Original Article

Is EQ-5D a Valid Quality of Life Instrument in Patients With Parkinson's Disease? A Study in Singapore

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Abstract

Introduction: The purpose of the present study was to evaluate the validity of the EQ-5D in patients with Parkinson's disease (PD) in Singapore. Materials and Methods: In a cross-sectional survey, patients with PD completed English or Chinese version of the EQ-5D, the 8-item Parkinson's disease questionnaire (PDQ-8), and questions assessing socio-demographic and health characteristics. Clinical data were retrieved from patients' medical records. The validity of the EQ-5D was assessed by testing a-priori hypotheses relating the EQ-5D to the PDQ-8 and clinical data. Results: Two hundred and eight PD patients (English speaking: 135) participated in the study. Spearman correlation coefficients between the EQ-5D and PDQ-8 ranged from 0.25 to 0.75 for English-speaking patients and from 0.16 to 0.67 for Chinese-speaking patients. By and large, the EQ-5D scores were weakly or moderately correlated with Hoehn and Yahr stage (correlation coefficients: 0.05 to 0.43), Schwab and England Activities of Daily Living score (correlation coefficients: 0.10 to 0.60), and duration of PD (correlation coefficients: 0.16 to 0.43). The EQ-5D index scores for patients with dyskinesia or "wearing off" periods were significantly lower than those without these problems. The EQ-5D Visual Analog Scale (EQ-VAS) scores also differed for English-speaking patients with deferring dyskinesia, "wearing off" periods, or health transition status; however, such differences were not observed in patients who completed the survey in Chinese. Conclusions: The EQ-5D questionnaire appears valid for measuring quality of life in patients with PD in Singapore. However, the validity of EQ-VAS in Chinese-speaking patients with PD should be further assessed.

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Key words: EQ-5D, Health-related quality of life, Parkinson's disease

Introduction

The EQ-5D is a preference-based, generic instrument that measures quality of life in three different ways.[1] The first part is a descriptive system providing a profile of respondents' health status in five dimensions. The second measure is a 0 to 100 visual analog scale for self-rating of own health. Thirdly, an index score can be generated to reflect the preference or utility of the measured health profile from the perspective of the general population. The EQ-5D index score is a legitimate measure of health outcomes necessarily for quality-adjusted life years (QALYs) calculation and cost-utility analysis (CUA) in economic evaluation of health technologies and interventions.[2,3]

As a generic instrument, the EQ-5D has been used to evaluate health outcomes in many therapeutic areas including the Parkinson's disease (PD)[4,5] where health-related quality of life (HRQoL) is considered as an important outcome measure. Actually, the EQ-5D was specifically developed as a brief measure to be used alongside disease-specific measures in outcomes research. Studies in the UK[6] and Germany[7] demonstrated the validity of the EQ-5D in patients with Parkinson's disease. In 2003, the EQ-5D was introduced into Singapore after proper cultural adaptation, and it was subsequently used to measure quality of life in local patients with Parkinson's disease.[8,9] However, no formal studies have been done to examine the validity of the EQ-5D in Asians with Parkinson's disease. It is generally

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recommended that a quality of life instrument should be evaluated when it is applied to a population for which the instrument is not originally designed.

The purpose of the present study was to evaluate the validity of the EQ-5D in patients with Parkinson's disease in Singapore. This study would not only provide new information on the validity of the EQ-5D in Parkinson's disease in general but also throw light on the appropriateness of using this generic instrument in Asia.

