ domains and the relevant SRS-22r domains. This meant that both measured the same construct. The result was comparable to those reported by Aulisa et al. [17]. However, the correlation (r) between BrQ self-esteem and aesthetics and SRS-22r pain was 0.06. In fact, these two domains were not much related to each other and therefore, it was well accepted that there was no correlation in between. Furthermore, 4 of the BrQ domains did not correlate well with the satisfaction with management domain of the SRS-22r. This could have occurred because satisfaction with management was not related to any of the BrQ domains. Nevertheless, no correlation was detected between all BrQ domains and in-brace Cobb angle. As suggested by Aulisa et al. [17], it was not the entity of the curve to affect QoL but wearing the brace itself.

The translated BrQ was able to discriminate between patients who aged 12 or below and aged 13 or above in terms of school activity and social functioning. Subjects aged 12 or below had a lower school activity score than those aged 13 or above. In the sample population, the majority of subjects were aged 11-12. Comparing to children aged 13 or above, those aged 12 or below were facing the transition from primary to secondary schools, with intensive school activity involvement and high academic achievement expected on them from their parents as well as from schools. They were indeed undergoing tremendous pressure, in addition to the brace treatment. This might explain the lower scoring of school activity for the subjects aged 12 or below. On the contrary, subjects aged 13 or above had a lower social functioning score than those aged 12 or below. Different from children aged 12

or below, those aged 13 or above might experience not only abrupt physical growth but also psychological instability. Brace wearing might further aggravate their negative perceptions and the social interaction with their counterpart could be ineffective.

The translated BrQ was also able to discriminate between brace wearing hours in terms of physical functioning, emotional functioning, vitality, bodily pain and social functioning. It was predicted that those reporting longer brace wearing hours would have a higher score of the related domains than those reporting shorter brace wearing hours. These might be due to the fact that patients who reported longer brace wearing hours were rather compliant with the brace treatment, when comparing to those who reported shorter brace wearing hours. According to Chan et al. [18], patient's quality of life would be enhanced when his/her compliance to brace treatment increased.

Conclusion

Significant differences were found in the BrQ school activity mean score ($p=0.042$) and social functioning mean score ($p=0.047$) between subject groups: age 12 or below and age 13 or above. Significant differences were also detected in the BrQ domain score including physical functioning ($p<0.001$), emotional functioning ($p=0.002$), vitality ($p=0.004$), bodily pain ($p<0.001$) and social functioning ($p=0.018$) between subject groups with different brace wearing hours (0-8 hours, 9-16 hours and 17-23 hours). The Chinese version of BrQ showed validity and reliability. It demonstrated good concurrent validity and discriminatory validity in the AIS population studied. It is ready for use in the Chinese population.

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