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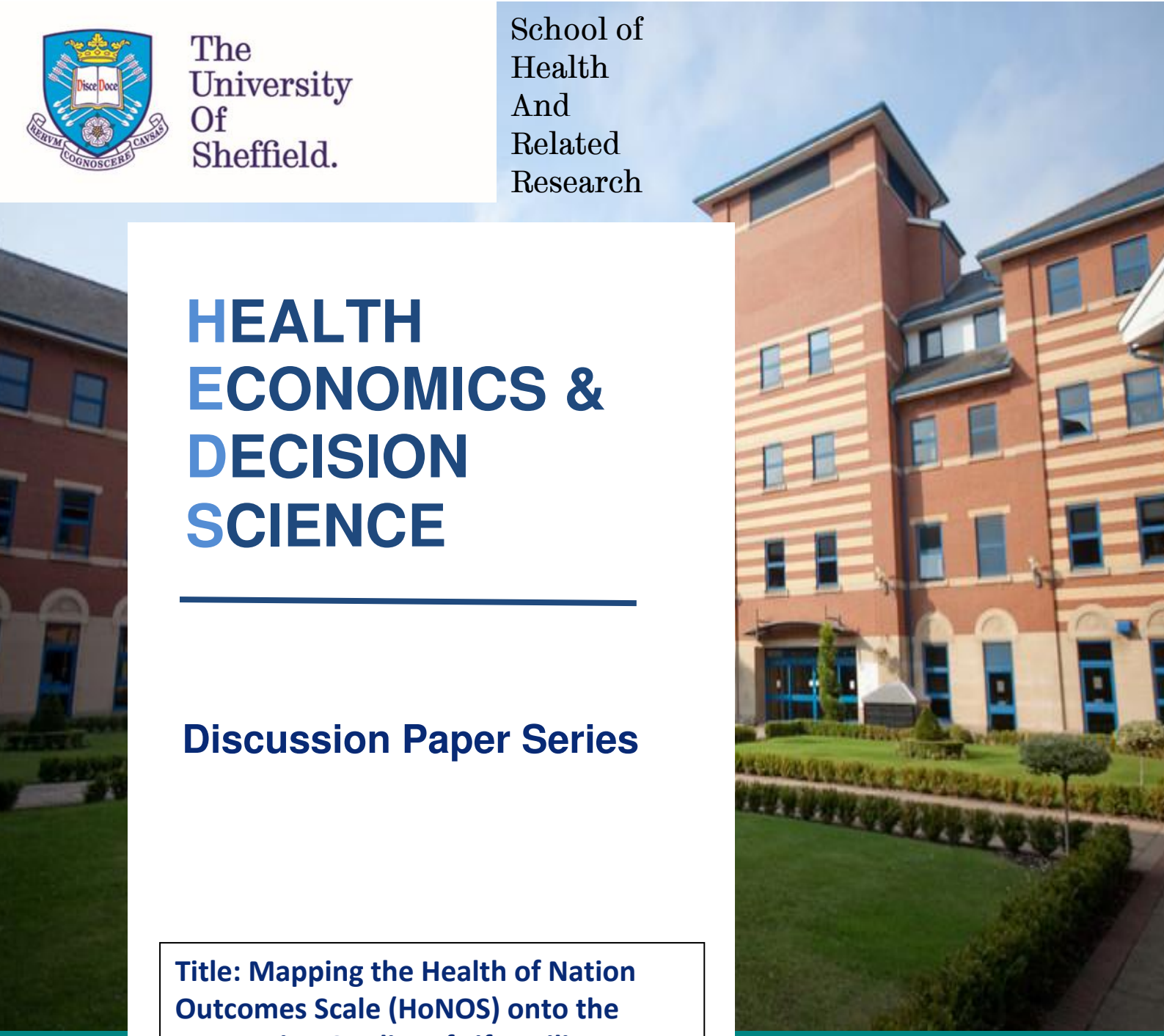

HEALTH ECONOMICS & DECISION SCIENCE

Discussion Paper Series

Title: Mapping the Health of Nation Outcomes Scale (HoNOS) onto the Recovering Quality of Life Utility Index (ReQoL-UI)

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HEDS discussion paper

Title: Mapping the Health of Nation Outcomes Scale (HoNOS) onto the Recovering Quality of Life Utility Index (ReQoL-UI)

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ReQoL and HoNOS mapping

Abstract

Aim: The aim of this project is to develop and assess a mapping function to predict ReQoL-UI (a patient-reported mental health-specific preference-based measure) scores from HoNOS scores (clinician-reported measure, Health of Nation Outcomes Score).

Methods: Participants were recruited from 14 secondary mental health services in England, UK, and their clinician completed HoNoS. Mapping models were estimated using Ordinary Least Squares (OLS) on individual level and mean level data and different model specifications were explored. Model performance was assessed using mean absolute error (MAE), root mean square error (RMSE), percentage of observations with absolute errors greater than 0.1, and plots of the observed and predicted ReQoL-UI utilities and errors.

Results: Matched ReQoL-UI and HoNOS scores were collected for 649 participants. The sample comprised 56% inpatients, with overall mean ReQoL-UI utility of 0.683 and range from 1 to -0.195. Correlations between ReQoL-UI (items and utility) and HoNOS scores were moderate ($0.2<r<0.4$) or small (<0.2). The best model was OLS estimated using mean level data, with lowest MAE (0.046) and RMSE (0.056).

Discussion: There is little conceptual overlap between ReQoL-UI and HoNOS. They measure different concepts and, arguably, service users and clinicians, who complete the measures respectively, have different perspectives. Under these circumstances, caution is recommended when applying these estimates.

Acknowledgements: This project was funded by the Health Foundation as part of a wider project assessing Efficiency, Cost and Quality of Mental Healthcare Provision as part of the Efficiency Research Programme. We would like to thank all participants for completing our survey. We would also like to thank all staff members who assisted in the data collection, and in particular our project administrator Donna Davis.

1. Aim and background

The aim of this research is to develop and assess a mapping function to predict ReQoL-UI scores from HoNOS scores. Mapping can be used to generate utility data where no utility data has been collected, or where the preferred measure to generate utility has not been included. This is undertaken by applying a mapping function to a dataset, for example a clinical trial or observational dataset, and using the data that was included in the dataset (for example HoNOS) to predict utilities (for example ReQoL-UI utilities). A mapping function is a prediction equation typically estimated using regression analysis, that is generated by regressing a target preference-based measure (for example ReQoL-UI) onto another measure (for example HoNOS) (Longworth and Rowen, 2013).

2. METHODS

2.1 Measures

2.1.1 ReQoL-10 and ReQoL-UI

ReQoL-10 is a patient-reported outcome measure (PROM) commissioned by the Department of Health for use in a mental health population aged 16 and over (Keetharuth et al., 2018). ReQoL-10 consists of 10 mental health items and 1 physical health item. The items are scored on a frequency scale with five responses: none of the time; only occasionally; sometimes; often; and most or all of the time. The items are scored on a scale of 0 to 4 and the negatively worded items rescored so that a higher score represents a higher quality of life for all items. The ReQoL raw score is calculated by summing the 10 mental health items.

