Assessing the EQ-5D Cognition Bolt-ons in the Japanese General Population for Estimating TTO Values: An Experimental Valuation Study

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BACKGROUNDS

- The need for adding a new dimension or multiple dimensions to EQ-5D has been discussed to better capture specific health conditions in the generic EQ-5D classification system. Among various conditions, a cognition bolt-on for EQ-5D and its 5-level response version (EQ-5D-5L) has been shown to improve their ability to evaluate health states[1,2)].
- Developing a new value set incorporating a bolt-on dimension using the standard EuroQol valuation technology (EQ-VT) protocol, however, raises some challenges. The standard approach requires a full-scale valuation study with a large general population sample. Additionally, generated value sets may become inconsistent with existing ones, and rank order after bolt-on may change due to sampling errors or interviewer effects. To overcome these challenges, a study recently proposed an approach for developing bolt-on value sets based on existing EQ-5D value sets[3)]. This approach uses a modified main-effects model (hereafter, a scaling factor model).
- We applied this approach and a conventional approach to previously published cognition dimensions using existing Japanese value sets[4,5)].

OBJECTIVES

- To experimentally evaluate the valuation methods of the EQ-5D-5L bolt-ons with the scaling factor model and conventional approach using three cognition dimensions, the cognition bolt-on version of the Japanese EQ-5D-5L (hereafter, EQ-5D-5L+C)[2,6)] and additional two previously experimentally developed cognition dimensions[7)], added to the EQ-5D-5L.

METHODS

- The use of EQ-5D-5L cognition bolt-on version was granted by the EuroQol group.
- This study was part of the research “Efficiency and Optimization of Care in Nursing Homes from the Perspectives of QOL and Medical Economics”, which was approved by the ethics committee of the Graduate School of Pharmaceutical Sciences, The University of Tokyo.

1. Study population

- Adults (≥18 years) living in Tokyo, Osaka, and Kumamoto who were capable of providing consent and comprehended Japanese were recruited from the Japanese general population using snowball sampling.
- With a target sample size of 810 individuals, the study planned to randomize participants into three arms of 270 individuals each (90 per city). Allocation was guided by the population composition by sex and age in Japan[8)]

2. Study procedure

- For EQ-5D-5L+C, the linguistically and psychometrically validated Japanese version[6)] was used. For Remembering things[7)] and Thinking clearly[7)], the Japanese versions were unavailable. Their translations were prepared according to the following three-step process: forward and back translations and finalization (**Figure 1**).
- Preferences were collected through face-to-face, one-on-one interviews conducted by 9 trained interviewers using the composite time trade-off (cTTO) valuation method[9,10)] (EQ-VT version 2.7.2). The interviews were conducted from June 27 to August 7, 2023.
- After giving consent, participants were randomized to three arms (Arm 1: EQ-5D-5L+C, Arm2: EQ-5D-5L+Remembering things, and Arm 3: EQ-5D-5L+Thinking clearly). Each participant valued a randomly selected block of 10 health states and the worst possible health state (555555).
- Using an orthogonal design[3)], we selected 31 health states on the basis of a 6*5 orthogonal array, i.e., 30 health states and the worst possible health state.

3. Data analysis

- The “1-cTTO” values were modeled for each arm independently using the scaling factor model, with EQ-5D-5L disutility weights estimated from the existing Japanese value sets[4,5)]. We also fitted the “1-cTTO” values into the 24-parameter conventional main-effects model. Both models used a Tobit model and maximum likelihood estimation.
- Model prediction accuracy was assessed using indices of fit, including mean absolute errors (MAEs) and Pearson’s correlation coefficient. Lower MAE values indicate higher prediction accuracy.

Figure 1. Three patterns of descriptions for cognition bolt-on dimensions

Arm 1: EQ-5D-5L+C

Original cognition dimension

COGNITION *(memory, comprehension, concentration, thinking)*

- I have no problems with cognition ☐
- I have slight problems with cognition ☐
- I have moderate problems with cognition ☐
- I have severe problems with cognition ☐
- I have extreme problems with cognition ☐

Japanese cognition dimension

認知機能 *（例：記憶力[もの忘れ]、理解力、集中力、思考力）*

- 認知機能に問題はない ☐
- 認知機能に少し問題がある ☐
- 認知機能に中程度の問題がある ☐
- 認知機能にかなり問題がある ☐
- 認知機能に極度の問題がある ☐

Arm 2: Remembering things

Original English wording

COGNITION

- I have no problems with remembering things ☐
- I have slight problems with remembering things ☐
- I have moderate problems with remembering things ☐
- I have severe problems with remembering things ☐
- I am unable to remember things ☐

Japanese translation prepared for this study

認知機能

- 物事を思い出したり、覚えておくのに問題はない ☐
- 物事を思い出したり、覚えておくのに少し問題がある ☐
- 物事を思い出したり、覚えておくのに中程度の問題がある ☐
- 物事を思い出したり、覚えておくのにかなり問題がある ☐
- 物事を思い出したり、覚えておくことができない ☐