Materials and Methods

Study Design

This was a cross-sectional study of a consecutive sample of patients with Parkinson's disease attending the Parkinson's Disease and Movement Disorders Centre at the National Neuroscience Institute (NNI) from July 2006 to June 2007. Inclusion criteria were (i) a diagnosis of Parkinson's disease according to the National Institute of Neurological Disorders and Stroke (NINDS) criteria[10] and (ii) ability to read English or Chinese. Exclusion criteria included (i) inability to read or communicate due to illiteracy or language barriers; (ii) severe disabilities; and (iii) a documented Chinese Mini Mental State (cMMSE) score of ≤20. The MMSE is a rating scale of cognitive functioning.[11] Its score range is 0 to 30; higher scores indicating better cognitive performance. Based on a previous validation study, a cMMSE score of 20 is the optimal cut-off point for dementia in Singapore.[12]

After informed consent was obtained, all patients were asked to self-administer a battery of questionnaires containing the EQ-5D, the 8-item Parkinson's Disease Questionnaire (PDQ-8),[13] and questions assessing socio-demographic and health characteristics. Identical English and Chinese versions of the questionnaires were prepared for patients to choose their own survey language. Some clinical data includes the cMMSE score, the modified Hoehn and Yahr (H&Y) staging scale, the Schwab and England Activities of Daily Living (S&E ADLs) scale, and the motor examination of the Unified Parkinson's disease rating scale (UPDRS)[14] were retrieved from patients' medical records. The H&Y score ranges from stage 1 (no signs of disease) to stage 5 (wheelchair bound or bedridden unless aided). The UPDRS motor score is a composite score ranging from 0 to 56 with higher scores indicating worse motor impairment. The Schwab and England ADLs score is a global assessment of ADLs, ranging from 0 (bedridden) to 100 (completely independent). All these rating scales were routinely used to assess patients with Parkinson's disease in the study clinic by neurologists or trained medical staff. The clinical data used in the present study were either obtained during the same visit in which the patients were surveyed or the immediate previous visit which was typically 3 months before. The study protocol was approved by the Institutional Review Board of the study site.

Instruments

The EQ-5D is a 2-page questionnaire. The first page is a 5-dimension health descriptive system. For each dimension (i.e., mobility, self-care, usual activities, pain/discomfort, or anxiety/depression), respondents are asked to describe their levels of health problems as none, moderate, or extreme. Thus, the descriptive system is able to identify 243 unique health states. Further, an index score can be derived for each health state to indicate its value or utility from the perspective of the general public. There are a number of country-specific EQ-5D value sets available and in the present study we elected to use the values of the general UK population because such values were not measured in Singapore yet. Scores in the UK EQ-5D value set[15] range from -0.59 for the worst possible health status to 1.0 for perfect health, with 0 on the scale representing the state of being dead. The second page of the EQ-5D is a 20 cm vertical visual analog scale (EQ VAS) with 100 at the top representing 'best imaginable health state' and 0 at the bottom representing 'worst imaginable health state.' The EQ VAS is for self-assessment of the overall health on the day of the survey. The Singaporean English and Chinese versions of the EQ-5D used in the present study were culturally adapted and validated in local patients with rheumatic diseases.[8,9] Typically, the EQ-5D questionnaire needs 1 to 3 minutes for self-completion.

The PDQ-8 consists of 8 questions, each measuring one health dimension that may be affected by Parkinson's disease (i.e. mobility, activities of daily living (ADL), emotional well-being, social support, cognition, communication, bodily discomfort, and stigma). Each PDQ-8 health problem is rated for frequency of occurrence on a 5-point response scale ranging from "never" to "always." A summary index (PDQ-8SI) can be calculated to measure the overall HRQoL, with higher scores indicating worse HRQoL (score range: 0-100). The PDQ-8 is derived from the 39-item Parkinson's Disease Questionnaire (PDQ-39)[16] and both the English and Chinese versions of the short- and long-form PDQ were psychometrically validated in Singapore before the present study.[17-19]

Statistical Analyses

The validity of the EQ-5D was assessed by testing a-priori hypotheses relating the EQ-5D to the PDQ-8 and clinical data. Based on the literature,[6,7] we hypothesised that (i) EQ-5D items, preference-based index and VAS scores would be moderately or strongly correlated with PDQ-8 items and PDQ-8SI score; (ii) EQ-5D index and VAS scores would be weakly or moderately correlated

with H&Y staging, S&E ADLs scale, UPDRS motor score, and cMMSE score; (iii) Patients who reported worsening health compared to the previous year would have lower EQ-5D index and VAS scores than those who reported similar or improved health. In addition, we also hypothesised that (iv) patients who experienced dyskinesia or "wearing off" periods would have lower EQ-5D index and VAS scores compared to those not having those problems. Dyskinesia refers to abnormal involuntary movements that occur in relation to PD medications and "wearing off" refers to the shortened duration of action of PD medications that occurs over the course of treatment.

