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Mapping IWQOL-Lite onto EQ-5D-5L and SF-6Dv2 in Chinese overweight and obese population

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BACKGROUND

- Obesity is a common chronic disease, which has a continuously increasing trend worldwide [1,2].
- In order to measure HRQoL and utility for overweight and obese people, some kinds of instruments are available.
  - ✓ EQ-5D and SF-6D are the most widely used generic preference-based instruments in worldwide.
  - ✓ However, generic preference-based instruments are insensitive to some dimensions which can reflect some characters of overweight and obesity [3].
- Some disease specific non-preference-based instruments in overweight and obesity are always used to measure HRQoL[4,5].
  - ✓ However, these instruments are time-consuming and cannot use to calculate utility.
- Mapping is a common solution to link disease-specific instrument scores and generic preference-based values [6].
  - ✓ Mapping in Chinese overweight and obese population is lacking.

OBJECTIVE

- The aim of the present study is using direct method to develop a mapping algorithm from IWQOL-Lite onto EQ-5D-5L and SF-6Dv2 utility values in Chinese overweight and obese people.

METHODS

Sample and Data

- Sample
  - ✓ Chinese overweight and obese people
  - ✓ 31 provinces in China according to the four characteristics including gender, age, BMI and regions which was reported in the latest published literatures (N=1000).
- Collection methods
  - ✓ online survey from December 2021 to February 2022.

Instruments

- IWQOL-Lite
  - ✓ 31 items refer to 5 dimensions, 5 levels rang from 5 “always true” to 1 “never true”.
  - ✓ A total score and scores on 5 dimensions can be calculated ranging from 0 to 100, where 100 represents the best quality of life and 0 represents the worst.
- EQ-5D-5L
  - ✓ 5 dimensions of health and characterized by 5 levels.
  - ✓ A Chinese value set has a theoretical range of scores from -0.391 (55555) to 1 (11111).
- SF-6Dv2
  - ✓ 6 dimension of health with 4-6 levels.
  - ✓ A Chinese value set has a theoretical range of scores from -0.277 (555655) to 1(111111).

Data Analysis

- Split and Estimate
  - ✓ The sample was randomly split into 4:1 as development (N=800) and external validation samples (N=200).
  - ✓ Spearman’s rank correlation coefficients between IWQOL-Lite and EQ-5D-5L/SF-6Dv2 in dimension scores and the total scores was calculated to test conceptual overlap.
- Model and Approach

Table 1 Models of mapping IWQOL-Lite to EQ-5D-5L and SF-6Dv2

Model 1	$U = \beta_i * x_i + \alpha$	U is the utility value of EQ-5D-5L/SF-6Dv2 x_i is the total score of IWQOL-Lite instrument.
Model 2.1	$U = \beta_1 * x_i + \beta_2 * x_i^2 + \alpha$	x_i^2 represents the square term of IWQOL-Lite total score.
Model 2.2	$U = \beta_1 * x_i + \beta_2 * x_i^2 + \beta_3 * x_i^3 + \alpha$	x_i^3 represents the cube term of IWQOL-Lite total score.
Model 3	$U = \beta_1 * x_1 + \cdots + \beta_5 * x_5 + \alpha$	x_n represents IWQOL-Lite 5 dimensions score.
Model 4	Model 3 with backward regression and deleting the illogical one	
Model 5	$U = \sum_k^n \beta_k * x_k + \alpha(k = 31)$	x_k represents IWQOL-Lite 5 dimensions score.
Model 6	Model 5 with backward regression and deleting the illogical one	
Model 7	$U = \sum_m^n \beta_m * x_m + \alpha(m = 124)$	x_m represents IWQOL-Lite 5 dimensions score.
Model 8	Model 7 with backward regression and deleting the illogical one	

- ✓ After determined 1-2 better models, five appropriate statistical methods were adopted for direct mapping.
  - ➢ OLS, Tobit, CLAD, GLM, PTM.
- ✓ Some additional basic characters were included to check whether they were suitable according to the p value and statistical criteria
  - ➢ Gender, age and BMI.
- Measure and Analysis
  - ✓ MAE, RMSE, AIC, BIC, the number and proportion of AE>0.05 and AE>0.1.
  - ✓ Scatter plot, bar chart and Bland-Altman Plot.
- External validation
  - ✓ Use the remaining 20% of the total sample (N=200).

