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Patient-Reported Outcomes

Comparison of EQ-5D-5L, VAS, and SF-6D in Thai Patients on Peritoneal Dialysis

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ABSTRACT

Objectives: To compare the utility scores derived from the 5-level EuroQol 5-dimensional questionnaire (EQ-5D-5L), the visual analogue scale (VAS), and the 6-dimensional health state short form (SF-6D) in Thai patients on peritoneal dialysis. **Methods:** Data were obtained from the 36-Item Kidney Disease Quality of Life questionnaire and the EuroQol questionnaires (EQ-5D-5L and VAS) via face-to-face interview for 64 patients on peritoneal dialysis. We compared the ceiling effect of all the utility tools by calculating the proportion at the highest scores. The mean difference in utility scores defined by patients' demographic characteristics and clinical laboratory value was evaluated using independent t tests or the Mann-Whitney U test. Moreover, the correlation was assessed using the Pearson correlation coefficient. The agreements among the instruments were illustrated with the Bland and Altman plots. **Results:** The mean score of the EQ-5D-5L, SF-6D, and VAS were 0.801, 0.784, and 0.733, respectively. The EQ-5D-5L presented a higher percentage of the ceiling effect than did the SF-6D and VAS. The EQ-5D-5L was able to distinguish the mean difference between age groups with significant difference ($P < .001$). The Pearson

correlation coefficients between utility scores and the 3 dimensions of the 36-Item Kidney Disease Quality of Life questionnaire had a significantly positive correlation, especially for the SF-6D. The Bland and Altman plots portrayed that the utility scores from the EQ-5D-5L were lower than those from the SF-6D and VAS among the patients in the poorer health state. **Conclusions:** Among the SF-6D, EQ-5D-5L, and VAS, only the EQ-5D-5L could distinguish the utility scores between different age groups. Nevertheless, the EQ-5D-5L presented the ceiling effect, whereas there was no evidence of the ceiling effect for the SF-6D. The SF-6D presented better correlation with the kidney disease-specific dimensions than did the EQ-5D-5L and VAS. Thus, the advantages and disadvantages of each utility tool should be considered.

Keywords: EQ-5D-5L, peritoneal dialysis, quality of life, SF-6D, utility, VAS.

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Introduction

The increasing use of health technology assessment in health policy decision making has emphasized the importance of economic evaluation tools. Quality-adjusted life-year (QALY) has gained higher attention in terms of the primary outcome for economic evaluation. QALY is a composite measure of disease burden including both quality and quantity measures of life lived. Utilities indicate the preference for a health state in the uncertainty situation. Utility scores could be measured directly from many tools such as the standard gamble, rating scale, and time trade-off or indirectly from the Quality of Well-Being scale, the Health Utility Index (versions 2 and 3), the 5-level EuroQol

5-dimensional questionnaire (EQ-5D-5L), and the 6-dimensional health state short form (SF-6D) [1].

These preference-based indirect measures have often been mentioned in studies [2–6]. The EQ-5D and the SF-6D are 2 of the most popular general quality-of-life (QOL) measures [2,3,7]. Many studies in end-stage renal disease (ESRD) evaluate QOL with the SF-6D and the 3-level EQ-5D (EQ-5D-3L) [8–13]. In the past, the EQ-5D-3L has been used to report the ceiling effect in patients on hemodialysis [8] and in those with other diseases [14,15]. The EQ-5D-5L has been developed from the original version (EQ-5D-3L) by adding 2 response choices in each dimension, which can increase the discriminative property and decrease the ceiling effect [4,15–18].

Conflicts of interest: The authors declare that they have no competing interests.

