Mapping EQ-5D-3L From Modified Rankin Scale Based on Chinese Patients With Ischemic Stroke

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Luying Wang[1,2], Xin Guan[1,2], Hongchao Li[1,2*]

[1] School of International Pharmaceutical Business, China Pharmaceutical University, Nanjing, China
[2] Center for Pharmacoeconomics and Outcomes Research, China Pharmaceutical University, Nanjing, China

INTRODUCTION

- As the indicator of HRQoL, health quality index has been applied to patient outcomes assessment, medical and healthcare decision and pharmacoeconomics[1].
- Ischemic stroke has brought about substantial burden to the Chinese patients due to the high incidence rate, high recurrence rate, high disability rate and expensive medical costs[2].

OBJECTIVES

- This study aimed to calculate the mapping algorithm from modified Rankin Scale (mRS) to EQ-5D-3L for Chinese ischemic stroke (IS) patients.

METHODS

- Data were collected from a longitudinal multicenter post-market trial, including sociodemographic information, baseline clinical characteristics, mRS levels and EQ-5D-3L records.
- HRQoL data of Chinese IS patients were recorded from 4 series visits.
- Correlation analysis and influential factors analysis were applied to test the feasibility to map the mRS to EQ-5D-3L[3]. Least ordinal square (OLS) model, Tobit model, ordered Logistic model, multinomial Logistic model and mixed effect model were used to build the mapping algorithm.
- 10-fold cross-validation and several indicators such as Akaike information criterion, Bayesian information criterion, mean absolute error and root mean squared error were conducted to assess the model prediction.

RESULTS

- A total of 9788 patients were included in the study (Table 1). The feasibility of mapping EQ-5D-3L from mRS was proved according to the high correlation among the 2 scales.
- Tobit model (model 1) was preferred when the data collected at admission visit were used for the mapping construction while OLS model (model 2) was superior when both the data collected at discharge visit and pooled 4 visits data were used for the mapping construction.
- When taking into account the internal correlation among longitudinal data thus applying mixed liner model (model 3) and mixed multinomial Logistic model (model 4) (Table 1) to build the mapping algorithms, both models exhibited good property of prediction.
- Based on the internal and external estimation results (Table 3-4, Figure 1-4), the mixed multinomial Logistic model was recommended as the best model for the relatively small errors and high consistency of estimated and observed utility density curves.