The ReQoL-UI is a preference-based measure derived from ReQoL-10, which is generated using ReQoL-10 data. The ReQoL-UI health classification consists of the following six mental health items and one physical items (Table 1). Preference weights for ReQoL-UI were constructed with data collected from 300 members of the general population using the MVH TTO protocol (Keetharuth et al., 2020, manuscript under review). The ReQoL-UI is scored from 0 to 1 where 0 represents dead and 1, full health and negative values refer to states worse than dead.

2.1.2 Health of Nation Outcomes Score (HoNOS)

HoNOS is a 12-item clinician reported measure (CROM) with items assessing clinical and social problems (Wing et al., 1998). Items are scored from 0 to 4 where 4 indicates the highest level of severity. A high HoNOS score indicates higher severity (low QoL) contrary to the ReQoL measures.

2.2 Data collection

Participants were recruited from 14 secondary mental health services between November 2017 and September 2018. All participants were recruited face-to-face by clinical studies officers or clinicians. The recruiting member of staff would add a pseudo ID or the hospital number on the booklet. Participants were asked to complete the booklet containing ReQoL-10, SWEMWBS, CORE-10 and some demographics questions (Appendix 1). Upon completing the booklet, it was put it in an envelope which the healthcare staff collected and sent to the University of Sheffield. Data were entered manually on a Google form.

HoNOS data was collected from clinicians in a number of ways. In a few cases the HoNOS was filled on the computer system by the clinician as part of the mental health clustering tool. In these cases, data were collated in a report and sent electronically. In the remaining cases, clinicians completed the HoNOS on paper and added either the pseudo ID or the hospital number. When completed

manually the HoNOS and the booklet were kept together as much as possible and sent to the University of Sheffield for manual data entry on a Google form.

Ethical approval for this stage of data collection was approved as a substantial amendment to the overall ReQoL project from the Edgbaston National Research Ethics Service Committee, West Midlands (14/WM/1062). Governance permission was obtained from each of the participating NHS Trusts. Informed implicit consent was obtained from all participants.

Table 1 ReQoL-UI health classification system (reproduced from Keetharuth et al, 2020)

Theme	Original question (over the last week…)	Health state classification description
Mental health component		
1. Activity	I enjoyed what I did (reqol7)	I enjoy what I do **most or all of the time**
		I often **enjoy** what I do
		I **sometimes** enjoy what I do
		I **only occasionally** enjoy what I do
		I **never** enjoy what I do
2. Belonging and relationships	I felt lonely (reqol9)	I **never** feel lonely
		I **only occasionally** feel lonely
		I **sometimes** feel lonely
		I **often** feel lonely
		I feel lonely **most or all of the time**
3. Choice, control and autonomy	I felt unable to cope (reqol3)	I **never** feel **unable** to cope
		I **only occasionally** feel unable to cope
		I **sometimes** feel unable to cope
		I **often** feel unable to cope
		I feel unable to cope **most or all of the time**
4. Hope	I thought life was not worth living (reqol6)	I **never** think that my life is not worth living
		I **only occasionally** think that my life is not worth living
		I **sometimes** think my life is not worth living
		I **often** think my life is not worth living
		Most or all of the time I think my life is not worth living
5. Self-perception	I felt confident in myself (reqol10)	I feel confident in myself **most or all of the time**
		I **often** feel confident in myself
		I **sometime**s feel confident in myself
		I **only occasionally** feel confident in myself
		I **never** feel confident in myself none of the time
6. Wellbeing	I felt happy (reqol5)	I feel happy **most or all of the time**
		I **often** feel happy
		I **sometimes** feel happy
		I **only occasionally** feel happy
		I **never** feel happy
7. Physical health item		I have **no problems** with physical health
		I have **slight problems** with physical health
		I have **moderate problems** with physical health
		I have **severe problems** with physical health
		I have **very severe problems** with physical health

2.3 Data analysis and modelling

Sociodemographic, geographical and health data of the sample was summarised. The distribution of ReQoL-UI utilities, ReQoL-10 item responses and HoNOS scores were assessed. Correlations were estimated between ReQoL-10 and HoNOS items using the Spearman rank correlation coefficient, and between ReQoL-UI utilities and HoNOS scores using the Pearson correlation coefficient.

The modelling approaches used in this project are informed by the literature (Mukuria et al., 2019) where OLS remains the most used technique for mapping. First, we estimated models on mean level data by regressing ReQoL-UI scores on mean HoNOS total scores. Second, we tried to regress ReQoL-UI scores on HoNOS total scores using individual level data. Third, we estimated OLS models regressing ReQoL-UI scores on responses to the HoNOS items, both with and without covariates included as dummy variables. We also estimated response mapping models to predict the responses of the ReQoL items from HoNOS items (Gray & Clarke 2006), however these models performed very poorly and are not reported here. Across all specifications, model performance was assessed using mean absolute error (MAE), root mean square error (RMSE), percentage of observations with absolute errors greater than 0.1, and plots of the observed and predicted ReQoL-UI utilities and errors (Mukuria et al., 2019).

3 RESULTS

3.1 The sample

A total of 676 participants were recruited to the study. We could match up 649 completed HoNOS and ReQOL questionnaires (96%). The remaining HoNOS and ReQoL completed questionnaires could not be matched for a number of reasons: wrong IDs, death, and inability to get a HoNOS questionnaire completed in the time frame. The participants' characteristics are presented in Table 2. Recruitment sites and the services where participants were recruited are reported in Tables 3 and 4 respectively.

Table 2 Demographics (whole sample, n=649)

	Mean	**SD**	**Range**
Age	41.2	13.8	18 to 81
Life satisfaction score	4.5	2.9	0 to 10
		n	**Percentage (%)**
Gender	Male	334	49.6
	Female	335	49.8
	Other	4	0.6
Marital Status	Single	204	30.2
	Married / Partner	84	12.4
	Widowed	371	55.0
	Prefer not to say	16	2.4
Ethnicity	White	566	85.0
	Asian / Asian British	54	8.1
	Black / African / Caribbean / Black British	20	3.0
	Mixed	19	2.9
	Other ethnic group	7	1.0
Degree	No	465	69.4
	Yes	205	30.6
Main activity	Employed	174	2602
	Retired	67	10.1
	Housework	52	7.8
	Student	34	5.1
	Unemployed	338	50.8
Overall health	Excellent	159	23.6
	Very good	188	27.9
	Good	170	25.3
	Fair	109	16.2
	Poor	47	7.0
Age categories	16-25	108	16.0
	26-64	517	76.5
	65 and over	51	7.54
General mental health	Excellent	122	18.3
	Good	182	27.3
	Fair	174	26.0
	Poor	137	20.5
	Very poor	53	7.9

Table 3 Recruitment sites

	ReQoL completed	
Site	**n**	**%**
Black Country Partnership NHS Foundation Trust	10	1.48
Bradford District Care NHS Foundation Trust	44	6.51
Birmingham and Solihull Mental Health Foundation Trust	109	16.12
Cumbria Partnership NHS Foundation Trust	75	11.09
Dorset Healthcare NHS Trust	10	1.48
Dudley and Walsall Mental Health Partnership NHS Trust	25	3.7
Kent and Medway NHS and Social Care Partnership Trust	113	16.72
Newcastle Tyne and Wear NHS Foundation Trust	21	3.11
South Staffordshire and Shropshire Healthcare NHS FT[a]	131	19.38
Sussex Partnership NHS Foundation Trust	28	4.14
South West London & St George's Mental Health NHS Trust	25	3.7
South West Yorkshire Partnership NHS Foundation Trust	50	7.4
Tyne Ere Wyre NHS Foundation Trust	22	3.25
Worcestershire Health and Care NHS Trust	13	1.92
Total	**676**	**100**

[a] Midlands Partnership NHS Foundation Trust was formed on 1 June 2018 following a merger between South Staffordshire and Shropshire Healthcare NHS Foundation Trust and Staffordshire and Stoke on Trent Partnership NHS Trust.