RESULTS

- After excluded 171 participants who quit the interview voluntarily, the study included 1,000 participants totally **(Table 2).**
- The results of Spearman's correlation coefficients shown that all five dimensions of IWQOL-Lite had a strong correlation with utility getting from EQ-5D-5L and SF-6Dv2.
- As for regress models, using IWQOL-Lite total score(model 2) or 5 dimensions scores(model 3) as the independent variable shown better results **(Table 3 and Figure 1-4)**.

Table 2 Social-demographic characteristics of participants in China

Basic characteristics	Quota (n=1000)		Overall (n=1000)		Development (n=800)		Validation (n=200)	
	n	%	n	%	n	%	n	%
BMI								
overweight	677	67.7%	677*	67.7%	538‡	67.3%	139	69.5%
obesity	323	32.3%	323*	32.3%	262‡	32.8%	61	30.5%
Gender								
female	520	52.0%	520*	52.0%	410‡	51.3%	110	55.0%
male	480	48.0%	480*	48.0%	390‡	48.8%	90	45.0%
Age								
18-34	174	17.4%	174*	17.4%	147‡	18.4%	27	13.5%
35-44	162	16.2%	162*	16.2%	126‡	15.8%	36	18.0%
45-54	192	19.2%	192*	19.2%	147‡	18.4%	45	22.5%
55-64	179	17.9%	179*	17.9%	140‡	17.5%	39	19.5%
⩾65	293	29.3%	293*	29.3%	240‡	30.0%	53	26.5%
Regions								
northeast	173	17.3%	173*	17.3%	139‡	17.4%	34	17.0%
eastern China	134	13.4%	134*	13.4%	103‡	12.9%	31	15.5%
northern China	185	18.5%	185*	18.5%	148‡	18.5%	37	18.5%
central China	136	13.6%	136*	13.6%	110‡	13.8%	26	13.0%
southern China	96	9.6%	96*	9.6%	80‡	10.0%	16	8.0%
southwest	131	13.1%	131*	13.1%	105‡	13.1%	26	13.0%
northwest	145	14.5%	145*	14.5%	115‡	14.4%	30	15.0%

Note:
——indicated there was no relevant statistics reported; * indicated the difference between overall and development samples was insignificantly (P＞0.05); ‡ indicated the difference between development and validation samples was insignificantly (P＞0.05).