Table 2 Mixed Multinomial Logistic Model

Dimension	Model Effect	mRS	Coefficient/Variance	SE/SD	t/χ^2	p	df
Mobility							
Level 2	Fixed	1	2.6785	0.10918	24.533	<0.001	29481
		2	5.3556	0.11345	47.205	<0.001	29481
		3	7.1835	0.14283	50.293	<0.001	29481
		4	8.0777	0.26767	30.178	<0.001	29481
		5	6.1699	0.75997	8.119	<0.001	29481
		Constant	-3.9798	0.10591	-37.576	<0.001	7912
	Random	Random Error	1.196	1.43038	10669.54	<0.001	7912
Level 3	Fixed	1	0.4542	0.26324	1.725	0.084	29481
		2	3.3509	0.24601	13.621	<0.001	29481
		3	6.1261	0.24964	24.54	<0.001	29481
		4	10.7193	0.3267	32.811	<0.001	29481
		5	12.5166	0.7307	17.13	<0.001	29481
		Constant	-5.6533	0.21764	-25.976	<0.001	7912
	Random	Random Error	1.6611	2.75908	4603.323	>0.500	7912
Self-care							
Level 2	Fixed	1	2.4593	0.13777	17.851	<0.001	29481
		2	5.1408	0.13875	37.05	<0.001	29481
		3	7.4724	0.16039	46.589	<0.001	29481
		4	8.1812	0.22718	36.012	<0.001	29481
		5	7.2458	0.60867	11.904	<0.001	29481
		Constant	-4.5068	0.13428	-33.562	<0.001	7912
	Random	Random Error	1.112	1.23657	9427.651	<0.001	7912
Level 3	Fixed	1	-0.2154	0.30212	-0.713	0.476	29481
		2	2.496	0.26991	9.247	<0.001	29481
		3	6.6084	0.25617	25.797	<0.001	29481
		4	10.1659	0.29642	34.296	<0.001	29481
		5	12.1882	0.61556	19.8	<0.001	29481
		Constant	-5.7589	0.23368	-24.644	<0.001	7912
	Random	Random Error	1.7355	3.01185	4570.7	>0.500	7912
Usual activities							
Level 2	Fixed	1	2.6997	0.11783	22.913	<0.001	29481
		2	5.6744	0.12222	46.428	<0.001	29481
		3	7.524	0.1596	47.142	<0.001	29481
		4	8.4427	0.27536	30.66	<0.001	29481
		5	7.3825	0.72854	10.133	<0.001	29481
		Constant	-4.0501	0.11478	-35.284	<0.001	7912
	Random	Random Error	1.0084	1.01691	9370.629	<0.001	7912
Level 3	Fixed	1	0.2016	0.31389	0.642	0.52	29481
		2	3.5149	0.28567	12.304	<0.001	29481
		3	6.9109	0.28698	24.082	<0.001	29481
		4	10.7635	0.35738	30.118	<0.001	29481
		5	12.6274	0.74796	16.883	<0.001	29481
		Constant	-5.8202	0.25623	-22.715	<0.001	7912
	Random	Random Error	1.5276	2.33359	4255.229	>0.500	7912
Pain/discomfort							
Level 2	Fixed	1	2.3194	0.09672	23.981	<0.001	29481
		2	3.3551	0.09883	33.949	<0.001	29481
		3	4.0172	0.10199	39.389	<0.001	29481
		4	4.6101	0.10391	44.367	<0.001	29481
		5	5.0329	0.1269	39.659	<0.001	29481
		Constant	-3.8273	0.09268	-41.298	<0.001	7912
	Random	Random Error	1.0154	1.03097	11940.81	<0.001	7912
Level 3	Fixed	1	0.7064	0.47498	1.487	0.137	29481
		2	2.6394	0.44933	5.874	<0.001	29481
		3	4.1815	0.43848	9.536	<0.001	29481
		4	5.9637	0.42865	13.913	<0.001	29481
		5	8.1372	0.43285	18.799	<0.001	29481
		Constant	-6.9926	0.42179	-16.578	<0.001	7912
	Random	Random Error	1.6894	2.85422	4613.242	>0.500	7912
Anxiety/depression							
Level 2	Fixed	1	1.5814	0.08063	19.615	<0.001	29481
		2	2.6312	0.08307	31.675	<0.001	29481
		3	3.3527	0.08711	38.489	<0.001	29481
		4	4.0191	0.0886	45.36	<0.001	29481
		5	4.51	0.11082	40.695	<0.001	29481
		Constant	-3.3255	0.07556	-44.012	<0.001	7912
	Random	Random Error	0.9562	0.91437	11226.54	<0.001	7912
Level 3	Fixed	1	1.0126	0.3743	2.705	0.007	29481
		2	2.7778	0.35823	7.754	<0.001	29481
		3	4.0087	0.35323	11.349	<0.001	29481
		4	5.6705	0.34394	16.487	<0.001	29481
		5	7.5473	0.349	21.626	<0.001	29481
		Constant	-6.7586	0.33598	-20.116	<0.001	7912
	Random	Random Error	1.718	2.95158	4906.428	>0.500	7912

Table 1 Characteristics

characteristic	Value
Sample Size	8788
Age mean(SD)	64.11 (11.91)
Gender	
Man %(n)	65.56% (5761)
Insurance	
Urban employee insurance %(n)	39.87% (3504)
Urban resident insurance %(n)	19.56% (1719)
New rural cooperative medical insurance %(n)	20.74% (1823)
Free medical insurance %(n)	0.98% (86)
Commercial health insurance %(n)	1.56% (137)
Self-paying %(n)	17.28% (1519)
Case History	
IS %(n)	23.87% (2098)
Hypertension %(n)	64.95% (5708)
Diabetes %(n)	25.77% (2265)
Dyslipidemia %(n)	3.11% (273)
CHD %(n)	13.71% (1205)
AF %(n)	4.37% (384)
Carotid plaque %(n)	0.69% (61)
Cancer %(n)	2.36% (207)

Table 3 Model Verification

Indicator	Model 1	Model 2	Model 3	Model 4
MAE	0.1108	0.1050	0.1048	0.1191
RMSE	0.1484	0.1434	0.1434	0.1707
Prediction Error≤0.1 (%)	51.20%	45.50%	45.80%	49.70%
Prediction Error≤0.05(%)	33.90%	35.80%	35.80%	35.20%

Table 4 Comparison of Predicted Value and Observed Value

mRS	0	1	2	3	4	5
Observed	0.9895	0.8963	0.6662	0.5457	0.2785	0.1089
Model 1	0.9868	0.8511	0.6259	0.5154	0.2362	0.0311
Model 2	0.9825	0.8938	0.6805	0.5586	0.2719	0.0544
Model 3	0.9842	0.8914	0.6789	0.5551	0.2709	0.0566
Model 4	0.9809	0.8982	0.6676	0.5562	0.2684	0.0470