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The general QOL measures are simple and convenient, and can be used to compute utility scores for economic evaluations. Nevertheless, these provide less specific information on the condition of the disease than do disease-specific QOL measures. It is essential to determine the QOL of patients on peritoneal dialysis (PD) because their daily-life activities are limited by disease, socioeconomic, and treatment conditions [19,20]. At present, the 36-Item Kidney Disease Quality of Life (KDQOL-36) questionnaire is the kidney disease-specific questionnaire that has been assessed for its validity and reliability in Thai dialysis patients [21]. The questionnaire consists of the 12-item short form health survey (SF-12) and 3 major kidney disease-targeted dimensions such as symptoms and problems, the effects of kidney disease on daily life, and the burden of kidney disease. The scores of the KDQOL-36 questionnaire were transformed to a 0 to 100 range using the KDQOL-36 scoring program [22]. Measuring QOL with different tools gives different scores. Each tool has its own advantages and disadvantages. The use of both a general questionnaire and a disease-specific questionnaire may be a good option for both patient care and economic evaluation. To evaluate utility score, we can compute the SF-6D from the SF-12 in the KDQOL-36. The Thai preference score of the SF-6D was, however, not available. On the contrary, the scoring function of the Thai preference of the EQ-5D-5L was available. Thus, selecting the most suitable utility instrument in determining health-related quality of life (HRQOL) for patients on PD was the main interest of this study. The study compares the utility scores of the EQ-5D-5L, the SF-6D, and the visual analogue scale (VAS). The correlation between the utility scores and the disease-specific HRQOL scores using the KDQOL-36 questionnaire was also evaluated.

Methods

The study was conducted at the PD center of Siriraj Hospital in Thailand. The study population consisted of patients on PD. The inclusion criteria were as follows: (1) outpatients who were treated by continuous ambulatory PD or automated PD; (2) patients were at least 18 years old; (3) they were on dialysis for at least 3 months; (4) they were able to communicate in Thai; and (5) they provided informed consent to participate in the study. The study was approved by the Institutional Review Board Ethics Committee of Siriraj Hospital (IRB No. 12/2558(EC1)).

Sample Size Calculation

To calculate the required sample size for the evaluation of the correlation between the utility tools and the 3 kidney disease-specific scores, G*Power 3.1.9.2 was used with a 2-sided significance level of .050 and a power of 80%. The low correlation (a value of ≥ 0.2 and < 0.5) was considered at 0.35 for sample size calculation. The required sample size was 61 patients. In addition, the other objective was to discriminate the utility scores of patients in different health status. From the Cohen *d* effect sizes, a value was defined as small (≥ 0.2 and < 0.5), medium (≥ 0.5 and < 0.8), and large (≥ 0.8) [23,24]. Thus, we considered *d* at 0.3, 0.6, and 0.8 for small, moderate, and large effect sizes, respectively. Using G*Power 3.1.9.2 with a 2-sided significance level of .050 and a power of 80%, the required sample sizes were 176, 45, and 26 patients, respectively. At the time of study, there were 64 patients on PD in the setting, which was sufficient to evaluate the correlation with low size and to detect the differences between subgroups with large effect sizes.

Data Collection

The present study had a cross-sectional descriptive design. After giving informed consent, the investigator administered the study questionnaire via face-to-face interviews with 64 patients on PD

at Siriraj Hospital between April 2016 and May 2017. All the patients completed the KDQOL-36, the EQ-5D-5L, and a sociodemographic questionnaire. The EQ-5D-5L consisted of the VAS and had 5 dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). Each item included 5 levels (no problems, slight problem, moderate problem, severe problem, and extreme problem or unable to do [for mobility, self-care, and usual activities]). The EQ-5D-5L, KDQOL-36, and sociodemographic questionnaires were administered in the same order for every patient. To compute the utility scores, the EQ-5D-5L was used on the basis of the scoring function of the Thai preference, which was available at the time of this study [25]. The VAS of the EQ-5D-5L was used as the direct well-being score. From the SF-12 in the KDQOL-36, the SF-6D score was calculated by applying the scoring method derived from the UK preference because the scoring function of the Thai preference was not available. The QOL scores obtained from the KDQOL-36 were transformed to a 0 to 100 range, and higher scores reflected better QOL [22].