Associations between continuous variables were examined using Spearman's rank correlation coefficient. A coefficient value of >0.5, 0.35 to 0.50, <0.35 was considered as strong, moderate, and weak correlation, respectively.[20,21] Comparisons of quality of life scores measured by the EQ-5D or PDQ-8 across subgroups of patients were conducted using the Mann-Whitney test or the Kruskall-Wallis test. Data from patients who completed the English and Chinese versions of the survey were analysed separately. All statistical tests were two-sided and performed with STATA (Version 9.1; Stata Corporation, 2005).

Results

Two hundred and eight PD patients participated in the present study. Two Chinese patients were excluded because of missing answers to the EQ-5D questionnaire, leaving a total of 206 patients being analysed in this study. The mean (standard deviation) duration of PD was 5.2 (5.3) years. The mean (standard deviation) PDQ8SI, EQ-5D index, and EQ-VAS scores were 24.1 (18.8), 0.73 (0.26), 71.6 (15.9), respectively. Fifty-six patients (27.2%) reported "full health" with the EQ-5D and had a health index score of 1.0. The least and most self-reported health problems with the EQ-5D, either moderate or extreme, were self-care (25.7%) and pain/discomfort (52.9%), respectively. Detailed socio-demographic and clinical characteristics of the patients are displayed in Table 1.

English-speaking (n = 135) and Chinese-speaking (n = 71) patients were similar in socio-demographic and clinical characteristics except that more Chinese-speaking patients had primary or lower education (45.0% versus 12.6%, P <0.001, Chi-square test) and were living in a 3-bedroom or smaller apartment (62.0% versus 41.5%, P = 0.016, Chi-square test) than their English-speaking counterparts (Table 1).

Spearman correlation coefficients between the EQ-5D and PDQ-8 ranged from 0.25 to 0.75 for English-speaking patients and from 0.16 to 0.67 for Chinese-speaking patients. Generally, the correlations between the two quality of life instruments were stronger in the English-speaking patients than the Chinese-speaking patients, especially for the corrections between the EQ-VAS and the PDQ-8 scores (Tables 2 and 3).

The strength of correlations between the EQ-5D and clinical variables varied depending on both the clinical variable and the survey language (Tables 4 and 5). By and large, the EQ-5D scores were weakly or moderately correlated with H&Y stage (correlation coefficients: 0.05 to 0.43), S&E ADLs score (correlation coefficients: 0.10 to 0.60), and duration of PD (correlation coefficients: 0.16 to 0.43). However, there was essentially no correlation between the EQ-5D and cMMSE scores (correlation coefficients: 0.01 to 0.22). The correlations between the EQ-5D and UPDRS motor scores differed markedly in the English-speaking patients (correlation coefficients: 0.17 to 0.47) and the Chinese-speaking patients (correlation coefficients: 0.03 to 0.22).

The EQ-5D index scores for patients with dyskinesia or "wearing off" periods were significantly lower than those without these problems. Similarly, patients who reported worsened health status had significantly lower EQ-5D scores compared to those who reported unchanged or improved health compared to the previous year (Tables 6 and 7). For example, the median EQ-5D index score for English-speaking patients with and without dyskinesia was 0.52 and 0.80, respectively (P <0.0001 Mann-Whitney test). Similarly, the EQ-VAS scores differed for English-speaking patients with deferring dyskinesia, "wearing off" periods, or health transition status (Table 6). In contrast, such differences were not observed in patients who completed the survey in Chinese (Table 7).

