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ORIGINAL RESEARCH

The EQ-5D-5L Valuation study in Thailand

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ABSTRACT

Background: At present, health technology assessment (HTA) guidelines of many countries including Thailand have recommended EQ-5D as the preferred method for assessing utility. This study aims to generate an EQ-5D-5L value set based on societal preferences of Thai population.
Methods: A 1,207 representative sample was recruited using a stratified multi-stage quota sampling technique. Face-to-face, computer-assisted interviews using the EuroQol Valuation Technology (EQ-VT) software were employed. To elicit preference score, each respondent was asked to value health states using composite time trade-off (cTTO), and discrete choice experiment (DCE). All data were integrated and analyzed using a hybrid regression model to estimate the value set.
Results: Characteristics of 1,207 participants were generally similar to those of Thai general population. The coefficients generated from a hybrid model were logically consistent. The second best value is 0.9436 for health state 11121 and the worst state (55555) value is −0.4212. Mobility shows the greatest impact to utility decrement.
Conclusions: Our study developed a Thai value set for EQ-5D using hybrid model. The findings from this study are of important to facilitate health technology assessment studies to inform policy decision-making as well as to promote the use of EQ-5D-5L in various health research in Thailand.

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EQ-5D-5L; health status index; quality of life; utility; value set

1. Introduction

Health technology assessment (HTA) is a systemic way to evaluate the effect and/or impacts of health technology in order to inform a policy decision-making [1]. Due to scarcity of health resource and increasing high cost of available health technology, demand for HTA evidences is increasing. During a past decade, HTA has received great attention by stakeholders and has a significant tool for evidence-based policy decision-making in Thailand [2,3]. According to the Thai national guidelines of HTA [4,5], a cost-utility analysis has been recommended as a preferred method for assessing the cost-effectiveness of health technology. For cost-utility analysis, outcome of health technology is measured in terms of quality-adjusted life year (QALY), which enable comparison across different types of health technology. QALY is calculated by the amount of life expectancy multiplied by the utility score, which is varied by each individual's preferences of his/her health status. The Thai national guideline of HTA has recommended EQ-5D as the preferred instrument for assessing the utility for HTA studies.

The EQ-5D is a widely used generic instrument for describing health outcome [6]. It contains five dimensions i.e. mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. EQ-5D-3L, the first version of EQ-5D, comprises three levels of responses, i.e. no problems, some/moderate problems, and unable/extreme problems, which generates total of 243 possible health states (3^5). However, the main limitation of the EQ-5D-3L, e.g. ceiling effect, has been well documented [7–10]. In response to this problem, the 5-level of EQ-5D, EQ-5D-5L, was developed by a task force within the EuroQol group in 2005 [11]. This version includes five levels of impairment in each of the existing five EQ-5D dimensions, resulting in 3,125 possible health states (5^5). Several studies [12–15] examining its measurement property and found the improvement in its validity and reliability compared to the EQ-5D-3L.

To get the utility score, the descriptive answers from the EQ-5D are transformed into the index score using a value set. As there are differences in socioeconomic and cultural across countries, country-specific value set is needed. Recently, the value sets for EQ-5D-5L have been generated for many countries such as England [16], Canada [17], Korea [18], Japan [19], China [20], Uruguay [21], Indonesia [22], and the Netherlands [23]. In Thailand, the Thai EQ-5D-3L value set was established based on time trade-off (TTO) method, using the Measurement and Valuation in Health (MVH) protocol since 2009 [24]. According to the Thai EQ-5D-3L value set, the second best score is 0.766 for state 11112 while the lowest score is −0.454 for the worst state (33333). Recently, the Thai version of EQ-5D-5L has been developed. Previous study in Thailand indicated the improvement of EQ-5D-5L as compared to EQ-5D-3L in several psychometric properties [25]. Nevertheless, a

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value set for EQ-5D-5L has not been generated for Thai population yet. This paper aims to produce a value set for the EQ-5D-5L Thai version which can be used in HTA, clinical research, and population surveys.