Data Analysis

Descriptive statistics were used to summarize the characteristics of the patients. The Pearson correlation coefficient was used for statistical testing of the correlation between the SF-6D, the EQ-5D-5L, the VAS, and the kidney disease-specific questionnaire. Furthermore, the ceiling effect was compared across the different

Table 1 – Characteristics of patients.

Characteristic (n = 64)	Value
Age (y), mean \pm SD	63.44 \pm 16.57
Sex, n (%)	
Male	44 (68.75)
Female	20 (31.25)
Marital status, n (%)	
Single	10 (15.63)
Couple	38 (59.38)
Divorce	4 (6.25)
Widow	12 (18.75)
Scheme, n (%)	
CSMBS	49 (76.56)
SSS	7 (10.94)
UC	6 (9.38)
Other	2 (3.13)
Education level, n (%)	
Below bachelor's degree	30 (46.88)
Bachelor's degree or higher	34 (53.13)
Family income (baht/mo), n (%)	
<50 000	29 (45.32)
≥ 50 000	35 (54.69)
Admission (previous year), n (%)	
Yes	37 (57.81)
No	27 (42.19)
Number of underlying diseases, n (%)	
1-2 diseases	23 (35.94)
≥ 3 diseases	41 (64.06)
Type of PD, n (%)	
CAPD	34 (53.13)
APD	30 (46.87)
Length of PD (y), mean \pm SD	3.63 \pm 2.55
Hb level	10.58 \pm 1.48

APD indicates automated peritoneal dialysis; CAPD, continuous ambulatory peritoneal dialysis; CSMBS, Civil Servant Medical Benefits Scheme; Hb, hemoglobin; PD, peritoneal dialysis; SSS, Social Security Scheme; UC, Universal Coverage Scheme.

measurement tools. Not only were correlation coefficients analyzed for comparison among the measurement tools, but graphical techniques were also used to describe scatterplots as well as the Bland and Altman plots [26]. The Bland and Altman plots portrayed the agreement among utility scores from the SF-6D, the EQ-5D-5L, and the VAS. The 95% limits of agreement were bordered by ± 1.96 SD of the difference in the mean score between the 2 compared scores along the y-axis [27]. The Bland and Altman plots illustrated the mean score and the difference in score between 2 utility measurements and how the values were distributed over the range of the score of the 2 measurement points. Utility tools were able to discriminate between patient groups on the basis of disease severity or socioeconomic status. For example, utility scores would be higher for patients in a better health status than for those in a worse health status [28,29]. The patients were dichotomized into subgroups of better and worse health status. The study used the mean score as the cutoff value for some variables such as age, number of comorbidities, hospital admission, and family income. For the cutoff value of the hemoglobin (Hb) level, the study used an Hb level of 10 g/dL [30] as recommended by the Nephrology Society of Thailand [31]. Independent *t* tests or the Mann-Whitney *U* test was used to compare the ability of the SF-6D, the EQ-5D-5L, and the VAS to discriminate among patient groups as appropriate.

Results

The mean age of patients was 63.44 ± 16.57 years, and 68.75% were men (Table 1). More than half of the patients on PD (59.38%) were married/living with a partner. Most of the patients on PD (76.56%)

were covered by the Civil Servant Medical Benefits Scheme, which was the health scheme for government employees, their dependents (children, spouses, and parents), and government retirees. The scheme provided medical benefits, including inpatient and outpatient services and medications. Thirty-four patients (53.13%) were treated by continuous ambulatory PD and 30 patients (46.87%) were treated by automated PD. Most of the patients (64.06%) had at least 3 comorbidities, and hypertension was found to be the major health problem in 89.06% of patients, followed by diabetes (57.81%). The duration of PD was 3.63 ± 2.55 years.

The EQ-5D-5L had the highest mean utility score including the highest variation (0.801 ± 0.228). The mean utility score of the SF-6D was 0.784 ± 0.152 , with the narrowest variation as compared with the EQ-5D-5L and the VAS. The VAS showed the lowest average utility score at 0.733 ± 0.167 (Table 2).