Discussion

There are no gold standards in quality of life research. As such, quality of life instruments are indirectly validated through a hypothesis testing approach. To assess validity, investigators need to make *a priori* hypotheses predicting how the instrument would be associated with other variables and collect data to verify those hypotheses.[22] In this study, we aimed to assess the validity of the EQ-5D questionnaire in Singaporean patients with PD by testing the hypotheses that relate the EQ-5D to the PDQ-8, a locally validated PD-specific quality of life instrument, and clinical variables. In accordance with general practice in such research, we tested the English and Chinese versions of the EQ-5D separately.

Our results based on the English-speaking patients supported the validity of the English version of the EQ-5D questionnaire for measuring quality life in local patients with PD. As we hypothesised, the correlations between the EQ-5D and the PDQ-8 were stronger than the correlations

Table 1. Characteristics of Patients

	Total (n = 206)	English-speaking (n = 135)	Chinese-speaking (n = 71)	*P* value*
Male, N (%)	163 (79.1)	109 (80.7)	54 (76.1)	0.432
Age at survey, mean (SD)	62.1(9.0)	61.7 (9.4)	62.8 (8.4)	0.407
Ethnicity, N (%)				
Chinese	179 (86.9)	108 (80.0)	71 (100.0)	-
Malays	13 (6.3)	13 (9.6)	-	
Indians/others	14 (7.8)	14 (10.4)	-	
Education attainment, N (%)				
No/ primary education	49 (23.8)	17 (12.6)	32 (45.0)	<0.001
O-Level	88 (42.7)	65 (48.2)	23 (32.4)	
A Level/Diploma	31 (15.1)	21 (15.6)	10 (14.1)	
Degree	38 (18.5)	32 (23.7)	6 (8.5)	
Employment status, N (%)				
Employed	58 (28.2)	43 (31.9)	15 (21.1)	0.378
Housekeeper/unemployed	25 (12.0)	15 (11.0)	10 (14.1)	
Retired due to PD	37 (18.0)	24 (17.8)	13 (18.3)	
Retired due to other reasons	86 (41.8)	53 (39.3)	33 (46.5)	
Housing type, N (%)				
1-2/3-4 room HDB	100 (48.6)	56 (41.5)	44 (62.0)	0.016
5 room/ Executive HDB	70 (34.0)	50 (37.0)	20 (28.2)	
Private property	36 (17.5)	29 (21.5)	7 (9.9)	
With a caregiver, N (%)	192 (93.2)	127 (94.1)	65 (91.5)	0.529
PD duration (years), mean (SD)	5.2 (5.3)	5.5 (5.8)	4.8 (4.4)	0.413
H&Y stage, mean (SD)	2.1 (0.5)	2.2 (0.5)	2.1 (0.6)	0.387
1 or 1.5	17 (8.6)	10 (7.4)	7 (8.3)	0.849
2 or 2.5	165 (80.1)	109 (80.7)	56 (80.1)	
3 or 4	24 (11.7)	16 (11.9)	8 (11.7)	
S&E ADLs score, mean (SD)	87.6 (8.9)	87.7 (9.2)	87.3 (8.2)	0.710
UPDRS motor score, mean (SD)	20.9 (8.6)	20.9 (8.8)	21.0 (8.1)	0.933
cMMSE score, mean (SD)	26.5 (1.8)	26.4 (1.9)	26.5 (1.7)	0.746
PDQ8SI score, mean (SD)	24.1 (18.8)	23.0 (18.7)	26.1 (19.0)	0.250
EQ-5D index score, mean (SD)	0.73 (0.26)	0.72 (0.26)	0.74 (0.28)	0.523
EQ-VAS score, mean (SD)	71.6 (15.9)	71.1 (16.5)	72.5 (14.6)	0.531
Self-reported problems, N (%)				
Mobility	83 (40.3)	56 (41.5)	27 (38.0)	0.631
Self-care	53 (25.7)	39 (28.9)	14 (19.7)	0.152
Usual activities	78 (37.9)	52 (38.5)	26 (36.6)	0.789
Pain/discomfort	109 (52.9)	77 (57.0)	32 (45.1)	0.102
Anxiety/depression	92 (44.7)	63 (46.7)	29 (40.9)	0.424