2. Methodology

2.1. Protocol

This study was a cross-sectional survey, using the EuroQol Group's Valuation Technology (EQ-VT), the standardized valuation study protocol generated by the EuroQol group [26]. The data were collected using laptop installed with the EQ-VT software. The EQ-VT comprises 5 parts as follows: (1) introduction; (2) reporting their own health using the EQ-5D-5L (official Thai version) and visual analogue scale (VAS); (3) background questions (i.e. age, gender, experience on illness); (4) 10 questions of composite time trade-off (cTTO); and (5) 7 pairs of discrete choice experiment (DCE) task.

2.2. Study population and sampling method

According to the EQ-VT protocol, a minimum of 1,000 respondents was required as this number generates a small error (0.01–0.06) of the observed mean of health state measured by cTTO [26,27]. To ensure the representativeness of general Thai population, the sample size of 1,207 based on multi-stage quota sampling technique was suggested by the Thai National Statistical Office. For sampling technique, first, all 77 provinces in Thailand were stratified into Bangkok and 4 regions: North, Northeast, Central, South. The primary sampling unit was province. Eleven provinces and Bangkok (total = 12) were randomly selected using systematic sampling. Those eleven provinces included Sing Buri, Trat, Suphan Buri, Chiang Mai, Chiang Rai, Sukhothai, Surin, Nong Bua Lam Phu, Roi Et, Krabi, and Nakhon Si Thammarat. The secondary sampling unit was enumeration areas (EAs), the operational geographic units for the data collection. Each EA may vary considerably in size of household and population, so probability proportional to size was applied. In our study, 120 EAs was selected from the total of approximately 120,000 EAs in Thailand. For each EA, 10 respondents were selected using quota sampling by age and gender according to the Thai population structure. The inclusion criteria were as follows; (1) being 18+ years old; (2) able to understand the tasks (as judged by the interviewer); and (3) able to give informed consent. We excluded a person with presence of acute illness or cognitive impairment that would interfere with the study task. Respondents were identified and invited by area coordinator prior to interview date. All respondents provided written informed consent prior to inclusion in the study. After completing the questionnaire, the respondents received 3.25 USD for compensation (1 USD = 30.73 Baht).

2.3. Data collection and eliciting preferences methods

The data collection was conducted using face-to-face, computer-assisted interview, between August 2013 and January 2014. This study employed 6 interviewers who graduated at least bachelor degree and had experiences in health sciences interview. They were intensively trained prior to field work and also joined a pilot study which comprised a total of 100 respondents recruited from similar settings.

Regarding preference elicitation by cTTO, a total of 86 health states were selected from 3,125 health states. They consisted of 5 very mild states (11112, 11121, 11211, 12111, 21111); 1 anchored state (55555); and 80 other states of varying severity. All 86 health states were divided into 10 blocks. One out of 10 blocks was randomly selected by the EQ-VT software for each respondent.

The respondent was asked to imagine two alternative health states: life A – living in full health for X years; or life B – living in poor health state (Y) for t years, and choose the better one from their opinion. When a health state was considered as better than dead (BTD) by the respondents, the number of life B (t) equal to 10 year [26]. The X years in life A are varied until the respondent is indifferent between 2 alternatives. In this case, the value for health state Y is defined as X/10. However when a health state was considered as worse than dead (WTD), a lead time approach, which limit the lowest value to −1, was used [28]. According to EQ-VT, the lead time was 10 years of full health, so the two alternative health states were (1) life A X years in full health; and (2) life B 10 years in full health, then 10 years in the poor health state (Y). In this case, the value of health state Y is defined as (X-10)/10.