Table 4 Services where recruitment occurred

	n	%
Inpatient	379	56
Outpatient	287	42
Mail out	2	0
Home visit	1	0
Others	2	0
Missing	5	1
Total	676	

3.2 Distribution of HoNOS and ReQoL scores

Summary statistics for HoNOS and ReQoL are reported in Table 5. ReQoL-UI and HoNOS item responses are reported in tables 5 and 6 respectively. The distribution of ReQoL-UI utilities and HoNOS scores are plotted in figures 1 and 2 respectively. It is noted that the highest HoNOS score observed was 35 which is much lower than the maximum possible score of 48.

Table 5 Summary scores

	N	mean	SD	Min	Max
ReQoL UI	650	0.683	0.259	-0.195	1
ReQoL score	671	18.9	9.6	0	40
ReQoL score with physical health item	*660*	*21.5*	*10.1*	*0*	*44*
HoNOS score	605	13.3	6.6	0	35

Table 6 Frequency endorsements of items in ReQoL-UI

	0 Worst	1	2	3	4 Best	Missing
reqol3 I felt unable to cope	122	137	161	124	125	7
reqol5 I felt happy	137	192	167	80	94	6
reqol6 I thought my life was not worth living	125	100	106	109	231	5
reqol7 I enjoyed what I did	114	145	192	111	105	9
reqol9 I felt lonely	161	138	150	93	129	5
reqol10 I felt confident in myself	190	159	149	80	95	3
reqolphy Please describe your physical health	211	146	155	102	51	11

Figure 1 ReQoL-UI distribution of scores

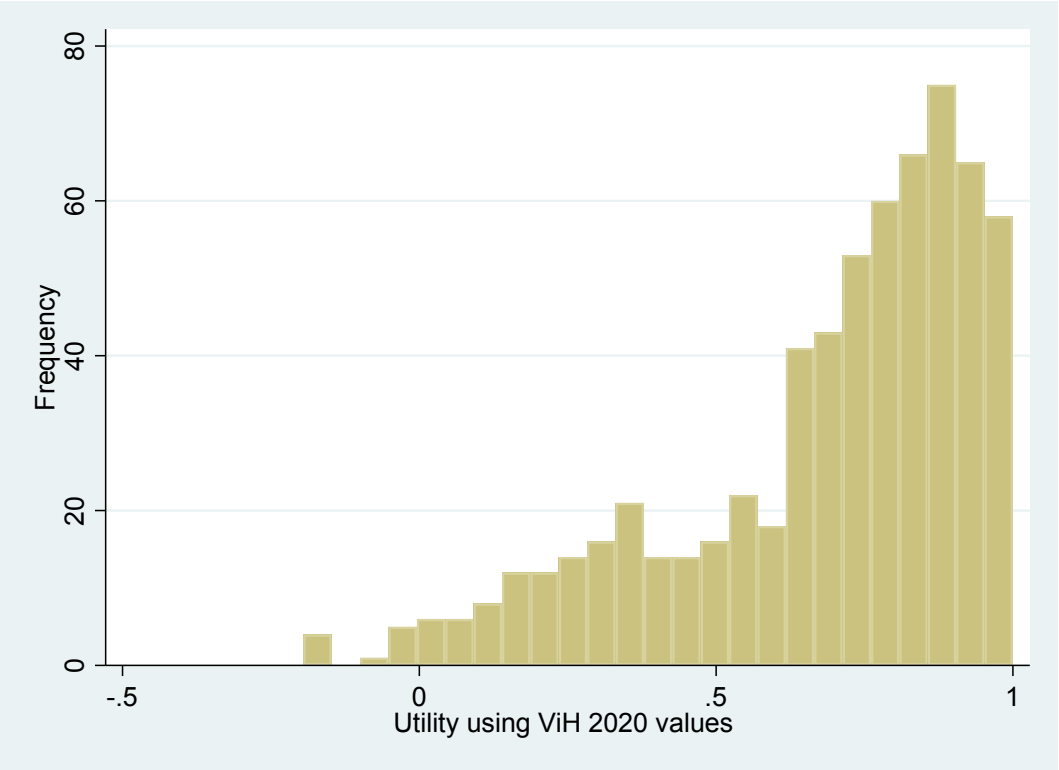
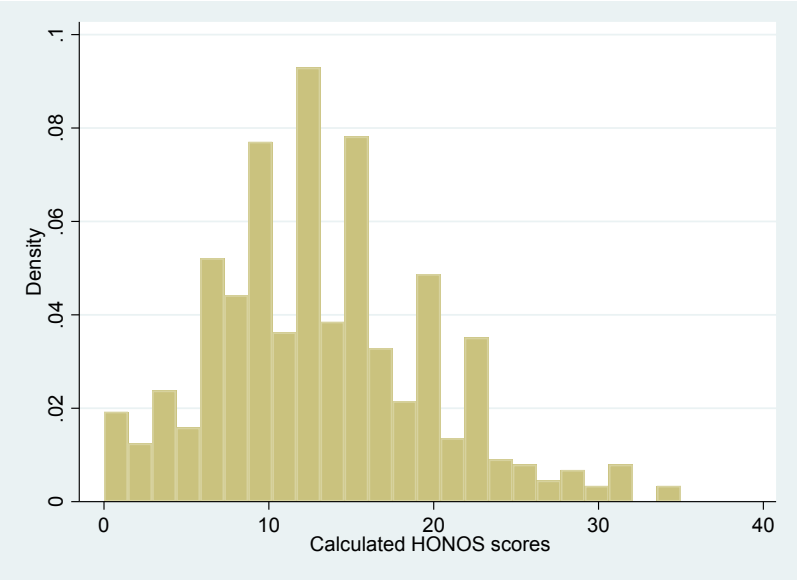


Table 7 Frequency endorsements of HoNOS items

		0 Best	1	2	3	4 Worst	9 Unknown	Missing
H1	Overactive aggressive disruptive or agitated behaviour	263	143	131	91	20	1	0
H2	Non-accidental self-injury	421	69	62	67	29	1	0
H3	Problem drinking or drug taking	445	58	58	55	28	5	0
H4	Cognitive problems	432	96	71	37	8	5	0
H5	Physical illness or disability problems	334	100	118	66	26	5	0
H6	Problems with hallucinations and delusions	376	58	94	90	26	4	1
H7	Problems with depressed moods	142	100	213	141	49	4	0
H8a	Other mental and behavioural problems	123	74	209	185	42	3	13[a]
H9	Problems with relationships	189	151	175	105	20	8	1
H10	Problems with activities of daily living	235	150	176	62	20	6	0
H11	Problems with living conditions	408	91	73	43	24	10	0
H12	Problems with occupation and activities	238	135	167	85	14	6	1

[a] The relatively higher number of missing is a confusion by one of the trusts with Q8b in the extraction of data

Figure 2 HoNOS distribution of scores



3.3 Correlations between HoNOs and ReQoL items to assess overlap prior to mapping

As shown in Table 8, the majority of HoNOs and ReQoL correlations are small (<0.2) and a number are moderate (0.2<r<0.4). The correlations between the ReQoL items are H4 and H7 have the wrong sign.