Utility scores from all the measures depicted negatively skewed distributions. The SF-6D scores (Fig. 1A) were more evenly distributed, with the least negatively skewed distribution ranging from 0.417 to 1.000. The EQ-5D-5L scores (Fig. 1B) presented the widest range (0.061-1.000) at the higher end. The VAS scores (Fig. 1C) depicted the most obvious multimodal distribution ranging from 0.300 to 1.000.

Figure 2 depicts the widest limits of agreement (0.86) as the Bland and Altman plot between the difference and the average of the EQ-5D-5L and the VAS, followed by the EQ-5D-5L and the SF-6D (0.81) and the SF-6D and the VAS (0.58), respectively. Figure 2A shows that approximately 93.75% of the differences in utility scores between the EQ-5D-5L and SF-6D were within the limits of agreement. Nevertheless, 6.25% of the differences in utility scores were below the lower agreement line. About 92.19% of the

Table 2 – Utility scores and grouping variable.*

Grouping (n)	SF-6D	EQ-5D-5L	VAS
Utility score (all patients)			
Mean \pm SD	0.784 ± 0.152	0.801 ± 0.228	0.733 ± 0.167
Median (minimum-maximum)	0.797 (0.417-1.000)	0.881 (0.061-1.000)	0.790 (0.300-1.000)
Age (y), mean \pm SD			
<63 (26)	0.814 ± 0.143	0.910 ± 0.133	0.760 ± 0.141
≥ 63 (38)	0.763 ± 0.156	0.727 ± 0.250	0.715 ± 0.183
Mean difference	0.051	0.183	0.045
P value	.191	<.001	.296
Underlying diseases, mean \pm SD			
0-3 (32)	0.806 ± 0.147	0.811 ± 0.197	0.731 ± 0.163
4+ (32)	0.762 ± 0.156	0.791 ± 0.258	0.736 ± 0.175
Mean difference	0.044	0.020	0.005
P value	.248	.761	.897
Family income (baht/mo), mean \pm SD			
<50 000 (29)	0.776 ± 0.137	0.788 ± 0.263	0.738 ± 0.171
≥ 50 000 (35)	0.791 ± 0.165	0.812 ± 0.198	0.730 ± 0.167
Mean difference	0.015	0.024	0.008
P value	.695	.786	.846
Hospital admission (previous year), mean \pm SD			
Yes (37)	0.786 ± 0.153	0.796 ± 0.262	0.727 ± 0.178
No (27)	0.781 ± 0.153	0.809 ± 0.175	0.742 ± 0.155
Mean difference	0.005	0.013	0.015
P value	.903	.481	.733
Hb level (g/dL), mean \pm SD			
<10 (18)	0.767 ± 0.129	0.743 ± 0.261	0.739 ± 0.166
≥ 10 (46)	0.790 ± 0.161	0.824 ± 0.213	0.731 ± 0.170
Mean difference	0.023	0.081	0.008
P value	.582	.220	.871

EQ-5D-5L indicates 5-level EuroQol 5-dimensional questionnaire; Hb, hemoglobin; SF-6D, 6-dimensional health state short form; VAS, visual analogue scale.

* Significance test with *t* test for the SF-6D and the VAS, and Mann-Whitney test for the EQ-5D-5L.