The EQ-VT software included a complementary preference elicitation using DCE. The protocol consisted of 196 pairs of health states which were arranged into 28 blocks. Each block contained 7 pairs of health states; life A and life B, which was similar misery index. The EQ-VT software randomly selected 1 block for each participant. During the interview, each respondent was asked to imagine both life A and B described on screen; and make a forced choice from two alternative health states.

2.4. Quality control

All responses were electronically recorded and submitted to the EuroQol group data center. The quality control process was employed using the EQ-VT QC tool developed by the EuroQol group [29]. It was used to assess the pattern of responses and the interviewer performance in order to decrease interviewer effects. The EQ-VT QC tool could produce a report, focusing on time spent on explanation and complete 10 cTTO tasks, inconsistencies responses from cTTO, unusual response from DCE task. The interviewers were feedback bi-weekly according to their performance. In addition, the EuroQol group's expert communicated with the principal investigator regularly regarding the data quality.

2.5. Exclusion criteria and data management

The following cTTO responses were excluded prior to analysis: (1) all 10 states got the same value; (2) positive slope which means that the respondent gave higher value when the severity level of health states increased; (3) very irrational responses, for example, gave value 1.0 for worst health state (55555) while the better health state got lower value.

A logical dominance relationship between two health states was defined as follows: state A dominates state B when state A is better than state B in at least one dimension while no worse than state B in the remaining dimension [30,31]. In this case, logical inconsistency may occur when the elicited values of state B was better than a dominating state A.

With regard to estimate the value set, both cTTO and DCE dataset were used. This study generated 3 models: cTTO model and DCE model for comparison purpose, and hybrid model as preferred model to estimate the value set as it maximized the available information. The dependent variable was disutility (i.e. 1 – cTTO observed value). The independent variables were 5 dimensions of EQ-5D which each dimension contained 5 options. Level 1 was used as the reference, hence 20 dummy variables (4 levels × 5 dimensions) were produced in the main effect model. These dummies represented the utility decrement of moving from the level 1 (reference) to any of the remaining levels (levels 2–5).

2.6. Data analysis

Statistical analysis was undertaken using STATA statistical package. For cTTO, multilevel regression models (i.e. random coefficient model) were undertaken to estimate coefficients. DCE data were analyzed differently from cTTO data as the values obtained from DCE valuation were not directly observed and have to be calculated from the binary responses. The health state chosen by the respondents was assumed that it gave them higher utility, so the conditional logit model was employed to estimate health value. However, the values generated were on an arbitrary scale and needed to be rescaled. All coefficients obtained from a conditional logistic model were divided by a scalar, which was calculated as follows: (worst health state$_{DCE}$ − 1)/(worst health state$_{cTTO}$ − 1) [32]. The coefficients represented the utility decrements for the DCE rescaled model.

A hybrid regression model, which is a novel analysis method developed by Oppe and van Hout [33], was employed to estimate coefficients. Continuous responses from cTTO and dichotomous responses from DCE were combined in a single model using 'hyreg' command developed by Ramos-Goñi et al. [34] which fits the model by maximizing a single likelihood function. This command allows the continuous and dichotomous responses to have different distributions (logistic and normal), and have different independent variables to model scaling terms. Since the variance of cTTO data is not homogenous, a heteroskedastic model was estimated in which cTTO responses were censored at −1.

The predicted utilities for 3,125 health states from 3 models were assessed in terms of strength and direction of association using the Pearson product-moment correlation coefficient.

3. Results

3.1. Respondent's characteristic and their self-reported health

A total of 1,207 respondents completed the valuation study interviewed. The characteristic of sample was similar to the Thai general population in terms of gender, age group, residential area, and number of child (Table 1).

Table 1. Demographic characteristic of respondents.