Arm 3: Thinking clearly

Original English wording

COGNITION

- I have no problems in thinking clearly ☐
- I have slight problems in thinking clearly ☐
- I have moderate problems in thinking clearly ☐
- I have severe problems in thinking clearly ☐
- I am unable to think clearly ☐

Japanese translation prepared for this study

認知機能

- 考えをまとめるのに問題はない ☐
- 考えをまとめるのに少し問題がある ☐
- 考えをまとめるのに中程度の問題がある ☐
- 考えをまとめるのにかなり問題がある ☐
- 考えをまとめることができない ☐

RESULTS

1. Study population

- In total, 864 Japanese participated in this study. The distribution of sex and age were similar across the three arms (**Table 1**).
- For statistical analysis, one participant was excluded due to data inaccuracy, and data of 863 participants were analyzed.

Table 1. Participant demographic characteristics

Characteristics		Arm 1 n (%)	Arm 2 n (%)	Arm 3 n (%)
Total		287	289	288
Sex	Male	144 (50.2)	143 (49.5)	144 (50.0)
	Female	143 (49.8)	146 (50.5)	144 (50.0)
Age, years	18 – 24	25 (8.7)	28 (9.7)	27 (9.4)
	25 – 34	52 (18.1)	49 (17.0)	49 (17.0)
	35 – 44	57 (19.9)	59 (20.4)	56 (19.4)
	45 – 54	63 (22.0)	56 (19.4)	66 (22.9)
	55 – 64	58 (20.2)	64 (22.1)	54 (18.8)
	65 – 74	30 (10.5)	29 (10.0)	35 (12.2)
	≥75	2 (0.7)	4 (1.4)	1 (0.3)
Employment type	Working full-time	151 (52.6)	159 (55.0)	149 (51.7)
	Working full-time (nonregular)	11 (3.8)	11 (3.8)	2 (0.7)
	Working part-time	46 (16.0)	46 (15.9)	58 (20.1)
	Self-employed	26 (9.1)	26 (9.0)	24 (8.3)
	Unemployed (stay-at-home mother/father)	30 (10.5)	30 (10.4)	31 (10.8)
	Unemployed (retired)	7 (2.4)	6 (2.1)	15 (5.2)
	Student	16 (5.6)	11 (3.8)	9 (3.1)
	Others	0 (0.0)	0 (0.0)	0 (0.0)
Educational attainment	Junior high school	3 (1.0)	5 (1.7)	1 (0.3)
	High school	90 (31.4)	88 (30.4)	97 (33.7)
	Vocational school	39 (13.6)	37 (12.8)	47 (16.3)
	Junior college	32 (11.1)	37 (12.8)	25 (8.7)
	University	118 (41.1)	118 (40.8)	110 (38.2)
	Graduate school	5 (1.7)	3 (1.0)	8 (2.8)
	Others	0 (0.0)	1 (0.3)	0 (0.0)
History of serious sickness/disease, Yes		39 (13.6)	40 (13.8)	44 (15.3)
History of serious sickness/disease in the family, Yes		127 (44.3)	124 (42.9)	130 (45.1)
Experience of caregiving to non-family members, Yes		21 (7.3)	30 (10.4)	20 (6.9)

Note: Percentages may not sum to 100% due to rounding.

2. Scaling factor model and conventional linear mixed model

- After adding each cognition dimension to the existing EQ-5D-5L, the estimated coefficients for the scaling factor model expanded in all arms, and the rank order of two core dimensions in the conventional linear mixed model changed for Arm 1 (**Table 2**).

Table 2. Coefficients of scaling factor model and conventional linear mixed model

