Research Report

Reliability and Validity of a Hong Kong Chinese Version of the St George's Respiratory Questionnaire in Patients with COPD

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Abstract: The St George's Respiratory Questionnaire (SGRQ) is a self-administered questionnaire designed to measure quality of life (QOL) covering three areas (symptoms, activity and impacts) in patients with chronic obstructive pulmonary disease (COPD). The aim of the present study was to develop a Chinese version of the SGRQ (SGRQ-HK) and assess its psychometric properties. A forward and back-translation method was used, which included professional and lay people. Psychometric and clinical evaluations included 54 patients with COPD (31 males: mean age, 71.22 ± 5.95 years; 23 females: mean age, 68.8 ± 8.64 years). An additional QOL questionnaire and clinical and physiological data were also collected. The correlation coefficient between "symptoms" and dyspnoea was 0.67, that between "activity" and the 6-minute walk test was –0.78, between "impacts" and "mental health" of the SF-36 Health Survey Mental Health Inventory was –0.62; and between "total" and "general health" of the SF-36 was –0.87. Cronbach's α ranged from 0.74 to 0.95 for the whole questionnaire and its three subscales. Test–retest reliability showed intraclass correlation coefficients of all the dimensions exceeding 0.70. The three-factor structure of the SGRQ-HK was established. In conclusion, the SGRQ-HK is reliable and valid and compares well with the original English version.

Key words: chronic obstructive pulmonary disease, quality of life, St George's Respiratory Questionnaire, validity, reliability

Introduction

Chronic obstructive pulmonary disease (COPD) is a prevalent condition and an important cause of morbidity and mortality in Hong Kong. In 2001, about 7.7 people per 1,000 in Hong Kong suffered from COPD and the mortality rate was 0.32 per 1,000. COPD ranked fifth after malignant neoplasm, heart diseases, cerebrovascular disease and pneumonia in a morbidity survey of the elderly population in 2001 [1].

Patients with COPD are characterized by progressive airflow obstruction that negatively affects ventilation and gas exchange and results in dyspnoea on exertion. As the disease progresses further, its impact on both physical and emotional aspects of life may lead to permanent disability and an impaired mood state [2]. This in turn influences the quality of life (QOL) for these patients. Many health-related QOL (HRQOL) questionnaires have been developed in Western countries; however, few are applicable to the people of Hong Kong. The major obstacle in adapting a HRQOL questionnaire is the cultural and language differences between the populations of Hong Kong and Western countries [3]. According to the 2001 Population Census, about 90% of the people in Hong Kong speak Cantonese and Mandarin, and only about 3.2% of the population use English as their usual

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language [4]. The translation of HRQOL instruments into Chinese and testing for validity and reliability are thus required before an HRQOL survey can be applied to people in Hong Kong.

The St George's Respiratory Questionnaire (SGRQ) was developed by Jones et al in 1992 to measure QOL among people with COPD [5]. Although a Chinese version of the SGRQ for patients with bronchiectasis was established by Chan et al in 2002 [6], the establishment of another Chinese version specifically for patients with COPD is also necessary, as the clinical manifestations of COPD and bronchiectasis are different [7]. The main aim of the study was to develop a Hong Kong Chinese version of the St George's Respiratory Questionnaire (SGRQ-HK) for patients with COPD and to examine the reliability and validity of this translated version.

Methods

Translation procedure

The SGRQ-HK was established by forward and backward translation in 2000. One professional English–Chinese translator and one physiotherapist whose first language was Chinese translated the original English version of the SGRQ into written Chinese. A panel consisting of one medical doctor who specialized in respiratory medicine and three physiotherapists who were on the committee of the Pulmonary Rehabilitation Working Group of the Coordinating Committee in Physiotherapy of Hong Kong's Hospital Authority reviewed the translations and identified ambiguous items and generated alternative expressions. The panel consequently developed the second version of the SGRQ-HK. This version was then back-translated into English by another independent translator and subsequently compared with the original English version. No major discrepancies between the back translation and the original version were found. The only exception was one item in Section 6, Part 2, that referred to shovelling snow. This item was deleted from the SGRQ-HK as it was not applicable to Hong Kong. Other small discrepancies were also resolved and a third version was developed. This third version was then pilot-tested on 20 patients with COPD for clarity and ease of understanding. No problems were encountered; therefore, the third version was adopted as the final version. The reliability and construct validity of this final version were examined in this study.