Variables	Respondent (*N* = 1,207) *n* (%)	Thai general population [45, 46] (%)
Gender		
Male	584 (48.38)	49.10
Female	623 (51.62)	50.90
Age (mean (SD))	43.55 (15.03)	44.20
18–29 yr	251 (20.80)	20.20
30–39 yr	262 (21.71)	22.70
40–49 yr	273 (22.62)	22.60
50–59 yr	208 (17.23)	16.90
≥60 yr	213 (17.65)	17.60
Marital status		
Single	231 (19.14)	30.90
Married	816 (67.61)	57.40
Widowed/Divorced/Separated	160 (13.26)	11.70
Residential area		
Urban	523 (43.33)	44.20
Rural	684 (56.67)	55.80
Education		
Primary school or lower	543 (44.99)	52.80
High school	533 (44.16)	30.10
Bachelor or higher	131 (10.85)	17.10
Occupation		
Agriculture/fishery	426 (35.29)	27.60
Service and business	499 (41.34)	43.70
Housewife	128 (10.60)	8.60
Student	64 (5.30)	8.00
Unemployed	40 (3.31)	0.90
Other	50 (4.14)	11.30
Household income in Baht (mean (SD))	22,602.86 (26,757.98)	25,194.00
Number of child (mean (SD))	1.75 (1.57)	1.50

Table 2. Self-reported health status.

Level of responses	EQ-5D-5L description (*n*(%)) Mobility	Self-care	Usual activities	Pain/ discomfort	Anxiety/ depression
No problems	873 (72.33)	1,163 (96.35)	952 (78.87)	571 (47.31)	823 (68.19)
Slight problems	235 (19.47)	32 (2.65)	188 (15.58)	525 (43.50)	313 (25.93)
Moderate problems	84 (6.96)	9 (0.75)	60 (4.97)	98 (8.12)	62 (5.14)
Severe problems	15 (1.24)	3 (0.25)	7 (0.58)	13 (1.08)	8 (0.66)
Unable/extreme problems	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.08)
VAS: mean (SD)			83.08 (11.88)		
Reported full health (11111): n (%)			366 (30.32%)		

Regarding health status of the respondents measured by the EQ-5D-5L, a majority of them reported 'no problems' for each dimension; ranging from 47.31% for pain/discomfort dimension to 96.35% for self-care dimension (Table 2). The mean VAS score was 83.08. There were 366 respondents (30.32%) reported their own health as full health (11111).

3.2. Data characteristics

All 1,207 respondents interviewed, thus 12,070 cTTO observations (10 health states × 1,207 respondents) were generated. Data from 2 respondents (20 observations) were excluded prior to analysis according to the exclusion criteria, i.e. 10 observations gave the same values for all 10

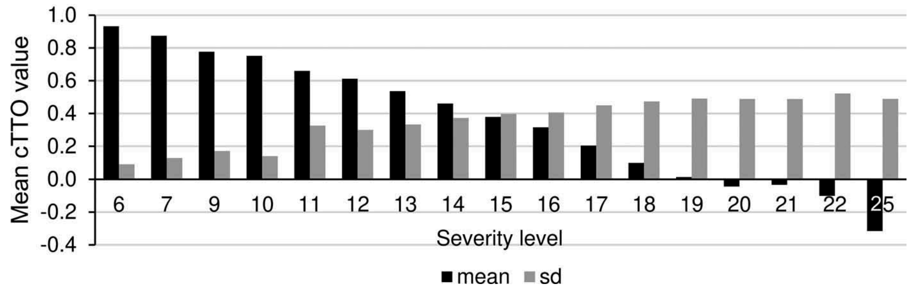

Figure 1. Mean observed cTTO value by severity level.