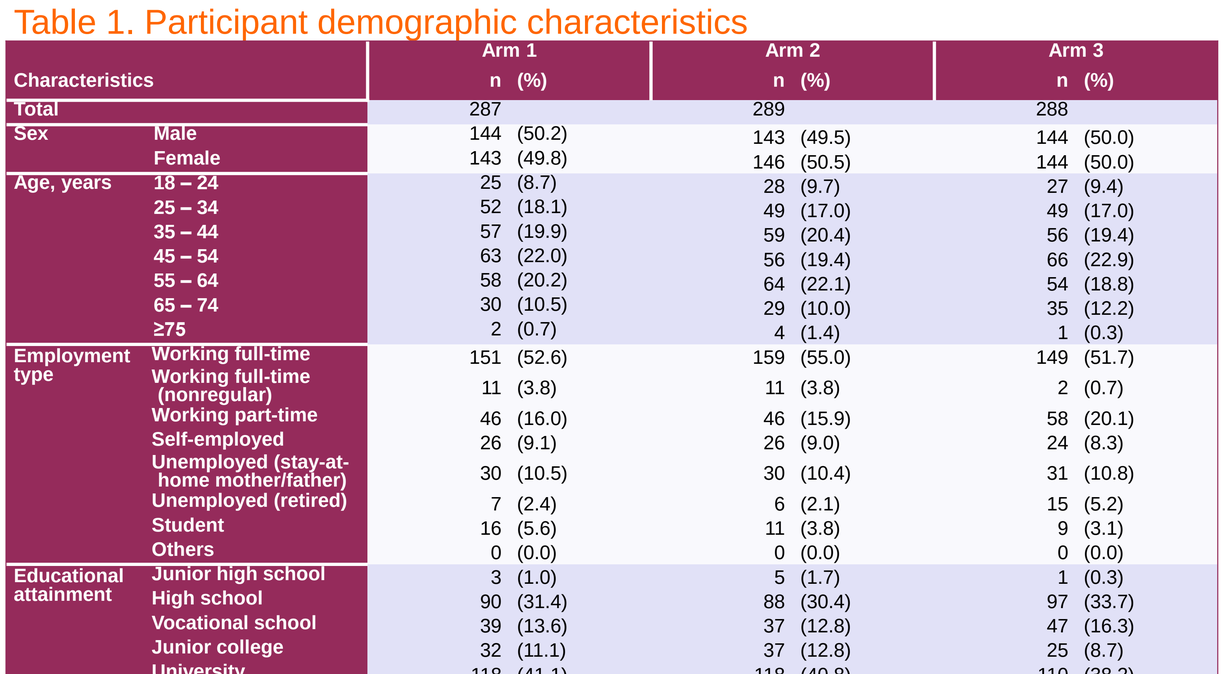
Model	Arm 1		Arm 2		Arm 3	
	Scaling factor model	Linear mixed model	Scaling factor model	Linear mixed model	Scaling factor model	Linear mixed model
1+Scale	1.3667	—	1.3991	—	1.4201	—
mo2	*0.0639*	0.0901		0.0312		0.0355
mo3	*0.1126*	0.1400		0.0999		0.0744
mo4	*0.1790*	0.2081		0.1833		0.1887
mo5	*0.2429*	0.2452		0.2196		0.2497
sc2	*0.0436*	0.0773		0.0595		0.0401
sc3	*0.0767*	0.1388		0.1040		0.0913
sc4	*0.1243*	0.2294		0.1909		0.1917
sc5	*0.1597*	0.2210		0.2525		0.2338
ua2	*0.0504*	0.0501		0.0380		0.0195
ua3	*0.0911*	0.0865	*Values identical to “Scaling factor model” for Arm 1*	0.0910	*Values identical to “Scaling factor model” for Arm 1*	0.0765
ua4	*0.1479*	0.2293		0.2275		0.2029
ua5	*0.1748*	0.2183		0.2395		0.2254
pd2	*0.0445*	0.0632		0.0300		0.0459
pd3	*0.0682*	0.1427		0.1078		0.1180
pd4	*0.1314*	0.2681		0.2655		0.3075
pd5	*0.1912*	0.4152		0.4017		0.4519
ad2	*0.0718*	0.0392		0.0690		0.0579
ad3	*0.1105*	0.0477		0.1124		0.0872
ad4	*0.1682*	0.1689		0.1652		0.1789
ad5	*0.1960*	0.2150		0.2685		0.2360
co2	0.0316	0.0362	0.0322	0.0463	0.0079	0.0396
co3	0.1318	0.1379	0.0620	0.0814	0.0534	0.0894
co4	0.3291	0.3368	0.2053	0.2387	0.1403	0.1870
co5	0.3930	0.3980	0.2753	0.2646	0.2320	0.2382

Note: For all three arms, the italicized coefficients of the five core dimensions for the scaling factor model were extracted from Ikeda et al. 2015[4)]., and they were rounded to the fourth decimal place for this poster to enhance readability.

3. cTTO values

- The mean and predicted “1-cTTO” values are presented in **Figure 2**. These values were slightly discrepant, but no large discrepancies were observed in all three arms.

Figure 2. Mean and predicted cTTO values for 31 health states



Note: Health states are presented in ranked order.

4. Prediction accuracy

- The MAEs of the scaling factor model and conventional model were 0.0720 and 0.1305, 0.0748 and 0.0885, and 0.0985 and 0.0685 in Arms 1, 2, and 3, respectively (**Table 3**).

Table 3. Model prediction accuracy

Index for precision	Model	Arm 1: EQ-5D-5L+C	Arm 2: Remembering things	Arm 3: Thinking clearly
MAE	Scaling factor model	0.0720	0.0748	0.0985
	Linear mixed model	0.1305	0.0885	0.0685
Pearson’s correlation coefficient	Scaling factor model	0.9726	0.9706	0.9574
	Linear mixed model	0.9122	0.9539	0.9722

CONCLUSION

- **This experimental study examined the valuation methods for creating a tariff for the Japanese population.**
- **The results suggest that a scaling factor model may offer a comparable method to the conventional model, and the scaling factor model could be used to calculate “bolt-on” QOL scores.**
- **Further experimental studies on valuation using the recently proposed approach and cognition dimensions are warranted.**

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Abbreviations

cTTO, composite time trade-off; EQ-5D-5L+C, the cognition bolt-on version of the Japanese EQ-5D-5L; mo, mobility; sc, self-care; ua, usual activities; pd, pain/discomfort; ad, anxiety/depression; co, cognition; SD, standard deviation; CI, confidence interval.

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