Study design

A cross-sectional sample of patients with COPD was recruited. DesignPower™ (Statistical Design Analysis System, 1987; Scientific Software Inc, Pleasanton, CA, USA) was used for sample-size estimation based on an estimation of the correlation coefficient in the present study. With the estimated correlation coefficient between the sections of the SGRQ-HK and the clinical variables set at 0.8 and the confidence interval at 95% (0.97–0.75), the estimated sample size was 50.

The inclusion criteria for the study were inpatients of Kowloon Hospital with stable COPD who were admitted at least 2 weeks before the start of the study, a diagnosis of COPD without other cardiovascular disorders, COPD of stage I or II according to the staging suggested by the American Thoracic Society [8], and an ability to understand and speak Cantonese, which is the predominant dialect of Chinese spoken in Hong Kong.

All patients were stratified according to the severity of their disease by pulmonary function test (% forced expiratory volume in 1 second, FEV_1) during the baseline visit. In addition to the SGRQ-HK, a 6-minute walk test (6MWT), and the Chinese version of the SF-36 Health Survey Mental Health Inventory [9] were administered and dyspnoea was scored using the modified Borg scale. All patients repeated the SGRQ-HK 6 hours after the baseline assessment and then 2 weeks later to examine the short- and long-term test–retest reliability, respectively. The design of the study was approved by the Ethics Committee of the Kowloon Hospital and the Human Subjects Subcommittee of the Hong Kong Polytechnic University.

HRQOL measurements

SGRQ-HK

The SGRQ-HK is a disease-specific assessment tool for people with COPD. It takes the form of a standardized questionnaire and can be scored either by health professionals at interview or by the patients themselves [5]. The SGRQ contains 76 items divided into three sections consisting of "symptoms", "activity" and "impacts". The symptoms section contains items concerning the level of symptomatology, including frequency of cough, sputum production, wheeze and breathlessness, and the duration and frequency of attacks of breathlessness or wheeze. The activity section is concerned with physical activities that cause or are limited by breathlessness. The impacts section covers a range of aspects concerned with employment, being in control of health, panic stigmatization, the need for medication and its side effects, and expectation for health and disturbance in daily life.

According to the user manual for the SGRQ, the weightings for all the subscales with a positive response are summed. The score is then calculated by dividing the summed weightings by the maximum possible weighting for that component. The sum of maximum possible weightings for the symptoms, activity, impacts and total scores are 662.5, 1,209.1, 2,117.8 and 3,989.4, respectively. These weights are the maximum possible that could be obtained for the worst possible state of the patient. Thus, a high score indicates poor QOL [5]. The weightings have been collected in six countries: England, Finland, Holland, Italy, Thailand and the USA.

Although weightings have not been established in Hong Kong, there is evidence that nationality has only a small effect [10]. Therefore, an empirically derived weighting of each item of the original SGRQ could confidently be adopted in the present study. The questionnaire takes approximately 10 minutes to complete. The SGRQ has been translated into Swedish, Spanish, Japanese and American-English versions that have been independently validated for reliability and sensitivity [11–14].

Chinese version of the SF-36

The SF-36 is a generic HRQOL assessment tool developed by Ware et al in the USA [9]. It consists of 36 items grouped under 11 questions. This questionnaire assesses eight domains of HRQOL over the preceding 4 weeks. The domains include physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitation due to emotional problems and general mental health. The raw scores for each domain are transformed to a 0–100-point scale such that 0 represents the poorest health and 100 the best health. The Chinese (HK) version of the SF-36 was developed by Lam et al in 1998 through forward and backward translation of the original English version. Its reliability, conceptual validity and construct validity have been established [3].

Physiological measurements

Pulmonary function test

Spirometry was performed using a Vitalograph spirometer (Autospiro AS 500, Osaka, Japan) to measure the FEV_1. The percentage of predicted FEV_1 ($\%FEV_1$) was obtained from the recorded FEV_1 divided by the FEV_1 of the published norm, with reference to the patient's gender, age and height [15].

6-minute walk test

The 6MWT was conducted on the basis of the greatest distance covered by the patient in 6 minutes. Patients were allowed to rest during the 6 minutes, if necessary [16]. The distance completed during this time was recorded. During the test, a stopwatch was used for timing and a Nellcor Pulse Oximeter NPB-40 (Nellcor Puritan Bennett Inc, Pleasanton, CA, USA) was used for spirometry (SpO_2) and pulse rate measurement. Each subject was allowed to perform the test twice to obtain the best result. The first and second trials were 15 minutes apart so that subjects had enough rest before attempting the second trial.

Dyspnoea

The modified Borg 10-point scale with a verbal expression of severity was used to measure the level of perceived dyspnoea [17]. A Chinese translated Borg scale was used in this study.