Table 8 Spearman correlations between ReQoL-UI and HONOS items

	reqol3	reqol5	reqol6	reqol7	reqol9	reqol10	reqolphy	ReQoL-UI	HoNOS score
H1 Overactive aggressive	-0.042	-0.125	-0.172	-0.129	-0.113	-0.098	-0.031	-0.099	0.549
H2 Non-accidental self-injury	-0.283	-0.281	-0.350	-0.281	-0.312	-0.279	0.023	-0.254	0.435
H3 Problem drinking/drug	-0.078	-0.165	-0.116	-0.162	-0.202	-0.107	0.057	-0.089	0.335
H4 Cognitive problems	0.138	0.109	0.108	0.115	0.106	0.104	-0.002	0.100	0.370
H5 Physical illness or disability problems	0.002	0.021	0.005	0.044	0.049	-0.006	-0.397	-0.218	0.280
H6 Problems with hallucinations and delusions	0.146	0.099	0.121	0.079	0.109	0.149	0.112	0.163	0.255
H7 Problems with depressed moods	-0.359	-0.416	-0.395	-0.362	-0.274	-0.382	-0.099	-0.387	0.473
H8a Other mental and behavioural problems	-0.163	-0.210	-0.210	-0.191	-0.180	-0.196	-0.046	-0.182	0.514
H9 Problems with relationships	-0.007	-0.077	-0.161	-0.145	-0.168	-0.053	-0.018	-0.090	0.570
H10 Problems with activities of daily living	-0.027	-0.009	-0.034	-0.026	-0.060	-0.032	-0.118	-0.110	0.599
H11 Problems with living conditions	-0.023	-0.024	-0.015	-0.080	-0.071	0.046	-0.035	-0.040	0.460
H12 Problems with occupation and activities	-0.030	-0.053	-0.074	-0.038	-0.027	-0.024	-0.064	-0.082	0.541

The correlation between ReQoL-UI and HoNOS score is moderate at -0.213.

Table 9 Pearson correlations between the ReQoL and HoNOS

	ReQoL UI	ReQoL-10 score mental health items only	ReQoL-10 score with physical health	HONOS total score	CORE-10 score	WEMWBS total
ReQoL UI	1					
ReQoL 10 score	0.693	1				
ReQoL-10 score with physical health	0.759	0.993	1			
HONOS score	-0.213	-0.269	-0.272	1		

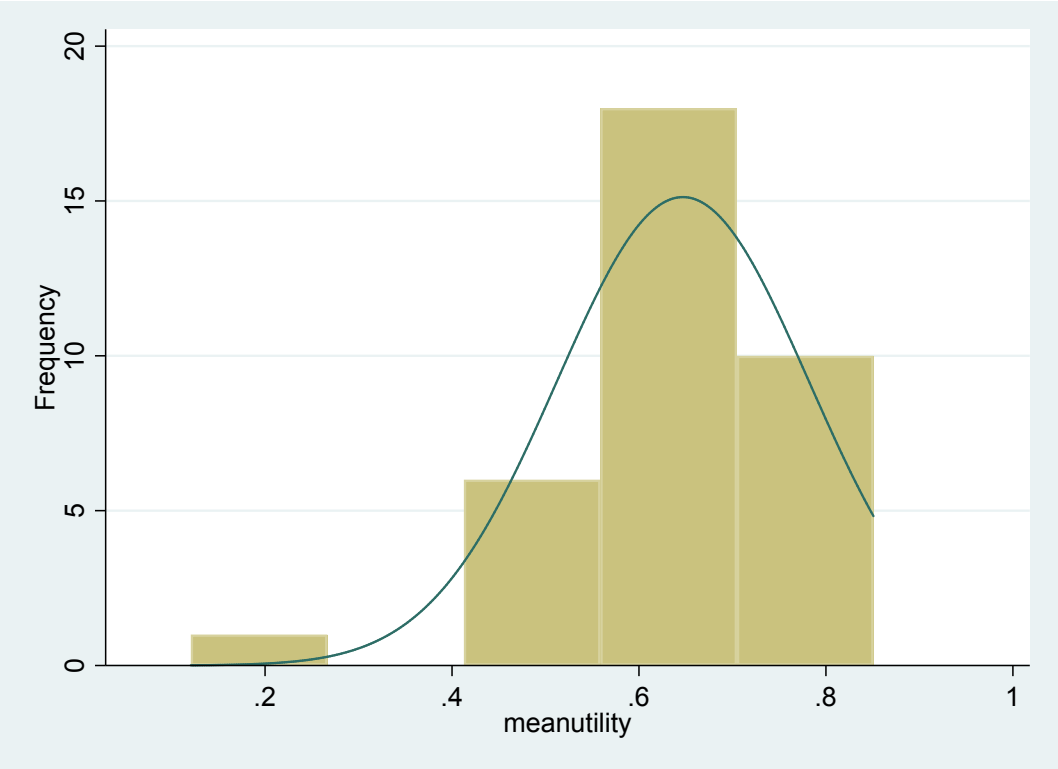
Table 10 below shows the mean and standard deviation of ReQoL-UI utility for each HoNOS score. Figure 3 plots these mean ReQoL utilities that were generated across the different HoNOS scores. This is used to generate the mean level data for the mapping models.

Table 10 Mean ReQoL-UI scores by HoNOS scores

HONOS score	n	Mean utility	SD
0	8	0.807	0.310
1	7	0.851	0.094
2	11	0.865	0.089
3	13	0.885	0.080
4	8	0.815	0.180
5	13	0.750	0.249
6	22	0.720	0.297
7	22	0.741	0.227
8	38	0.712	0.238
9	34	0.688	0.241
10	32	0.721	0.225
11	30	0.697	0.272
12	39	0.714	0.228
13	43	0.630	0.249
14	33	0.569	0.304
15	33	0.680	0.279
16	33	0.644	0.291
17	29	0.665	0.275
18	19	0.705	0.179
19	26	0.736	0.218
20	16	0.633	0.214
21	12	0.524	0.351
22	14	0.568	0.263
23	15	0.675	0.254
24	6	0.492	0.251
25	2	0.542	0.135
26	5	0.633	0.307
27	4	0.650	0.129
28	5	0.817	0.132
29	1	0.707	
30	3	0.632	0.206
31	5	0.689	0.267
32	2	0.136	0.184
34	2	0.429	0.308
35	1	0.745	
28 – 35	**19**	0.594	0.208

Given the low numbers for HoNOS scores >= 28 have been combined as one category, including HoNoS scores from 28 to35.

Figure 3 Distribution of mean ReQoL-UI score generated for each HoNOS score



3.4 Regressing mean ReQoL-UI scores by HoNOS scores (mean level models)

Table 11 reports the mapping models where ReQoL utilities were regressed on total HoNOS scores using OLS on mean level data. Figure 4 plots the observed and predicted ReQoL-UI utilities and the error in the predictions generated using the model.