Table 3 Regress models of mapping IWQOL-Lite to EQ-5D-5L and SF-6Dv2

	MAE	RMSE	AIC	BIC	mean	SD	max.	min.	AE>0.05 (%)	AE>0.1 (%)
EQ-5D-5L										
observed	——	——	——	——	0.856	0.192	-0.184	1.000	——	——
model 1	0.078	0.006	-1260.128	-1250.759	0.856	0.158	0.220	1.025	224(28.0%)	116(14.5%)
model 2.1	0.072	0.005	-1386.315	-1372.261	0.856	0.164	-0.072	0.980	195(24.4%)	86(10.8%)
model 2.2	0.072	0.005	-1406.450	-1387.711	0.856	0.164	0.067	0.963	175(21.9%)	83(10.4%)
model 3	0.076	0.006	-1263.267	-1235.159	0.856	0.159	0.212	1.020	219(27.4%)	111(13.9%)
model 4	0.076	0.006	-1263.267	-1235.159	0.856	0.159	0.212	1.020	219(27.4%)	111(13.9%)
model 5	0.074	0.006	-1263.267	-1235.159	0.856	0.159	0.212	1.020	200(25.0%)	109(13.6%)
model 6	0.074	0.006	-1289.493	-1237.962	0.856	0.160	0.209	1.028	208(26.0%)	112(14.0%)
model 7	0.059	0.003	-1561.326	-975.750	0.856	0.176	-0.186	1.014	171(21.4%)	63(7.9%)
model 8	0.054	0.004	-1584.624	-1444.085	0.856	0.172	-0.172	0.974	168(21.0%)	72(9.0%)
SF-6Dv2										
observed	——	——	——	——	0.736	0.167	-0.179	1.000	——	——
model 1	0.080	0.005	-1394.747	-1385.378	0.736	0.133	0.200	0.878	256(32.0%)	119(14.9%)
model 2.1	0.079	0.005	-1398.482	-1384.428	0.736	0.133	0.141	0.869	249(31.1%)	132(16.5%)
model 2.2	0.078	0.005	-1410.235	-1391.497	0.736	0.134	0.032	0.884	263(32.9%)	114(14.3%)
model 3	0.080	0.005	-1389.075	-1360.967	0.736	0.133	0.200	0.877	257(32.1%)	114(14.3%)
model 4	0.080	0.005	-1389.447	-1366.023	0.736	0.133	0.201	0.877	260(32.5%)	119(14.9%)
model 5	0.075	0.005	-1411.956	-1262.049	0.736	0.137	0.197	0.906	246(30.8%)	110(13.8%)
model 6	0.076	0.005	-1428.574	-1381.728	0.736	0.135	0.197	0.894	247(30.9%)	124(15.5%)
model 7	0.068	0.004	-1408.980	-823.403	0.736	0.143	-0.081	0.915	235(29.4%)	80(10.0%)
model 8	0.072	0.004	-1506.233	-1346.956	0.736	0.140	-0.051	0.897	234(29.3%)	99(12.4%)

Note:
——indicated there was no relevant statistics reported.

