Censoring in the time trade-off valuation of worse-than-dead EQ-5D-5L health states: can a willingness-to-accept question be the solution?

Meixia Liao[1] · Kim Rand[2] · Zhihao Yang[3] · Chien-Ning Hsu[4] · Hsiang-Wen Lin[5]· Nan Luo[1]

[1] National University of Singapore, Singapore; [2] Akershus University Hospital, Norway; [3] Guizhou Medical University, China; [4] Kaohsiung Chang Gung Memorial Hospital, Taiwan; [5] China Medical University, Taiwan

Introduction

- The left censoring design of the cTTO tasks in EQ-VT protocol leads to excessive amount of -1 values in some EQ-5D-5L valuation studies.
- This censoring of values brings about two undesirable consequences: overestimation of the utility values of some worse-than-dead (WTD) states, and insensitivity of negative utilities to health-state severity.
- Censoring of cTTO values has been handled by use of censored regression (Tobit regression) in data analysis.
- However, of concern is the violation of distributional assumptions of normality and homoscedasticity in Tobit model, which could produce biased estimates.

Objectives

- To investigate whether a willingness-to-accept (WTA) question can be used to elicit values lower than -1 and improve the estimation of EQ-5D-5L health-state values.

Methods

- This study was piggybacked on the EQ-5D-5L valuation study in Taiwan (N=1000).
- At the end of each cTTO task, if the value of the health state was indicated to be < -1, a WTA question eliciting the indifference point between a hypothetical life (i.e. x number of years in full health followed by 10 years in the health state) and immediate death was used to estimate its uncensored value.
- We compared the statistical characteristics of the censored and uncensored values, including

1) value distribution using frequency analysis and histograms;
2) sensitivity to health-state severity using Spearman's rank correlation coefficient;
3) logical consistency;
4) value set modelling with various model specifications and estimators (20-parameter additive models using OLS, GLS, and Tobit estimators, and with/without N45/N5 terms).
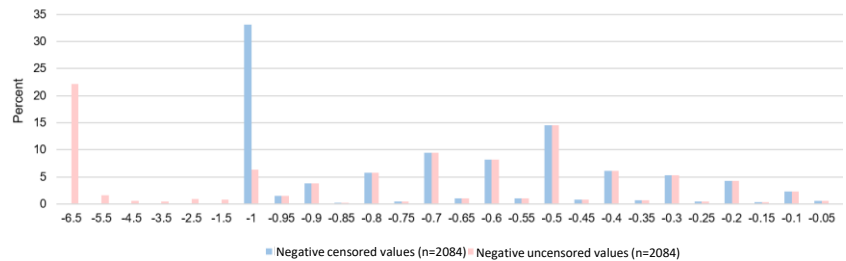
Results

Fig. 1 The histograms of negative censored and uncensored values derived from the WTA group (N=429).
- A total of 429 out of 1000 respondents failed to reach indifference in at least one cTTO task and therefore answered the WTA question.
- The WTA question was asked in 1071 out of 10000 cTTO tasks.
- Indifference was still not reached in 79.55% of WTA tasks, resulting a spike at -6.5 (22.15%) in uncensored values.

- In the WTA group, the Spearman's correlation with misery index was almost the same for negative censored data (ρ = -0.40) and for negative uncensored data (ρ = -0.41).
- A slightly higher logical inconsistency rate was observed for uncensored data than that for censored data (0.88% vs. 0.29%).
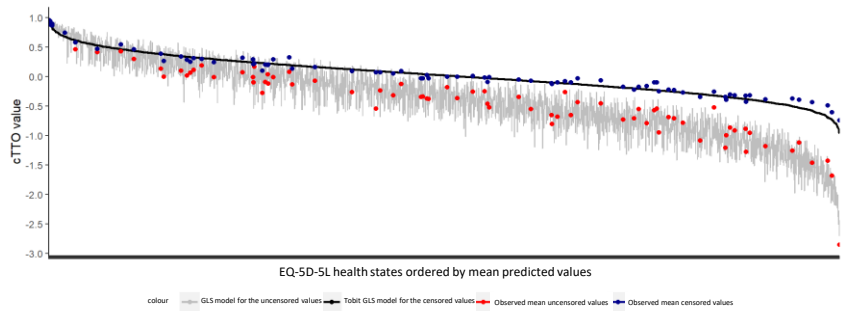

Fig. 2 Observed mean values for 86 health states and model predicted values for all 3125 health states.

Table 1 Modelling results for censored and uncensored values (N=1000).

	Censored values (Tobit GLS model censored at -1)		Uncensored values (GLS model)	
	Coef.	SE	Coef.	SE
Intercept	**0.021**	0.019	**0.012**	0.062
MO2	0.102**	0.014	**0.042**	0.048
MO3	0.224**	0.014	0.123*	0.05
MO4	0.356**	0.015	0.394**	0.054
MO5	0.455**	0.014	0.724**	0.05
SC2	0.076**	0.014	**0.054**	0.048
SC3	0.175**	0.015	0.198**	0.053
SC4	0.246**	0.015	0.333**	0.053
SC5	0.318**	0.014	0.764**	0.048
UA2	0.052**	0.014	**0.004**	0.049
UA3	0.140**	0.015	0.13*	0.053
UA4	0.292**	0.015	0.387**	0.052
UA5	0.322**	0.014	0.661**	0.048
PD2	0.074**	0.013	**0.046**	0.045
PD3	0.179**	0.015	0.216**	0.053
PD4	0.344**	0.014	0.582**	0.048
PD5	0.429**	0.015	0.779**	0.051
AD2	0.051*	0.015	**0.008**	0.052
AD3	0.201**	0.016	0.184*	0.057
AD4	0.342**	0.015	0.447**	0.053
AD5	0.422**	0.014	0.764**	0.048
Range of possible values	[-0.967, 0.979]		[-2.704, 0.988]	
Ranking of dimensions	MO>PD>AD>UA>SC		PD>AD=SC>MO>UA	

*$p<0.05$, **$p<0.001$.
- The 20-parameter Tobit GLS and GLS model was the preferred model for censored and uncensored data, respectively.
- Both models showed no issue of nonmonotonicity.
- Modelling of uncensored data resulted in coefficients with greater uncertainty (a larger number of insignificant coefficients) and much lower predictions (Fig. 2)

Discussions

- Indifference could not be reached in substantial amount of valuation tasks even direct elicitation without censoring was used. It is possible that some poor health states are so unacceptable that respondents are unwilling to tolerate those states, or that the WTA question is so challenging that respondents are unable to express their preferences properly.
- This finding suggests that censored values obtained with cTTO are likely to be overestimated. The negative infinity problem might be addressed by shortening the duration of lives used in cTTO tasks.

- The poorer modelling results for uncensored data could be due to worsened logical consistency or the greater variability of uncensored data.
- In summary, direct elicitation of values < -1 by granting more time to trade seems not a promising solution to the value censoring of the cTTO tasks. Other strategies for valuation of very poor health states should be explored.