Table 11 Mean scores models results

	Mean model1 (HoNOS 1-35)	**Mean model2 (HoNOS 1-28)[a]**
HoNOS score	-0.0076*** (0.002)	-0.0089***(0.001)
Constant	0.777*** (0.037)	0.788*** (0.021)
Observations	35	29
R-squared		
Adjusted R-squared	0.320	0.626
MAE	0.074	0.046
RMSE	0.108	0.056
% of observations with AE >0.1	6%	7%

[a] HoNOS scores 28 to 35 were merged given the small number of observations

Figure 4 Model mean1

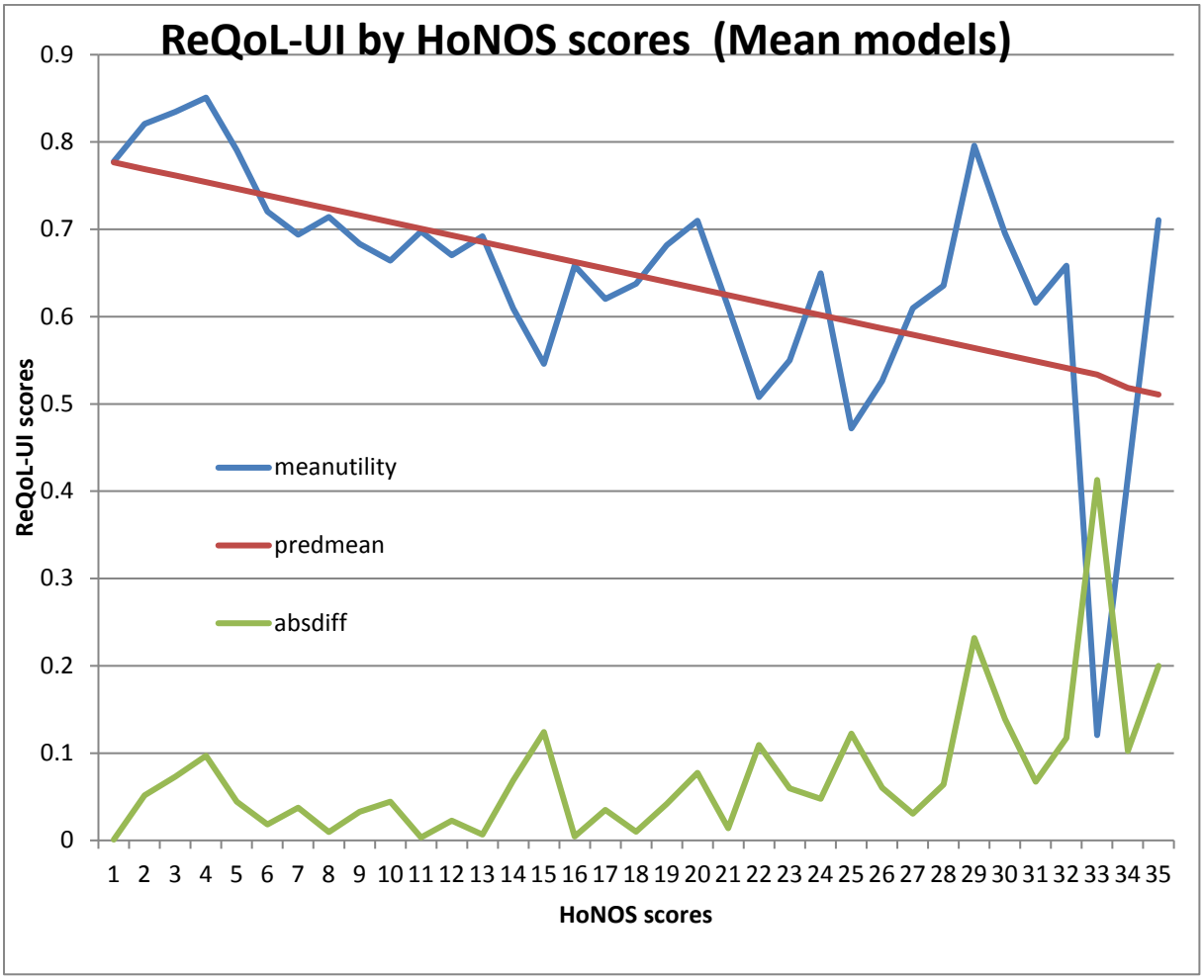
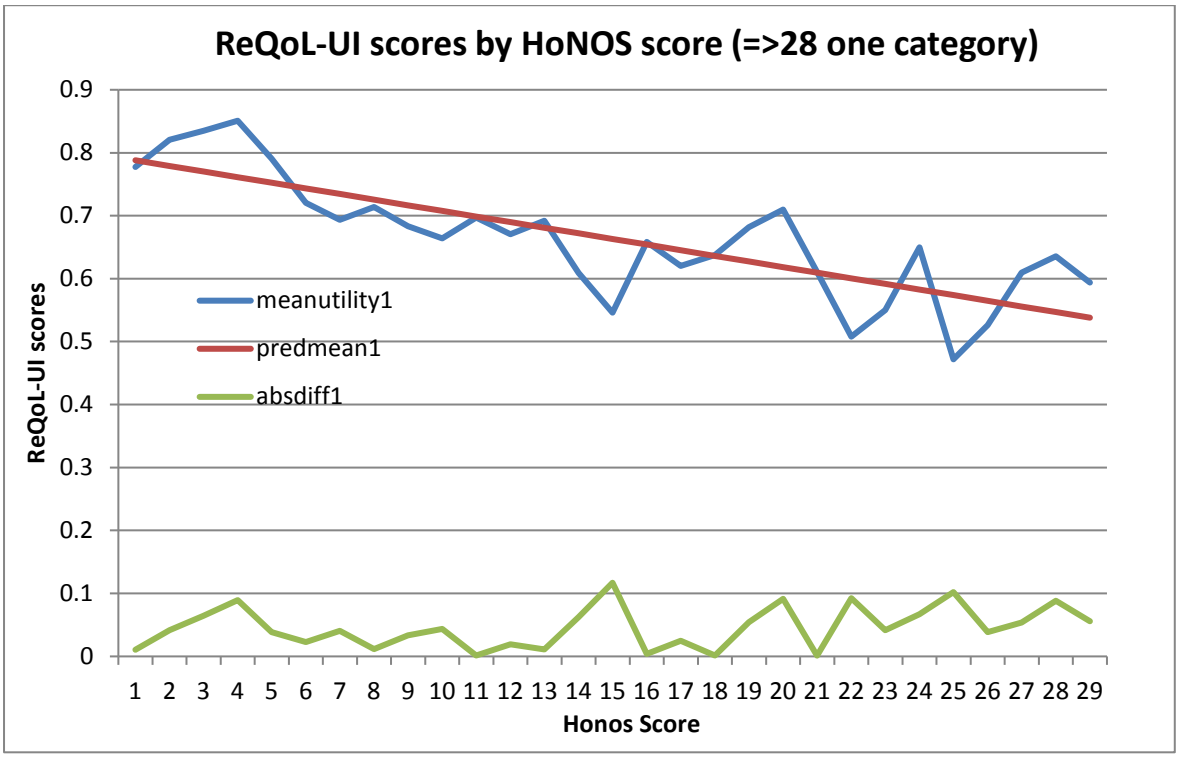