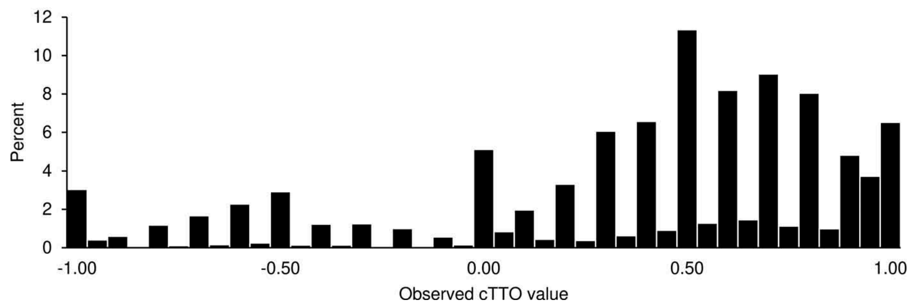

Figure 2. Observed cTTO value distribution.

states; 10 observations showed positive slope. The DCE data comprised 16,898 observations (7 pair × 2 health states × 1,207 respondents).

Figure 1 presents the mean observed cTTO value of 86 health state's profiles by severity level (i.e. sum of levels across dimensions). As shown in the figure, almost all of the cTTO mean values are in the positive side of the scale. The highest mean cTTO score is 0.94 for the following 4 health states: 11112, 11121, 12111, 21111. The lowest mean cTTO score is −0.31 for health state 55555. Eight out of 86 health states are valued as worse than death, i.e. 35245, 55225, 44345, 55424, 44553, 52455, 43555, 55555. The distribution of observed cTTO values is showed in Figure 2. A few clustering of certain values is found on the scale. The highest proportion of values is 0.5 (11.35%), followed by 0.7 (9.04%), and 0.6 (8.19%) respectively.

3.3. Modeling

Table 3 shows estimation results from cTTO, DCE, and hybrid model. The coefficients generated from cTTO and hybrid model are logically consistent. According to the hybrid model, mobility dimension has the highest impact to the utility decrement (disutility ranges from 0.0661 (level 2) to 0.3712 (level 5)), while usual activities dimension has less impact (disutility ranges from 0.0583 (level 2) to 0.2483 (level 5)). The maximum value is 1.00 for health state 11111 (full health). The second best value is 0.9436 for health state 11121 while the worst value is −0.4212 for health state 55555. The number of negative value (worse than dead) is 188 health states (6.0%), as shown in Table 3.

In our study, the utility weight can be estimated as 1 – the relevant decrement for each level of problem on each dimension (as shown in Table 3). For example, utility weight for health state '31245' can be calculated from hybrid model as follows; 1–0.0866 (moderate problems in mobility) – 0 (no problems in self-care) – 0.0583 (slight problems in usual activities) – 0.2069 (severe problems in pain/discomfort) – 0.2953 (extreme problems in anxiety/depression) = 0.3529.

Table 3. Coefficient estimated for cTTO, DCE, and hybrid model.

	cTTO model		DCE model		Hybrid model	
Variables	Coeff.	SE	Coeff.	SE	Coeff.	SE
Mobility (MO)						
mo2	0.0622	0.0089	0.0686	0.0089	0.0661	0.0049
mo3	0.1254	0.0095	0.0684	0.0103	0.0866	0.0072
mo4	0.2426	0.0103	0.1827	0.0107	0.2110	0.0071
mo5	0.3228	0.0096	0.3569	0.0123	0.3712	0.0072
Self-care (SC)						
sc2	0.0331	0.0086	0.0540	0.0097	0.0581	0.0047
sc3	0.0988	0.0103	0.0408	0.0108	0.0706	0.0067
sc4	0.2168	0.0102	0.1700	0.0107	0.1925	0.0071
sc5	0.2488	0.0093	0.2138	0.0105	0.2499	0.0066
Usual Activity (UA)						
ua2	0.0499	0.0090	0.0415	0.0094	0.0583	0.0047
ua3	0.0786	0.0098	0.0388	0.0105	0.0712	0.0065
ua4	0.1747	0.0098	0.1278	0.0104	0.1535	0.0067
ua5	0.2165	0.0090	0.2238	0.0108	0.2483	0.0067
Pain/Discomfort (PD)						
pd2	0.0415	0.0080	0.0354	0.0095	0.0564	0.0043
pd3	0.0726	0.0103	0.0482	0.0106	0.0665	0.0071
pd4	0.2281	0.0091	0.1825	0.0107	0.2069	0.0071
pd5	0.2733	0.0096	0.2282	0.0108	0.2564	0.0073
Anxiety/Depression (AD)						
ad2	0.0435	0.0090	0.0452	0.0103	0.0581	0.0043
ad3	0.1067	0.0106	0.0808	0.0101	0.0958	0.0068
ad4	0.2187	0.0097	0.2118	0.0109	0.2327	0.0066
ad5	0.2591	0.0091	0.2978	0.0115	0.2953	0.0066
Second best score	0.9669 (12111)		0.9646 (11121)		0.9436 (11121)	
Minimum score (55555)	−0.3205		−0.3205		−0.4212	
Range from the best to worst score	1.3205		1.3205		1.4212	
Number of negative value among 3,125 health states (%)	168 (5.4%)		85 (2.7%)		188 (6.0%)	