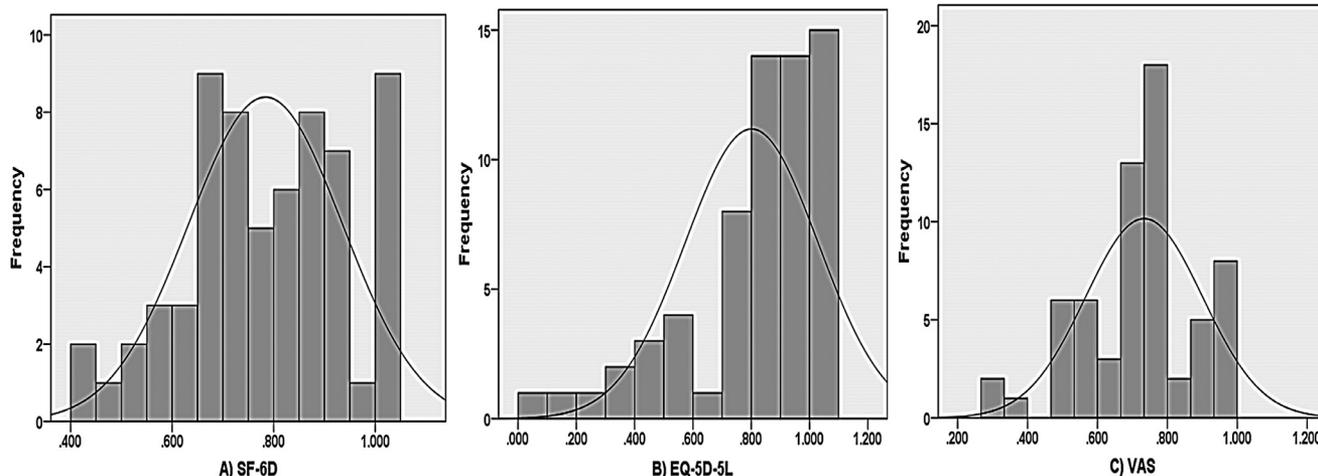


Fig. 1 – Distributions of the SF-6D, the EQ-5D-5L, and the VAS. EQ-5D-5L indicates 5-level EuroQol 5-dimensional questionnaire; SF-6D, 6-dimensional health state short form; VAS, visual analogue scale.

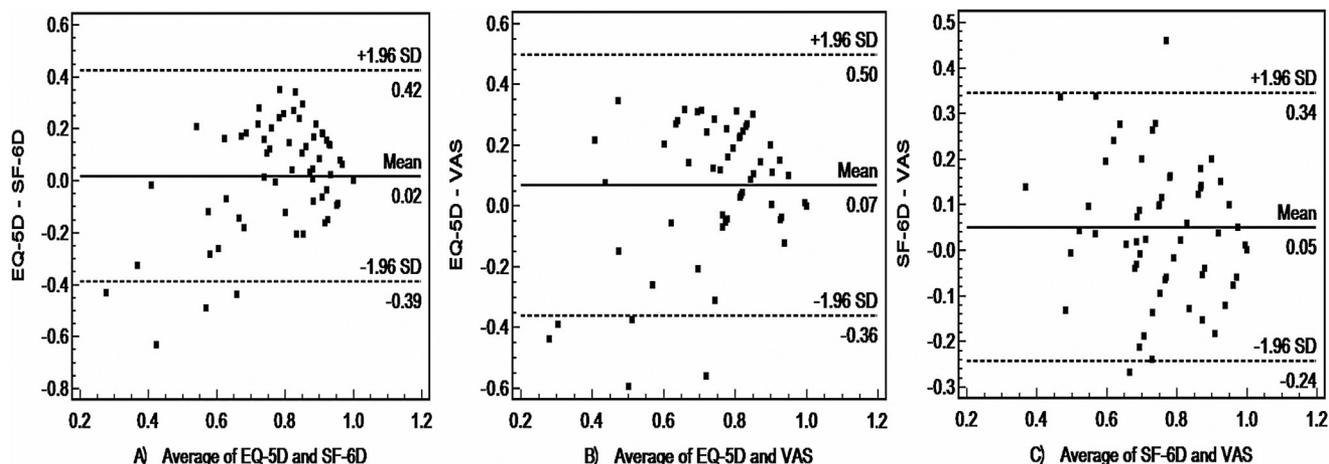


Fig. 2 – The Bland and Altman plots of the EQ-5D-5L with the SF-6D, the EQ-5D-5L with the VAS, and the SF-6D with the VAS. EQ-5D-5L indicates 5-level EuroQol 5-dimensional questionnaire; SF-6D, 6-dimensional health state short form; VAS, visual analogue scale.