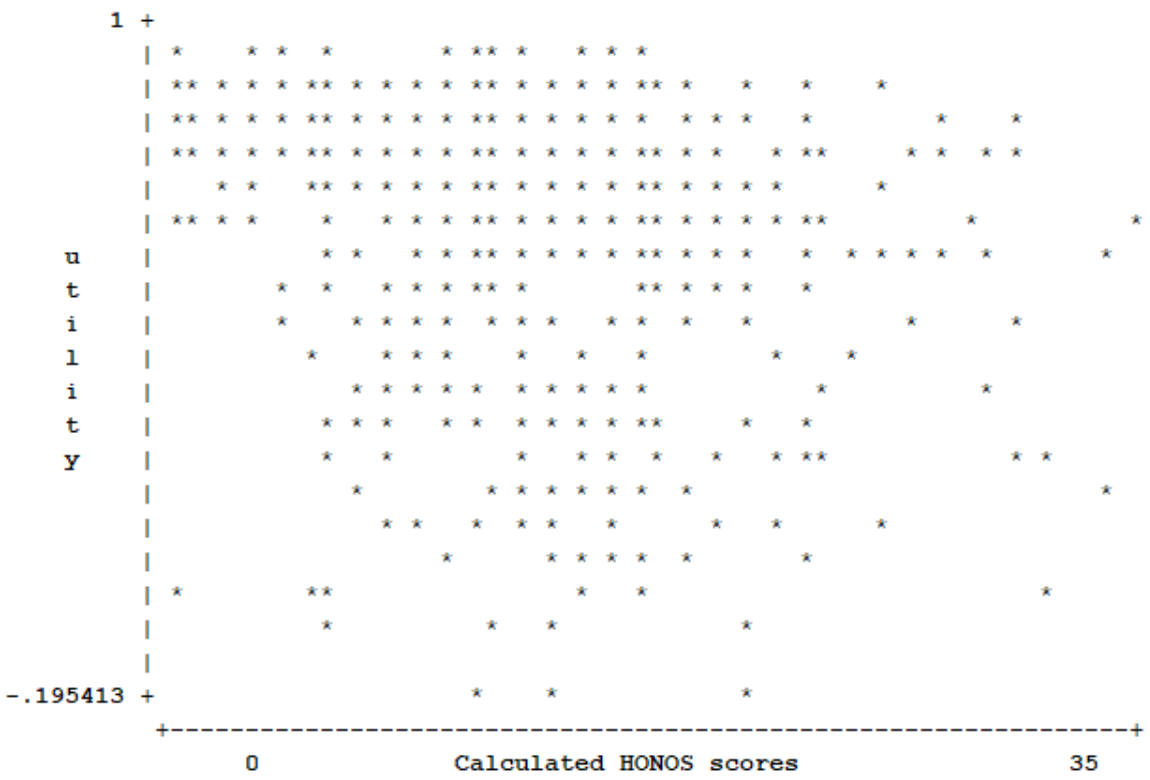
Figure 5 Model mean2



3.5 Regressing ReQoL UI score onto HoNOS total score using OLS (using individual level data)

The plot of ReQoL-UI scores and HoNOS scores is shown in Figure 6, demonstrating that the individual level data shows huge variability between HoNOS score and ReQoL-UI utility. The data is not conducive for estimating a regression model.

Figure 6 Plot of ReQoL UI score and HoNOS scores



Regressing ReQoL UI score onto HoNOS items using OLS

Models 1 and 2 without any demographics

Backward stepwise regression was used with ReQoL-UI as the dependent variable and all the HoNOS items as explanatory variables (Model 1a). Different models were estimated by first dropping one item at a time those with the wrong signs (H4 and H6); dropped items with the highest p value and merged levels to obtain the best model (Model 1n).

In Models 2 and 3, we added sociodemographic variables of age (continuous variable), gender, general health, life satisfaction, physical and mental health interaction term, unemployed (or not), education (dummy variable around whether education continued after the minimum school leaving age). The best performing models are presented in Table 12.

Table 12 model results

	(1)	(2)	(3)	(4)	(5)
	Model1a	Model1n	Model2j	Model3edu	Model3noedu
H1_1	-0.025		0.009		
H1_2	-0.036		0.021		
H1_3	-0.035		0.018		
H1_4	-0.063		-0.005		
H2_1	-0.047		-0.029	-0.0189	-0.0275
H2_2	-0.035		0.031	-0.0264	-0.0289
H2_3	-0.015		-0.006	-0.0297	-0.0314
H2_4	-0.083	-0.0792	-0.035	-0.130***	-0.133***
H3_1	0.007		0.030	-0.0271	-0.0293
H3_2	-0.119***	-0.139***	-0.093***	-0.150***	-0.153***
H3_3	0.005		-0.016		
H3_4	0.057		0.062		
H4_1	0.047		0.041*		
H4_2	0.076**		0.033		
H4_3	0.047		0.017		
H4_4	0.101		0.157*		
H5_1	-0.002		-0.005		
H5_2	-0.066**	-0.0627**	-0.02	-0.0262	-0.0295
H5_3	-0.160***	-0.145***	-0.084***	-0.122***	-0.124***
H5_4	-0.296***	-0.290***	-0.161***	-0.279***	-0.275***
H6_1	0.008		-2.68e-05		
H6_2	0.009		-0.007		
H6_3	0.096***		0.029		
H6_4	0.009		-0.049		
H7_1	-0.036	-0.0368	-0.007	-0.0526	-0.0433
H7_2	-0.120***	-0.130***	-0.01	-0.119***	-0.116***
H7_3	-0.131***	-0.153***	-0.014	-0.139***	-0.137***
H7_4	-0.161***	-0.200***	-0.023	-0.185***	-0.177***
H8a_1	-0.019		-0.049		
H8a_2	-0.035		-0.037		
H8a_3	0.002		0.002		
H8a_4	-0.031		-0.05		
H9_1	0.034		0.005		
H9_2	0.026		-0.026		
H9_3	0.017		0.004		
H9_4	0.049		-0.026		
H10_1	-0.061**	-0.0678***	-0.042*	-0.0630**	-0.0631**
H10_2	-0.055*	-0.0457**	-0.038	-0.0459*	-0.0427*
H10_3	0.013		-0.01		
H10_4	0.106		-0.045		
H11_1	-0.021		0.002		
H11_2	0.027		0.041		
H11_3	-0.072		-0.031		

H11_4	-0.088		-0.026		
H12_1	0.029		-0.004		
H12_2	0.0001		-0.008		
H12_3	0.023		0.004		
H12_4	-0.121		-0.013		
Age			-0.002**	-0.002**	-0.002***
Gender			-0.026	-0.039*	-0.035*
general mental health			0.078***		
general health			0.104***		
mental * physical health			-0.017***		
Life satisfaction			0.027***		
Education			0.038**	0.057***	
Unemployed			0.008	-0.040*	-0.050**
Constant	0.841***	0.864***	0.361***	0.952***	1.003***
Observations	584	609	546	546	546
R-squared	0.247	0.192	0.543	0.244	0.233
Adj R-squared	0.180	0.177	0.491	0.216	0.207
MAE	0.169	0.171	0.129	0.172	0.173
RMSE	0.411	0.224	0.272	0.228	0.229
% observations MAE>0.1	64%	64%	48%	62%	63%

*** p<0.01, ** p<0.05, * p<0.1

Figure 7a, 8a, and 9a report the predictive ability of the models by observed and predicted ReQoL-UI utility and error, ordered by observed individual level utilities. Figures 7b, 8b, and 9b plot observed and predicted ReQOL-UI utility and error ordered by HoNOS score.