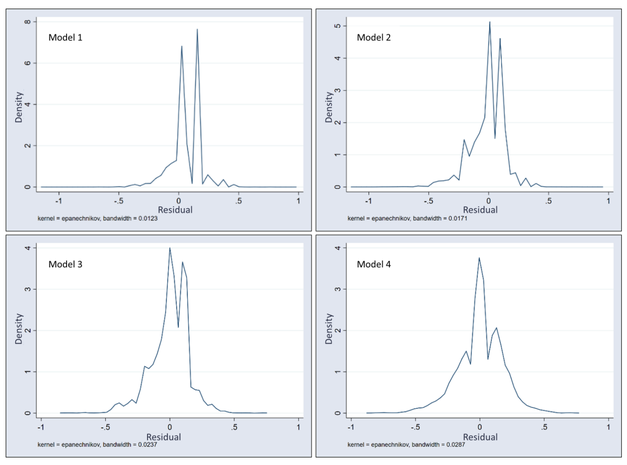

Figure 1 Error Probability Density

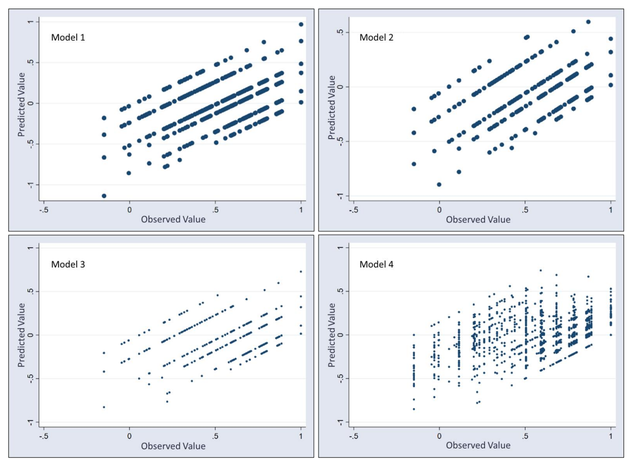

Figure 2 Prediction Error Scatter Plot

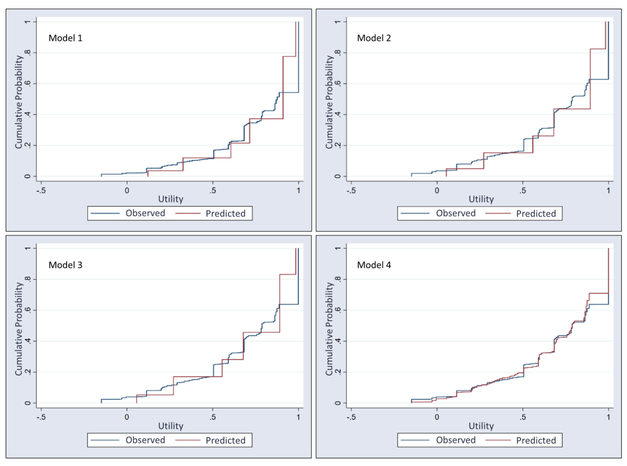

Figure 3 Cumulative Probability of Utility Value

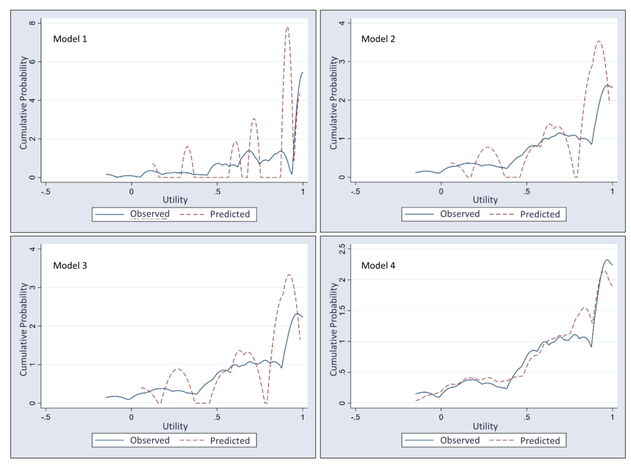

Figure 4 Probability density of utility value

CONCLUSION

Mixed effect models have superior prediction properties for longitudinal data. Due to the low prediction errors and the ability to predict patient-level utilities, mixed multinomial Logistic model is recommended as the best model for the mapping algorithm for mRS and EQ-5D-3L.

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Corresponding to: Hongchao Li. Email: lihongchao@cpu.edu.cn.