cTTO: composite time-trade-off, DCE: discrete choice experiment; MOx: mobility at level x, SCx: self-care at level x, UAx: usual activities at level x, PDx: pain/discomfort at level x, ADx: anxiety/depression at level x

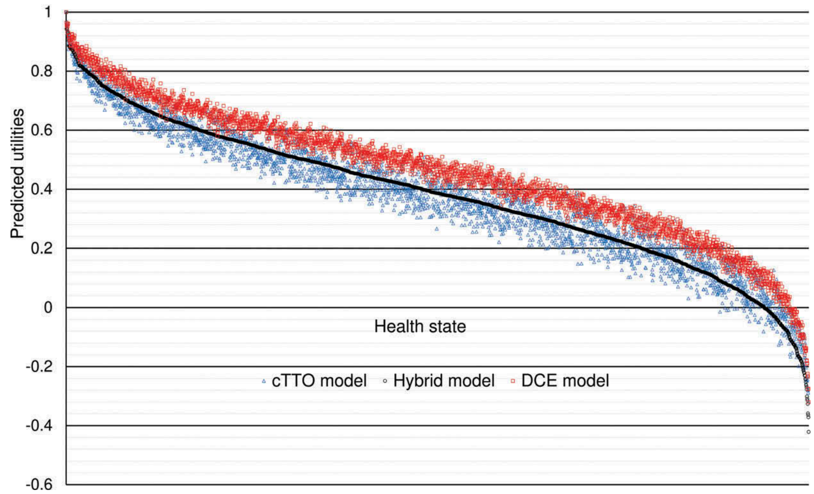

Figure 3. Scatter plot of predicted utilities from 3 models: cTTO, DCE, and hybrid model (red dot = DCE model, black dot = hybrid model, blue dot = cTTO model).

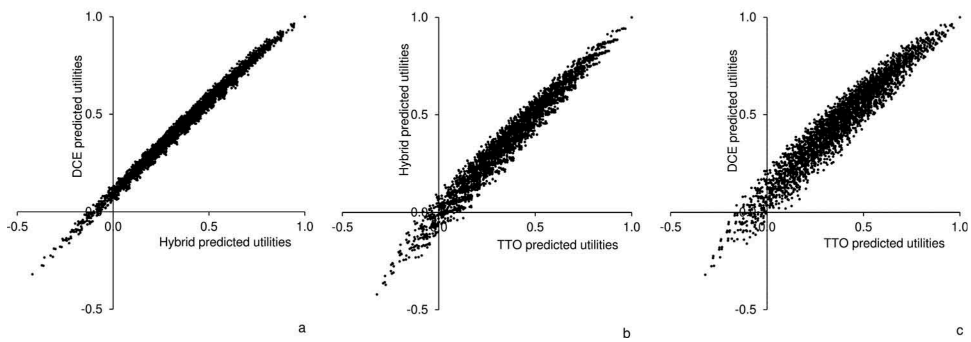

Figure 4. Association among predicted utilities from 3 models: cTTO, DCE, and Hybrid model.