Figure 7a Model 1n

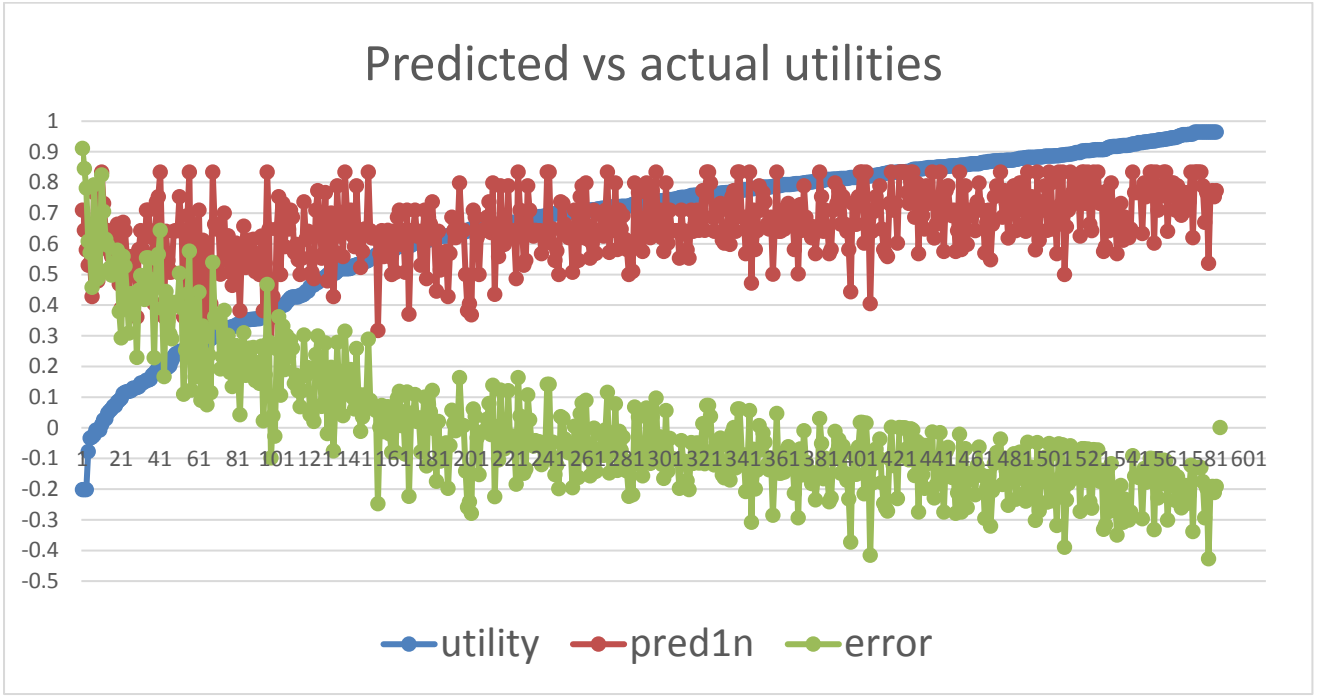


Figure 7b Model 1n by HoNOS score

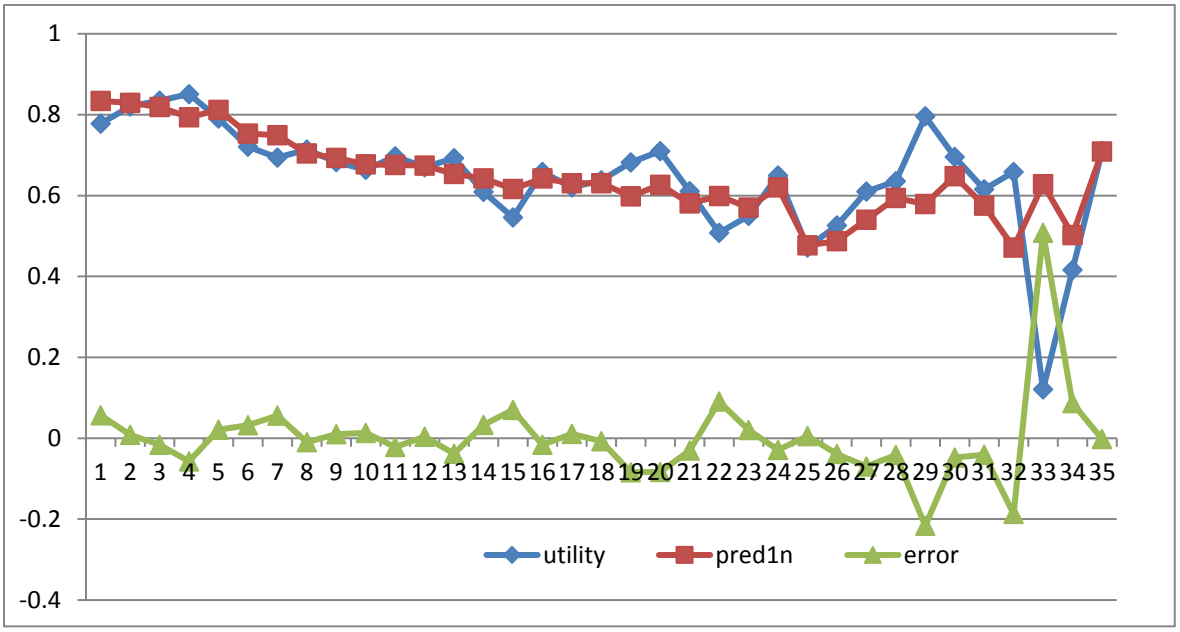


Figure 8a Model 2j by utility