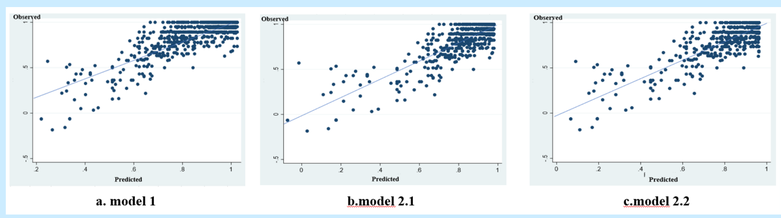

Figure 1 EQ-5D-5L Scatter plot of preferable regression models

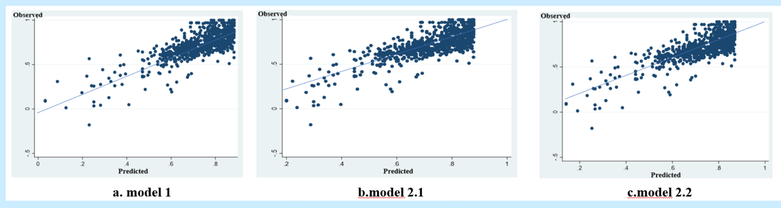

Figure 2 SF-6Dv2 Scatter plot of preferable regression models

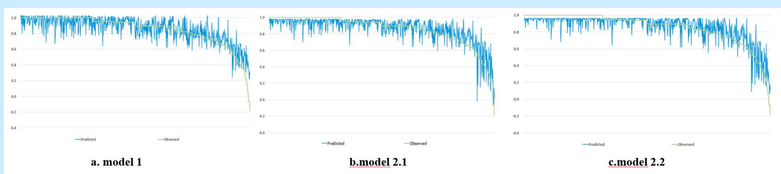

Figure 3 EQ-5D-5L bar chart of preferable regress models

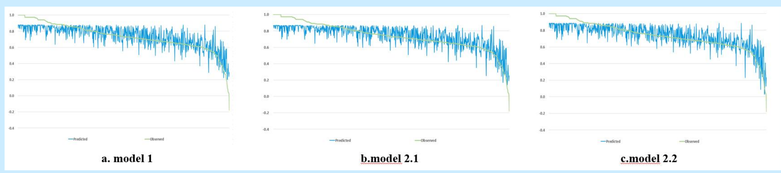

Figure 4 SF-6Dv2 bar chart of preferable regress models

- As a whole, the result for model 2 was better than the result for model 3 in regress methods **(Table 4).**
- CLAD method had a best results for both EQ-5D-5Land SF-6Dv2 **(Figure 4 and 5)** .
- The addition basic characters of age, gender and BMI had little impact on the goodness of fit and all these basic characters shown insignificant coefficients **(Figure 7).**
- The results of external validation were consistently with the development group.
  - ✓ Model 2.1 with CLAD methods was the best for EQ-5D-5L;
  - ✓ Model 2.2 with CLAD was the best for SF-6Dv2.

Table 4 Regress methods of the EQ-5D-5L and SF-6Dv2 utility values upon IWQOL-Lite

		MAE	RMSE	AIC	BIC	mean	SD	max.	min.	AE>0.05 (%)	AE>0.1 (%)
EQ-5D-5L											
	observed	——	——	——	——	0.856	0.192	-0.184	1.000	——	——
	OLS	0.072	0.005	-1386.315	-1372.261	0.856	0.164	-0.072	0.980	195 (24.4%)	86 (10.8%)
	Tobit	0.083	0.006	-288.977	-270.239	0.891	0.185	-0.035	1.056	131 (16.4%)	76 (9.5%)
model 2.1	CLAD	0.070	0.005	——	——	0.870	0.164	-0.033	1.000	160 (20.2%)	75 (9.4%)
	GLM	0.072	0.005	1302.519	1316.573	0.858	0.162	0.036	0.954	176 (22.0%)	72 (9.0%)
	PTM	0.072	0.005	-83.503	-55.395	0.856	0.163	-0.060	0.976	187 (23.4%)	100 (12.5%)
	OLS	0.076	0.006	-1263.267	-1235.159	0.856	0.159	0.212	1.020	219 (27.4%)	111 (13.9%)
	Tobit	0.094	0.007	-257.696	-224.904	0.894	0.186	0.139	1.091	148 (18.5%)	88 (11.0%)
model3	CLAD	0.087	0.007	——	——	0.908	0.193	0.138	1.117	136 (17.0%)	73 (9.1%)
	GLM	0.098	0.008	1319.692	1347.799	0.863	0.200	0.194	1.088	246 (30.8%)	143 (17.9%)
	PTM	0.073	0.006	2.206	58.421	0.856	0.159	0.198	0.997	176 (22.0%)	98 (12.3%)
SF-6Dv2											
	observed	——	——	——	——	0.736	0.167	-0.179	1.000	——	——
	OLS	0.078	0.005	-1410.235	-1391.497	0.736	0.134	0.032	0.884	263 (32.9%)	114 (14.3%)
	Tobit	0.078	0.005	-1258.008	-1234.585	0.738	0.135	0.027	0.890	257 (32.1%)	110 (13.8%)
model 2.2	CLAD	0.077	0.005	——	——	0.738	0.139	-0.148	0.907	238 (29.8%)	100 (12.5%)
	GLM	0.078	0.005	1401.586	1420.319	0.737	0.132	0.092	0.880	260 (32.5%)	113 (14.1%)
	PTM	0.077	0.005	-1532.081	-1497.727	0.738	0.127	0.119	0.893	237 (29.6%)	119 (14.9%)
	OLS	0.080	0.005	-1389.075	-1360.967	0.736	0.133	0.200	0.877	257 (32.1%)	114 (14.3%)
	Tobit	0.080	0.005	-1237.048	-1204.255	0.738	0.135	0.196	0.881	250 (31.3%)	112 (14.0%)
model3	CLAD	0.080	0.005	——	——	0.743	0.129	0.227	0.886	249 (31.1%)	121 (15.1%)
	GLM	0.080	0.005	1405.858	1433.958	0.737	0.136	0.191	0.879	259 (32.4%)	115 (14.4%)
	PTM	0.078	0.005	-1510.412	-1451.519	0.738	0.128	0.240	0.886	240 (30.0%)	124 (15.5%)

Note:
——indicated there was no relevant statistics reported.