differences in utility scores between the EQ-5D-5L and the VAS were within the limits of agreement, whereas 7.81% of the differences in utility scores were below the lower agreement line (Fig. 2B). About 96.88% of the differences in utility scores between the SF-6D and the VAS were within the limits of agreement and 3.12% of the differences in utility scores were above the agreement line (Fig. 2C). The Bland and Altman plots also revealed a pattern of relationship between the differences and the average utility scores. The relationship suggested that utility scores from the EQ-5D-5L were lower than those from the SF-6D among the patients in the poorer health state (Fig. 2A).

Among all the subgroups, the EQ-5D-5L (range 0.013-0.183) showed the widest mean differences in utility scores compared with the SF-6D (range 0.005-0.051) and the VAS (range 0.005-0.045), as presented in Table 2. Although the SF-6D, the EQ-5D-5L, and the VAS were able to detect the differences among subgroups, the differences were not statistically significant. Only the EQ-5D-5L was able to detect statistically significant differences in the age subgroup ($P < .001$). Utility scores measured by the EQ-5D-5L could detect higher scores in patients in better health status

Table 3 – Pearson correlation coefficients between utility scores and kidney disease-specific scores.

Kidney disease-specific scores	SF-6D	EQ-5D-5L	VAS
Symptoms and problems	0.405*	0.394*	0.391*
Effects of kidney disease on daily life	0.487*	0.283†	0.323*
Burden of kidney disease	0.546*	0.423*	0.439*

EQ-5D-5L indicates 5-level EuroQol 5-dimensional questionnaire; SF-6D, 6-dimensional health state short form; VAS, visual analogue scale.

* Significant at $P = .010$.

† Significant at $P = .050$.

and lower scores in patients in lower health status. For example, the utility scores of the older group (≥ 63 years) were lower than those of the younger group, the utility scores of the patients with fewer underlying diseases (< 3 diseases) were higher than of those

Table 4 – Percentage of patients reporting perfect health who scored <50 on kidney disease–specific dimension.

Instruments	Percentage of patients (n)		
	Symptoms and problems	Effects of kidney disease	Burden of kidney disease
SF-6D	0.00% (0 from 9)	0.00% (0 from 9)	0.00% (0 from 9)
EQ-5D-5L	0.00% (0 from 15)	0.00% (0 from 15)	20.00% (3 from 15)
VAS	0.00% (0 from 5)	0.00% (0 from 5)	40.00% (2 from 5)

EQ-5D-5L indicates 5-level EuroQol 5-dimensional questionnaire; SF-6D, 6-dimensional health state short form; VAS, visual analogue scale.

with more underlying diseases, the utility scores of patients who had a mean Hb level of 10 g/dL or more were higher than of those who had a lower Hb level. The Pearson correlation coefficients of the SF-6D and the EQ-5D-5L, the SF-6D and the VAS, and the EQ-5D-5L and the VAS were 0.473, 0.561, and 0.426, respectively. For the correlation between all utility scores and kidney disease–specific scores, all utility scores were significantly correlated with all kidney disease–specific scores, especially for the SF-6D. The highest correlation was the correlation between the SF-6D and the burden of kidney disease dimension ($r = 0.546$), followed by the VAS ($r = -0.439$) and the EQ-5D-5L ($r = 0.423$) (Table 3).

Fifteen patients (23.44%) reported perfect health on the EQ-5D-5L (11111), 9 patients (14.06%) reported perfect health on the SF-6D (645655), and 5 patients (7.81%) scored 100 on the VAS (Table 4). Patients with perfect health on the EQ-5D-5L had an average VAS score of 0.856 (range 0.700–1.000) and those on the SF-6D had a score of 0.881 (range 0.660–1.000). Twenty percent patients reporting perfect health on the EQ-5D-5L scored less than 50 on the burden of kidney disease dimension. Forty percent patients with perfect health on the VAS scored low HRQOL on the burden of kidney disease dimension. No respondents with perfect health on the SF-6D reported kidney disease scores less than 50.