Analysis

The internal consistency of each section score of the SGRQ-HK was assessed using Cronbach's coefficient α. An acceptable level of α for this study was taken as 0.7 or above [18]. To examine the short- and long-term test–retest reliability, one-way random model of the intraclass correlation coefficients (ICC) were calculated. The reliability was considered fair to good if ICC α was between 0.4 and 0.75, and results that exceeded 0.75 were considered to have excellent reliability [18]. The level of significance was set at 0.05 for all analyses.

Concurrent validity was examined by comparing the SGRQ-HK with other external references that could identify the presence or absence of a particular characteristic [18]. To examine the concurrent validity of the SGRQ-HK, correlations between the SGRQ-HK and the SF-36, $\%FEV_1$, Borg's dyspnoea score and the 6MWT were calculated. It was hypothesized that the symptoms score of the SGRQ-HK would be highly correlated with the clinical indicators of severity of COPD; a strong correlation would be found between the activity score and the physical component score of the SF-36 or the 6MWT; and a strong correlation would be found between impacts score and the mental health component score of the SF-36. Correlation matrices were created between physiological measurements, SF-36 scores and SGRQ-HK scores. These included correlation between the SGRQ-HK scores, $\%FEV_1$, Borg's dyspnoea score and 6MWT, and the correlation between the SGRQ-HK scores and the SF-36 subscale scores. The correlation was considered weak if r ranged from 0.00 to 0.25; an r of 0.25–0.5 was considered a fair degree of relationship; values of 0.5–0.75 were considered moderate to good, and values above 0.75 were considered good to excellent [18]. The level of significance was set at 0.05 for all analyses.

The construct validity was assessed by performing principal component analysis (PCA) for the SGRQ-HK. A correlation matrix of all the items was created. The factors were extracted for factor analysis by two criteria: factors with eigenvalues greater than 1 and the Scree test criterion, obtained by plotting the eigenvalues against the number of factors. A factor loading greater than 0.30 was considered significant. Orthogonal rotation using varimax rotation was used for the rotation of factors to improve the spatial structure of the variables so that distinct factors would be more visible [19].

Results

Baseline characteristics and SGRQ-HK data are presented in Table 1. Sixty patients who fulfilled the inclusion criteria were recruited for the study. Six subjects were not included in the data analysis. Two of them died during the study period due to an acute exacerbation of

Table 1. Baseline characteristics and scores on the Hong Kong Chinese version of the St George's Respiratory Questionnaire (SGRQ-HK) and SF-36 Health Survey Mental Health Inventory (SF-36) (n = 54)

Patient characteristics	Mean ± SD	HRQOL scores	Mean ± SD
Age (yr)	68.8 ± 8.4	SF-36	
$\%FEV_1$	49.7 ± 14.0	Physical functioning	45.1 ± 31.3
6MWT (m)	285.7 ± 33.4	Role physical	36.1 ± 39.7
		Bodily pain	76.4 ± 20.1
SGRQ-HK		General health	41.7 ± 28.9
Symptoms	59.5 ± 19.8	Vitality	40.4 ± 17.0
Activity	62.7 ± 26.0	Social functioning	59.1 ± 33.7
Impacts	48.1 ± 22.3	Role emotion	47.5 ± 46.5
Total	51.2 ± 21.7	Mental health	52.2 ± 33.5

SD = standard deviation; HRQOL = health-related quality of life; $\%FEV_1$ = % forced expiratory volume in 1 second; 6MWT = 6-minute walk test.

Table 2. Results of scaling properties and reliability of the Hong Kong Chinese version of the St George's Respiratory Questionnaire (SGRQ-HK)

	Symptoms	Activity	Impacts	Total
Number of items (n)	8	16	26	50
Scales levels (n)	29	16	31	76
Incomplete rate, %	0	0	0	0
Theoretical range	0–100	0–100	0–100	0–100
Observed range	22.5–97.4	11.21–100	10.8–92	9.7–85.3
Percentage at ceiling score	0	11.1	0	0
Percentage at floor score	0	0	0	0
Cronbach's α	0.74	0.92	0.90	0.95
Short-term test–retest reliability (r)	0.97	0.97	0.97	0.98
Long-term test–retest reliability (r)	0.77	0.86	0.78	0.70

the disease and four patients were considered unstable during the study period. Complete data were available for 54 patients (31 men, 23 women). The mean ages were 71.2 years ± 5.9 years for males and 65.5 years ± 10.2 years for females.