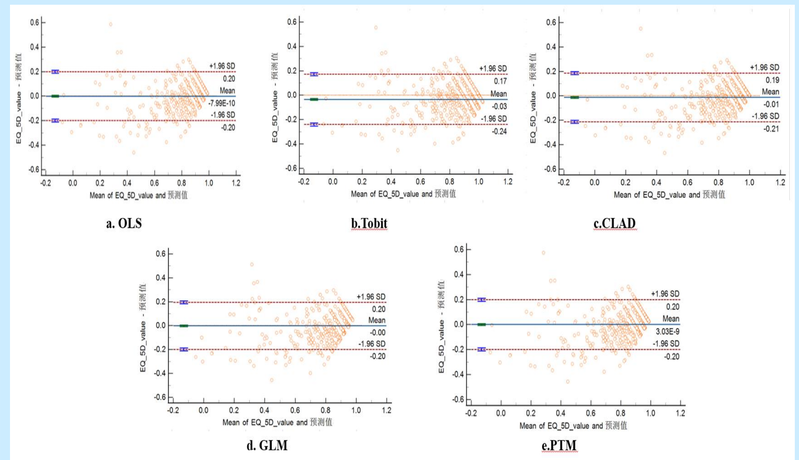

Figure 5 EQ-5D-5L Bland-Altman Plot of preferable regress methods

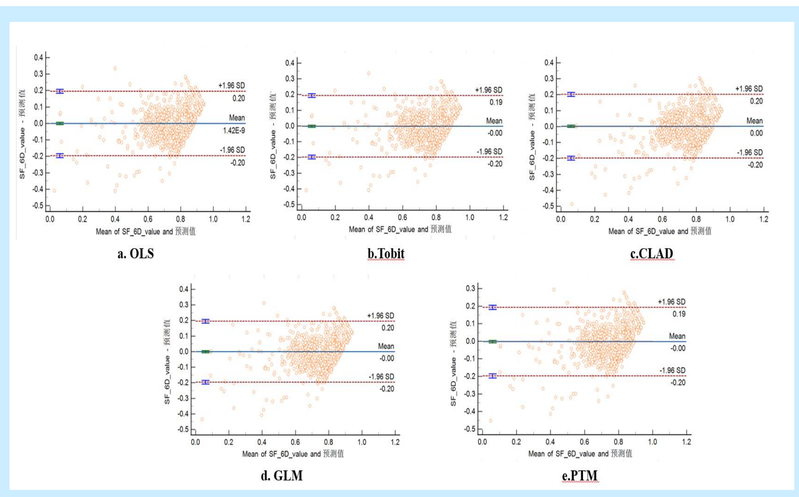

Figure 6 SF-6Dv2 Bland-Altman Plot of preferable regress methods

CLAD	Coef.	P>t
EQ-5D-5L Model 2.1		
age	1.7E-18	1.000
gender	5.8E-18	1.000
BMI	-6.2E-04	0.634
SF-6Dv2 Model 2.2		
age	-0.0004	0.194
gender	0.0021	0.825
BMI	-0.0002	0.906

Figure 7 Coefficients of additional basic characters

CONCLUSIONS

The CLAD with IWQOL-Lite total score and the squared one for EQ-5D-5L and the CLAD with IWQOL-Lite total score, the squared one and the cubic one for SF-6Dv2 were the best mapping algorithms in Chinese overweight and obesity people in our study.

$$U_{EQ-5D-5L} = 0.0178 * x_i - 0.0001 * x_i^2 - 0.0640$$
$$U_{SF-6Dv2} = 0.0270 * x_i - 0.0004 * x_i^2 + 0.000002 * x_i^3 - 0.0593$$

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