When looking at the results from DCE model, it was found that a few coefficients was logically inconsistent. The minimum score and range of scores from DCE model is the same as cTTO model as the worst value (health state 55555) estimated from cTTO model was used to anchor for the worst state of DCE model. However, the distribution of predicted utilities generated from DCE model was relatively high compared with cTTO model and hybrid model (Figure 3).

Figure 4 shows the association among 3 models. The strongest correlation was found between hybrid model vs. DCE model (r = 0.9954, p value <0.0001), while the correlation coefficient between hybrid model vs. cTTO model; and cTTO model vs. DCE model was 0.9811 and 0.9651 (p value< 0.0001) respectively.

4. Discussion

This population-based value set for the EQ-5D-5L reflects the societal preferences of the Thai population. The values for 3,125 EQ-5D-5L health states were elicited using cTTO and DCE, and preference data was modeled together by a hybrid model. To date, there are some studies [16,22,35–38] that used the hybrid model to estimate the value set of EQ-5D-5L. In our study, both hybrid and cTTO model demonstrates logical consistency. However, the advantage of the hybrid model is that it maximizes data usage by incorporating data from both cTTO and DCE, which provide different and complementary information. While cTTO measures preference for health state directly by asking respondent to trade-off between quality of life and length of life, the DCE study asked respondent to trade-off between quality of life and quality of life.

At the present, there is no standard protocol for estimating value set from DCE valuation. Previous studies showed the feasible and advantages of DCE over TTO valuation [39–41]. However, the main difficulty in analyzing DCE data was that the values generated from the regression model were on arbitrary scale which needed some methodology to anchor the values derived from DCE on the QALY scale [32,39,42]. A few strategies for anchoring worst state of DCE were employed: using the worst value estimated from cTTO model (55555) or anchored the worst value on the death state. The latter need more DCE question, i.e. whether life A was WTD and whether life B was WTD. In our study, the DCE questions from EQ-VT protocol had no such questions then the worst state of DCE was anchoring using the worst value from cTTO.

Similar to the study in Korea and Uruguay [18,21], our study identified the inconsistency from DCE model. However, our study indicated that integrating DCE information into cTTO information using the hybrid model could solve the consistency. This findings supported that hybrid model could make the DCE data more useful. During interview, we noticed that some respondents made decision on DCE task very quick, i.e.

they considered only whether the problems on a particular dimension existed or not; and did not consider the severity level of out-of-interest dimension. However, further research is needed to explore more about the cause of inconsistency and how to deal with these problems.

Similar to many countries such as Indonesia [22], Korea [18], Japan [38], Canada [17], Uruguay [21], we found that mobility is the most important health problem for Thai population. On the other hand, pain/discomfort and anxiety/depression are the most important dimensions in the Netherlands [23] and England [16]. Dimension which has the smallest impact to the utility decrement was varied by countries. In Thailand, the second best health state for Thai EQ-5D-5L is 11121 (utility = 0.9436) while they were 11211 and 21111 for England (utility = 0.950), 11211 for China (utility = 0.955), and 11112 for Indonesia (utility = 0.921). When looking at the worse than dead health state, our study found that 6.0% of the health states were considered worse than dead as compared to 5.1% from English study. The worst health state (55555) in our study yielded the value of −0.4212. When compared to the study using hybrid model, our worst health state had higher value than those of Indonesia (−0.865) but lower than those of English population (−0.285).