Table 2 presents the scaling properties and reliability values for the SGRQ-HK. The mean SGRQ-HK symptoms score was 59.5 ± 19.8%, the activity score was 62.7 ± 27%, the impacts score was 48.1 ± 22.3%, and the total score was 51.2 ± 21.7% of the possible maximum scores. Most of the subjects did not achieve the worst ("ceiling effect") or the best ("floor effect") possible score for any of the subscales. The one exception was the activity section, where 11.1% of patients achieved the worst possible score. Cronbach's α was calculated as 0.74 for the symptoms score, 0.92 for the activity score, 0.90 for the impacts score and 0.95 for the total score. The short-term test–retest reliability of the SGRQ-HK was excellent, with an ICC ranging from 0.97 to 0.98 ($p <$ 0.001). The long-term test–retest reliability was also good, with an ICC ranging from 0.70 to 0.86.

Table 3 shows the pattern of correlations between the SGRQ-HK scores and other validated external references. The SGRQ-HK scores showed significant correlations with those references that measured similar underlying dimensions (convergent validity) and weaker correlation with other variables that were not directly related (discriminant validity).

Construct validity was established by performing factor analysis on the SGRQ-HK data. Based on the criterion of an eigenvalue of more than 1, the data yielded 13 factors and explained almost 88% of variance. When the factors were further extracted using a Scree plot, a maximum of three factors were extracted. These three factors accounted for 52% of the variance in the data. The first factor showed positive correlations with 5 of the 8 symptoms items, 10 of the 16 activity items, and 13 of the 26 impacts items. We labelled it "physical activity" because many of the items were asking about exercise and activities. The second factor showed positive correlations with 3 of the 8 symptoms items, 3 of the 16 activity items, and 3 of the 26 impacts items. Since the

symptoms items contributed more in proportion, this factor was labelled "symptoms". The third factor showed positive correlations with the two activity items and 10 impacts items and was therefore labelled "impacts". The three-factor structure of the SGRQ-HK was established.

Discussion

This study examined the measurement properties of the SGRQ-HK for patients with COPD. The study has shown that the SGRQ-HK is a reliable and valid instrument that can be used to assess QOL in Hong Kong Chinese people with COPD. Although Chan et al recently conducted a similar study to examine the validity of a Chinese version of the SGRQ for bronchiectasis [6], assessing the reliability and validity of the questionnaire with COPD was also needed for several reasons. Firstly, bronchiectasis is a less common form of obstructive lung disease than COPD, both locally and worldwide [7]. Secondly, the underlying pathology of the two diseases is different. As a result, the clinical presentations of COPD and bronchiectasis are also different. For patients with COPD, disabling dyspnoea, wheeze, cough and sputum production are the common symptoms, whereas dyspnoea, chest pain and large quantities of purulent sputum production are more common in patients with bronchiectasis [7]. Thirdly, the sample characteristics of subjects recruited in the present study were more similar to the sample of the original study. Thus, the SGRQ-HK established in the present study would be more appropriate for assessing QOL in patients with COPD.

The SGRQ-HK showed high internal consistency, with the Cronbach's α of all subscales exceeding 0.7. These results are comparable to the studies of Engström et al [11] and Ferrer et al [12] in the development of the Swedish and Spanish versions of the SGRQ. The internal consistency was also much higher than found by Chan et al, who found Cronbach's α of 0.59–0.92. In our study, the short-term test–retest reliability of the SGRQ-HK was extremely high. Such high reliability reflects that the SGRQ-HK is stable and reliable for repeated measurements over a short period of time. As no similar short-term studies have been conducted in the past, the result cannot be compared with previous studies. The result was also satisfactory for long-term test–retest reliability. The lower test–retest reliability in our study, when compared with the original version and the study of Chan et al, might have resulted from a less stringent criterion for identifying stable patients and somewhat smaller sample size.

Although one item in Section 6, Part 2, was deleted from the SGRQ-HK, the content validity of the SGRQ-HK was not formally assessed in this study. On the other hand, the concurrent validity of the SGRQ-HK was established. We have shown that the SGRQ-HK correlated significantly with a number of measures of disease severity and activities relevant to people with COPD. The symptoms score was significantly correlated to items of symptomatology consistent with COPD such as breathlessness and low lung-function test scores. These results were comparable with those from studies conducted by Chan et al and Engström et al [6,11]. However, significant and stronger correlations were found between the

Table 3. Pearson's product moment correlation coefficients between the Hong Kong Chinese version of the St George's Respiratory Questionnaire total and component scores and clinical variables and component scores of the SF-36 Health Survey Mental Health Inventory (SF-36)