SD: standard deviation; PD: Parkinson's disease; H&Y: Hoehn and Yahr; S&E ADLs: Schwab and England activity of daily livings; UPDRS: unified Parkinson's disease rating scale; cMMSE: Chinese Mini Mental State

* Chi-square tests for categorical variables and independent two-sample *t*-tests for continuous variables.

Table 2. Spearman Correlation Coefficients Between EQ5D and PDQ-8 Items and Scores in English-speaking Patients (n = 135)

	EQ-5D						
	Mobility	**Self-care**	**Usual activities**	**Pain/ discomfort**	**Anxiety/ depression**	**Index**	**VAS**
PDQ-8							
Difficulty getting around	0.66***	0.48***	0.61***	0.40***	0.41***	-0.60***	-0.49***
Difficulty dressing	0.65***	0.63***	0.61***	0.33**	0.37***	-0.59***	-0.52***
Felt depressed	0.6***	0.47***	0.47***	0.39***	0.63***	-0.64***	-0.45***
Problems with close personal relationships	0.53***	0.51***	0.52***	0.31**	0.51***	-0.51***	-0.42***
Problems with concentration	0.43***	0.52***	0.47***	0.26*	0.53***	-0.50***	-0.52***
Felt unable to communicate properly	0.43***	0.41***	0.47***	0.35***	0.48***	-0.49***	-0.48***
Painful muscle cramps or spasm	0.36***	0.27***	0.25*	0.56***	0.38***	-0.53***	-0.48***
Felt embarrassed in public	0.35***	0.37***	0.32**	0.34***	0.31**	-0.42***	-0.40***
Summary index (PDQ8SI)	0.69***	0.60***	0.63***	0.51***	0.63***	-0.75***	-0.63***

* P <0.05, ** P <0.01, *** P <0.001

Table 3. Spearman Correlation Coefficients Between EQ5D and PDQ-8 Items and Scores in Chinese-speaking Patients (n = 71)

	EQ-5D						
	Mobility	**Self-care**	**Usual activities**	**Pain/ discomfort**	**Anxiety/ depression**	**Index**	**VAS**
PDQ-8							
Difficulty getting around	0.52***	0.31*	0.37*	0.27*	0.40***	-0.40**	-0.20
Difficulty dressing	0.44**	0.44**	0.36*	0.48***	0.32*	-0.52***	-0.26*
Felt depressed	0.23*	0.16	0.36*	0.32*	0.53***	-0.45**	-0.28*
Problems with close personal relationships	0.38*	0.31*	0.39**	0.24*	0.35*	-0.39**	-0.33*
Problems with concentration	0.31*	0.27*	0.40**	0.27*	0.26*	-0.38**	-0.25*
Felt unable to communicate properly	0.48***	0.39**	0.55***	0.44**	0.43**	-0.60***	-0.25*
Painful muscle cramps or spasm	0.39**	0.44**	0.39**	0.42**	0.41**	-0.54***	-0.19
Felt embarrassed in public	0.63***	0.39**	0.56***	0.38**	0.55***	-0.61***	-0.25*
Summary index (PDQ8SI)	0.57***	0.45**	0.56***	0.50***	0.53***	-0.67***	-0.35*

* P <0.05, ** P <0.01, *** P <0.001

Table 4. Spearman Correlation Coefficients of EQ-5D with Clinical Variables and Disease Duration in English-speaking Patients (n = 135)