When comparing Thai's EQ-5D-5L and EQ-5D-3L value set, the second best value of EQ-5D-5L was higher (0.9436 for health state 11121 of EQ-5D-5L vs. 0.766 for health state 11112 of EQ-5D-3L). In terms of the most important dimension, we found that mobility is the most important dimension for both Thai's EQ-5D-3L value set and EQ-5D-5L value set. Hence, health conditions which affect mobility could make great impact on the change of preference score for Thai population. In terms of the worst health state, we found that the value derived from EQ-5D-5L value set and EQ-5D-3L value set were quite similar (33333 = −0.454 vs. 55555 = −0.4212). Extensive comparison between the Thai's EQ-5D-5L and EQ-5D-3L value set as well as the impact of using different value set on the results of HTA studies in Thailand merit further investigation.

Regarding self-reported health status of the respondents, it was noticed that 1 respondent reported level 5 for anxiety/depression dimension. While he reported level 1 or 2 for the other dimensions, and gave 0.75 for VAS. However, finally, his cTTO valuation data was excluded according to the exclusion criteria as he gave negative values for all TTO tasks (−0.6-(−0.8).

One strength of our study is that our value set was generated using the standard protocol, hence permit the comparison across countries using the same protocol. Another strength is that very few data were excluded possibly due to the high quality of data collection process and the quality control process. Nevertheless, it should be noted that sampling bias could still occur during the final stage of the sampling when each respondent were selected by area coordinators. When comparing the general characteristics of the respondents against the general Thai population, the differences were noticed in terms of marital status, education, and occupation.

Interviewer effects were observed which could affect the quality of the data. Significant difference of the mean cTTO values between interviewers were found using Kruskal–Wallis test ($P < 0.0001$). In addition, the proportion of negative values among interviewers ranged from 10% to 27%. The interviewer effects have been reported in some EQ-5D-5L valuation studies [23,37,43,44]. Since cTTO task is detailed and complicated, it was important that the interviewers should adequate compliance with the standardized protocol. Nevertheless, this issue was concerned and improved in later EQ-VT QC tool [29].

This study did not compare the performance of the 3 models but preferred hybrid model as it maximized the available information. Although the information criteria (e.g. Akaike information criterion or Bayesian information criterion) was usually used to assess the goodness of fit of the regression model, it seems meaningless for this study because those 3 models were constructed from different datasets (cTTO, DCE, or both cTTO and DCE).

5. Conclusions

This paper demonstrates the use of hybrid model, which using both information from cTTO and DCE to estimate a value sets for the EQ-5D-5L in Thailand. This value set can be used to estimate utilities for use in HTA studies to support policy decision-making in Thailand. Studies examining the impact of using the EQ-5D-5L and EQ-5D-3L value set on the results of HTA studies in Thailand deserved further investigation.

Key issues

- The EQ-5D has been recommended by the Thai national guideline of health technology assessment (HTA) as the preferred instrument for assessing the utility for HTA studies.
- The value set for the EQ-5D-5L Thai version can be used to measure health status for HTA studies, clinical research, and population surveys.
- This Thai value set was generated using the standardized valuation study generated by the EuroQol group, hence, permits the comparison across countries using the same protocol.
- The two datasets (continuous data from composite time trade-off (cTTO) approach and dichotomous data from discrete choice experiment (DCE) approach) were combined and analyzed using the hybrid model which maximizes data usage.

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Declaration of Interest

J Manuel Ramos-Goñi is a member of the EuroQol Research Foundation (the copyright holders of the EQ-5D-5L). The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

Reviewer Disclosures

A reviewer on this manuscript has disclosed that they are members of the EQ Research Foundation.

Author contributions

JP, MT, and YT designed the study, acquired the funding, and provided detailed information regarding data collection processes in Thailand. JMR performed data quality control, and provided command for analysis. JP analyzed the data and prepared manuscript. All authors review the analysis, interpretation of the results, and reviewed the final manuscript.

Compliance with ethical standards

All procedures performed in studies involving human participants were comply with the ethical standards of the institutional research committee (the Mahidol University Institutional Review Board (MU-IRB), Thailand; and the Institute for the Development of Human Research Protections (IHRP), Ministry of Public Health, Thailand)

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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