	Correlation coefficient, *r*			
	Symptoms	Activity	Impacts	Total
$\%FEV_1$	–0.54*	–0.59*	–0.43*	–0.6*
Dyspnoea score	0.67*	0.68*	0.44*	0.79*
6MWT (m)	–0.73*	–0.78*	–0.49*	–0.75*
SF-36 Physical functioning	–0.65*	–0.90*	–0.64*	–0.86*
SF-36 Role physical	–0.39*	–0.59*	–0.41†	–0.56*
SF-36 Bodily pain	–0.39*	–0.49*	–0.45*	–0.49‡
SF-36 General health	–0.71*	–0.92*	–0.61†	–0.87*
SF-36 Vitality	–0.62*	–0.73*	–0.56†	–0.75*
SF-36 Social functioning	–0.60*	–0.80*	–0.66†	–0.79*
SF-36 Role emotion	–0.45*	–0.31‡	–0.33‡	–0.40‡
SF-36 Mental health	–0.58*	–0.59*	–0.62*	–0.68*

*Correlation significant at the 0.001 level (2-tailed); †correlation significant at the 0.01 level (2-tailed); ‡Correlation significant at the 0.05 level (2-tailed). $\%FEV_1$ = % forced expiratory volume in 1 second; 6MWT = 6-minute walk test.

symptoms score and the dyspnoea score and lung function in the original study [5]. This discrepancy could have come about because the original study also included people with asthma. In addition, the SGRQ-HK activity score was most strongly associated with exercise tolerance performance, as measure by the 6MWT and the physical component of the SF-36. The activity score was also moderately correlated with the dyspnoea score and spirometry. These findings were observed in the studies conducted by Jones et al, Engström et al and Ferrer et al [5,11,12], except that good correlation was found between the activity score and the Medical Research Council dyspnoea grade in the original study. However, only moderate correlation with the activity score and 6MWT was observed by Chan et al [6]. This can be explained because they recruited patients with bronchiectasis and good exercise tolerance who showed less limitation in their physical activities. This is also reflected by their relatively high floor percentage in the activity score (11.7%) [6]. The impacts score of the SGRQ-HK was moderately correlated with the mental health component of the SF-36. Our result was similar to the study of Chan et al, except that a higher correlation with the mental health component of the SF-36 was found in our study. The total score is intended to reflect all aspects of the patient's health impairment. It correlated significantly with all the domains of the SF-36. This was expected because the SF-36 is a measure of overall subjective well-being and social functioning, and this instrument is complementary to the SGRQ-HK in the assessment of patients with COPD.

The original developers of the SGRQ conducted PCA, which supported the partition of the questionnaire into three sections [5]. However, little information was published concerning item generation and the PCA results of the original SGRQ. Our study tried to replicate this result by performing PCA on the SGRQ-HK. An important step in factor analysis is to determine the number of factors that are to be extracted. One of the most widely used approaches is the eigenvalues greater than 1 rule [19,20]. In the present study, 13 factors were extracted under this rule (explaining 87.57% of variance). Another widely used method is the Scree plot, and three factors were extracted in this process (explaining 52.26% of variance). The three factors were closely related to the original domains of the SGRQ (symptoms, physical activity and impacts compared with symptoms, activity and impacts). However, the proportion of the variance of the SGRQ-HK that was explained by the model fell from 87.57% to 52.26% if three instead of 13 factors were extracted. In addition, 22% of the items (11 of 50 items) of the SGRQ-HK had a factor loading below ± 0.3, indicating that some of the items were weakly correlated with the domains. Similar results were observed by Rutten-van Mölken et al [21]. In their study, almost 50% of the items of the SGRQ had a factor loading below 0.4, indicating a lack of homogeneity [21]. One possible reason was the small sample size in both our study and that of Rutten-van Mölken et al. In factor analysis, when the factor structure is being explored, a small sample size may lead to large standard errors for the estimated parameters. This may result in incorrect estimation of both the number of factors and the structure of the factors [21]. As recommended by Hair et al [19], a minimum number of subjects of five or 10 times the number of observed variables should be recruited for the study. Thus, a minimum of 250 subjects would be required to perform factor analysis for the SGRQ.

Conclusion

Our results suggest that the SGRQ-HK is a valid measure to assess QOL in Chinese people with COPD. Moreover, this study has also shown that the SGRQ-HK has good repeatability, producing consistent scores in patients with a stable condition over a short period of time, as well as good internal consistency when applied to such a group of patients. However, the factor structure of the SGRQ-HK is still unclear and further study in this area is required.

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