	H&Y stage score	**S&E ADLs score**	**UPDRS motor score**	**PD duration**	**cMMSE**
EQ-5D					
Mobility	0.43***	-0.57***	0.47***	0.40***	-0.09
Self-care	0.34***	-0.51***	0.41***	0.43***	-0.20*
Usual activity	0.38***	-0.55***	0.41***	0.38***	-0.20*
Pain/discomfort	0.11	-0.22**	0.17*	0.16	-0.08
Anxiety/depression	0.20*	-0.38***	0.24**	0.24**	-0.22*
Index	-0.32***	0.51***	-0.39***	-0.34***	0.18*
EQ-VAS	-0.40***	0.41***	-0.36***	-0.31***	0.14

H&Y: Hoehn and Yahr; S&E ADLs: Schwab and England activity of daily livings; UPDRS: unified Parkinson's disease rating scale; cMMSE: Chinese Mini Mental State

* P <0.05, ** P <0.01, *** P <0.001.

Table 5. Spearman Correlation Coefficients of EQ-5D with Clinical Variables and Disease Duration in Chinese-speaking Patients (n = 71)

	H&Y stage	S&E ADLs	UPDRS motor	PD duration	cMMSE
EQ-5D					
Mobility	0.43***	-0.60***	0.22	0.37**	-0.09
Self-care	0.35**	-0.47***	0.07	0.30*	-0.20
Usual activity	0.15	-0.36**	0.03	0.32**	0.09
Pain/discomfort	0.18	-0.10	-0.07	0.28*	0.03
Anxiety/depression	-0.05	-0.20	-0.16	0.17	0.17
Index	-0.28*	0.36**	0.04	-0.40***	-0.01
EQ-VAS	-0.37**	0.27*	-0.19	-0.17	0.11

H&Y: Hoehn and Yahr; S&E ADLs: Schwab and England activity of daily livings; UPDRS: unified Parkinson's disease rating scale; cMMSE: Chinese Mini Mental State
*P <0.05, **P <0.01, ***P <0.001.

Table 6. Comparison of QoL Scores in English-speaking Patients Differing in Health or Clinical Status (n = 135)

Variable	n	EQ-5D Index		EQ-5D VAS	
		Median (inter-quartile)	*P* value	Median (inter-quartile)	*P* value*
Change in health over the previous year					
Better	46	0.80 (0.73,0.85)		76.5 (70.0, 85.0)	
Same	45	0.85 (0.73, 1.0)	<0.0001	80.0 (70.0, 80.0)	<0.0001
Worse	44	0.59 (0.52, 0.80)		65.0 (50.0, 74.5)	
Presence of dyskinesia					
No	116	0.80 (0.65, 1.0)	<0.0001	75.0 (65.0, 80.0)	0.004
Yes	19	0.52 (0.52, 0.73)		66.0 (50.0, 75.0)	
Presence of "wearing off" periods					
No	91	0.80 (0.71, 1.0)	<0.0001	78.0 (70.0, 80.0)	<0.0001
Yes	44	0.62 (0.52, 0.78)		68.0 (54.0, 75.0)	

* Kruskal-Wallis test for the three-group comparison and Mann-Whitney tests for two-group comparisons.

Table 7. Comparison of QoL Scores in Chinese-speaking Patients Differing in Health or Clinical Status (n = 71)

Variable	n	EQ-5D Index		EQ-5D VAS	
		Median(inter-quartile)	*P* value	Median(inter-quartile)	*P* value*
Change in health over the previous year					
Better	19	0.85 (0.66, 1.0)		70.0 (59.0, 85.0)	
Same	25	0.85 (0.74, 1.0)	0.032	80.0 (70.0, 89.0)	0.172
Worse	27	0.73 (0.26, 0.85)		70.0 (60.0, 80.0)	
Presence of dyskinesia					
No	64	0.81 (0.72, 1.0)	0.009	70.0 (60.0, 80.0)	0.654
Yes	7	0.52 (0.08, 0.62)		70.0 (50.0, 80.0)	
Presence of "wearing off" periods					
No	52	0.85 (0.77, 1.0)	<0.0001	75.0 (60.0, 85.0)	0.099
Yes	19	0.62 (0.26, 0.73)		69.0 (59.0, 80.0)	