Discussion

The EQ-5D-5L reflected a higher average utility score and variability (0.801 ± 0.228) compared with the SF-6D (0.784 ± 0.152) and the VAS (0.733 ± 0.167). The average EQ-5D-5L score of the whole PD sample group exceeded the average SF-6D score by 0.017 (Table 2). The correlation between the SF-6D and the VAS was stronger ($r = 0.561$) than that between the SF-6D and the EQ-5D-5L ($r = 0.473$), which differed from that in a previous study⁴ that found the correlation between the SF-6D and the EQ-5D-5L to be stronger ($r \geq 0.5$). Although the EQ-5D-5L could decrease the ceiling effect of the EQ-5D-3L and increase the discriminative power of health difference as in the previous study of patients with ESRD in Singapore [4] and in a study of patients with diabetes in China [32], it still presented the ceiling effect, as shown in the results. The ceiling effect of patients on PD on the EQ-5D-5L index in this study was consistent with what has been measured by the EQ-5D-3L in the study of ESRD in Thai patients [8]. Nevertheless, the EQ-5D-5L had a smaller ceiling effect than the EQ-5D-3L. Among patients who reported perfect health on the EQ-5D-5L, they had an average score of 0.881 on the SF-6D and 0.856 on the VAS. This implied that patients on PD reporting “no problems” on all 5 dimensions of the EQ-5D-5L encountered some problems that could be detected by the SF-6D and the VAS. This finding was confirmed by the responses on the KDQOL-36 (Table 4), which implied that the SF-6D and the EQ-5D-5L could not be used interchangeably in patients on PD.

It was observed that the patients with perfect health on the EQ-5D-5L and the VAS had reported low HRQOL on the burden of kidney disease on daily-life dimension. No patient with perfect health

on the SF-6D reported low HRQOL (<50) on any kidney disease–specific dimension. Thus, the SF-6D obtained a higher correlation with 3 kidney disease–specific dimensions compared with the EQ-5D-5L and the VAS—same as the results for the patients with ESRD in Singapore [4]. Nevertheless, the SF-6D was derived from the SF-12, which was a component of the KDQOL-36 and thus it seems probable that the correlation and the responses to the SF-6D and the kidney disease–specific dimensions could be better than those for the EQ-5D-5L and the VAS. All utility tools had the ability to detect differences among subgroups such as age, underlying disease, family income, and Hb level. Nevertheless, only the EQ-5D-5L detected significant differences between the older group (≥ 63 years) and the younger group. The trend of the EQ-5D-5L presented a higher utility gain than that of the SF-6D in patients on PD in different health status, as found in previous studies [33,34]. These results implied that the EQ-5D-5L might be useful to evaluate QALYs for cost-effectiveness analysis, especially in elderly patients on PD.

This study has some limitations that need to be pointed out. First, 64 patients might have been inadequate to detect the differences between subgroups with low effect size. Nevertheless, in our setting of a large dialysis center in Thailand, there were about 180 patients (data in 2016) on hemodialysis and 70 patients on PD. During the study period, some patients on PD had complications and so only 64 patients were included in the study. Second, this study was a cross-sectional study. Thus, it was essential to be aware of the analytical limitations of a cross-sectional study, which was a 1-time evaluation of the outcome. Finally, the Thai preference score of the SF-6D was not available and so the results may not reflect the true preference in Thai context.

Conclusions

The EQ-5D-5L could detect significant differences between the older group and the younger group. Nevertheless, the EQ-5D-5L still presented the ceiling effect, whereas there was no evidence of the ceiling effect for the SF-6D. Moreover, the SF-6D presented better correlation with kidney disease–specific dimensions than did the EQ-5D-5L and the VAS. Thus, the advantages and disadvantages of using different utility tools should be considered.

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