* Kruskal-Wallis test for the three-group comparison and Mann-Whitney tests for two-group comparisons.

between the EQ-5D and selected clinical variables and the strength of the correlations were as we expected for all variables except for the cMMSE (Tables 2 and 4). Based on Schrag et al's study,[6] we hypothesised a weak correlation between the EQ-5D and cMMSE scores; however, it turned out that there was no correlation between the 2 measures in our study. One possible reason for this unexpected result was the homogeneity of cognitive function in our study; 89% of our patients had a cMMSE score of 26 to 28. Statistically, even real association cannot be revealed with an overly homogenous sample. Thus, we intend to consider this unexpected result to be caused by the data but not the study instrument.

Similarly, our analyses of the data collected by the Chinese version of survey forms provided some evidence on the validity of the Chinese version of the EQ-5D for PD in Singapore. Generally, the EQ-5D items and index scores were correlated with PDQ-8 scores or clinical variables as we hypothesised, supporting construct validity. One unexpected result for the Chinese EQ-5D was that the EQ-5D and UPDRS motor scores were not correlated, which was in contrast with the result for the English EQ-5D. Interestingly, there was no correlation between the PDQ8SI and UPDRS scores among Chinese-speaking patients as well (data not shown). One possible reason for these results is culturally different response patterns of Chinese-speaking patients to survey questions. The correlation between UPDRS motor and HRQoL scores in Chinese-speaking patients with PD should be further studied in the future.

The evidence for the validity of the EQ-VAS was not as strong as that for the index score for the Chinese EQ-5D. The VAS score was correlated with PDQ-8, H&Y, and S&E ADLs scores; however, it did not differentiate between Chinese-speaking patients with differing dyskinesia, "wearing off" periods, or health transition status. Weaker-than-expected correlations with other variables were also documented for the EQ-VAS in a study of Chinese-speaking local patients with rheumatic diseases. [9] This may be due to the small sample size of Chinese-speaking patients. It is also possible that some poorly educated Chinese-speaking patients do not know how to use the numerical VAS to rate their own health or they use the VAS differently. However, we analysed the data separately for Chinese-speaking patients with and without secondary or higher education and did not find significant differences (results not shown but available from the first author upon request). Further research using qualitative methods such as in-depth interview is therefore needed to elucidate the reasons behind these results.

According to the EQ-5D, more than a quarter of our patients (27.2%) had the highest index score of 1.0, suggesting some degree of ceiling effects. In health surveys of the general US population, approximately half of the respondents reported full health with the EQ-5D.[23,24] The impact of ceiling effects on the measurement properties of the EQ-5D cannot be overlooked. For example, that patients who reported a positive change in health did not have higher EQ-5D scores than patients who reported no change in health (Tables 6 and 7) may be due to the ceiling effects of the EQ-5D index scores; among those patients who reported positive change in health, 29.2% reported full health (data not shown previously). How the ceiling effects may affect the discriminative power of the EQ-5D scores should be studied in the future.

Limitations of our study include incomplete assessment of the study instrument and uncertain representativeness of the study sample. In this cross-sectional study, we were not able to test the longitudinal validity of the EQ-5D such as test-retest reliability and sensitivity to change. These properties are necessary for a quality of life instrument to evaluate the treatment benefit of clinical interventions. Our patients were recruited from a single tertiary hospital. Therefore, our study sample may not be representative of the patient population with PD of Singapore.

In conclusion, this study provides initial evidence on the validity of the EQ-5D questionnaire for measuring quality of life in both English- and Chinese-speaking patients with Parkinson's disease in Singapore. Future validation studies of the instrument should also evaluate its responsiveness to change and pay special attention to the validity of EQ-VAS in Chinese-speaking patients with Parkinson's disease.

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