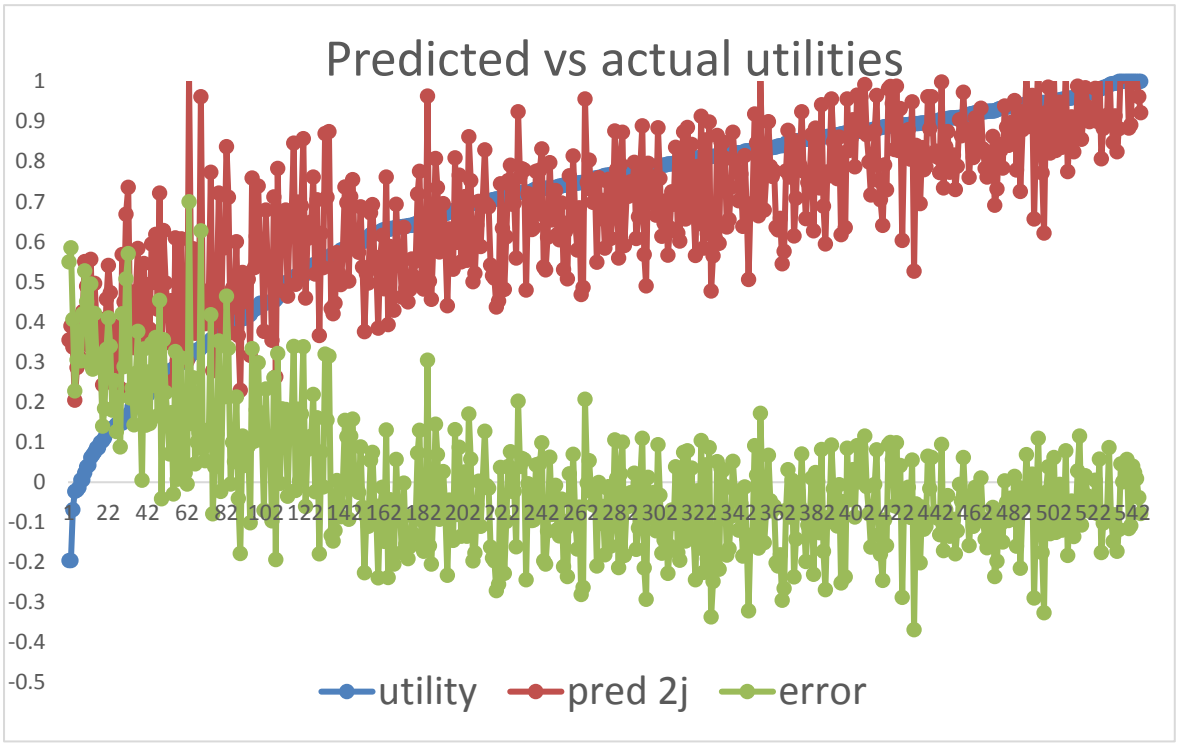


Figure 8b Model 2j by HoNOS score

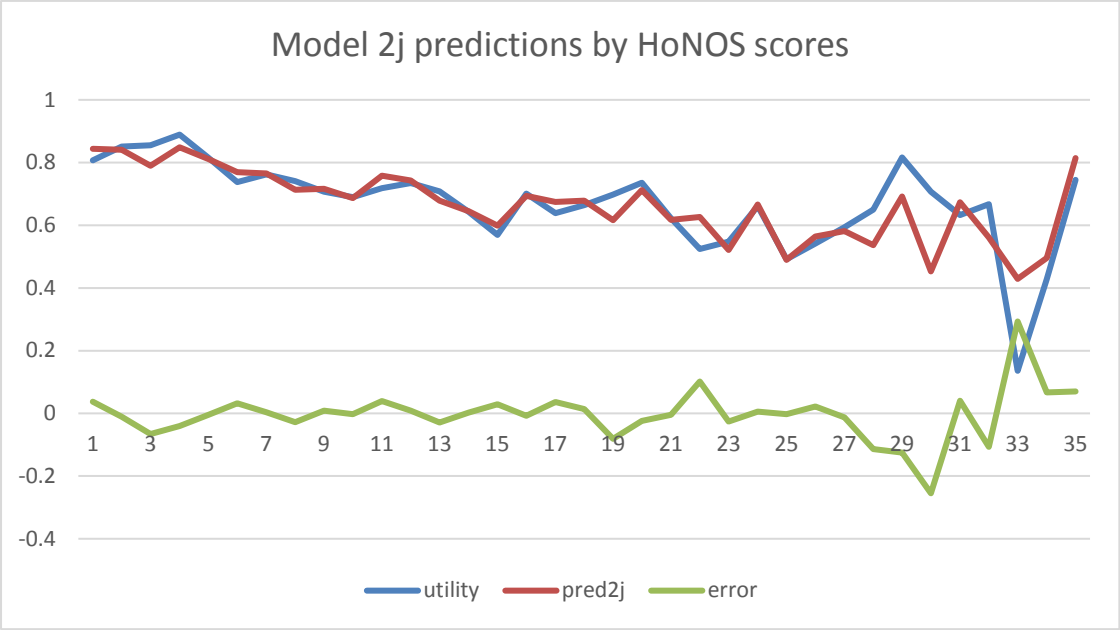


Figure 9a Model 3noedu by utility

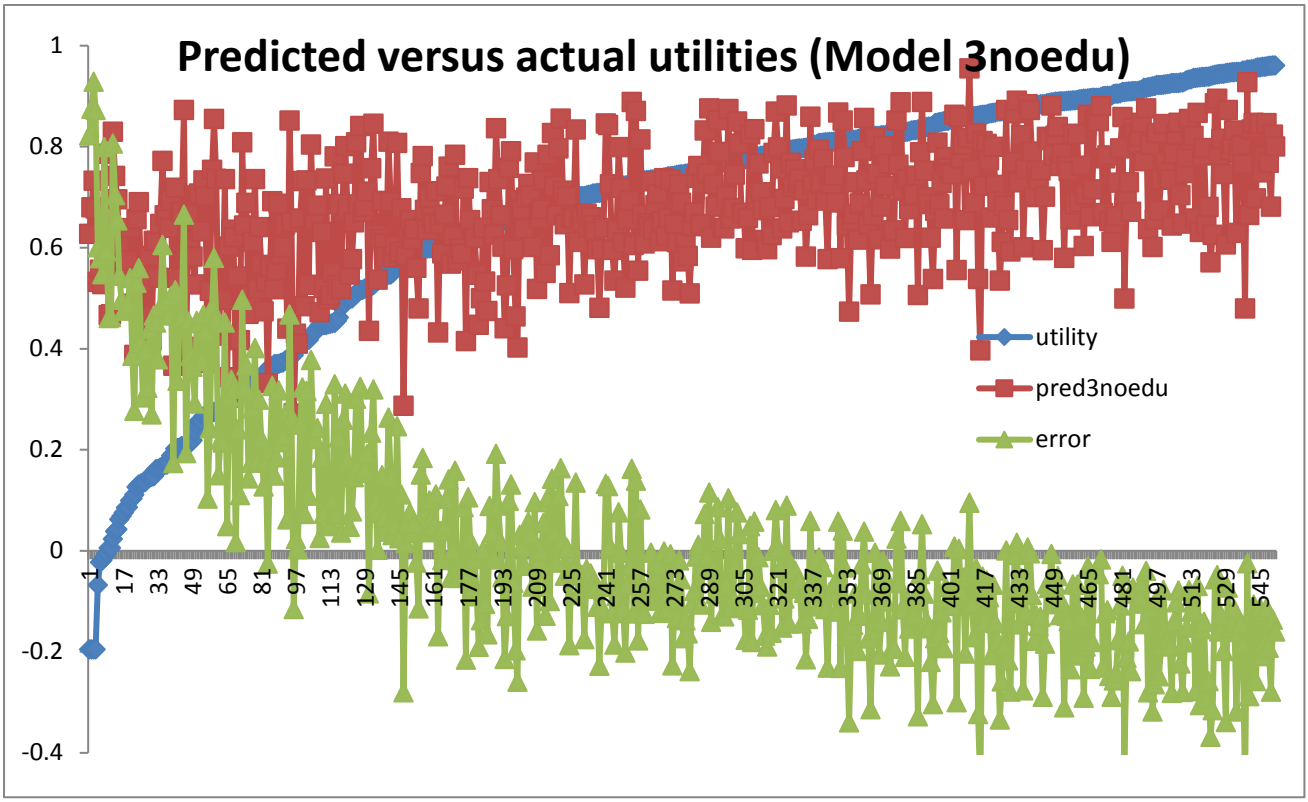
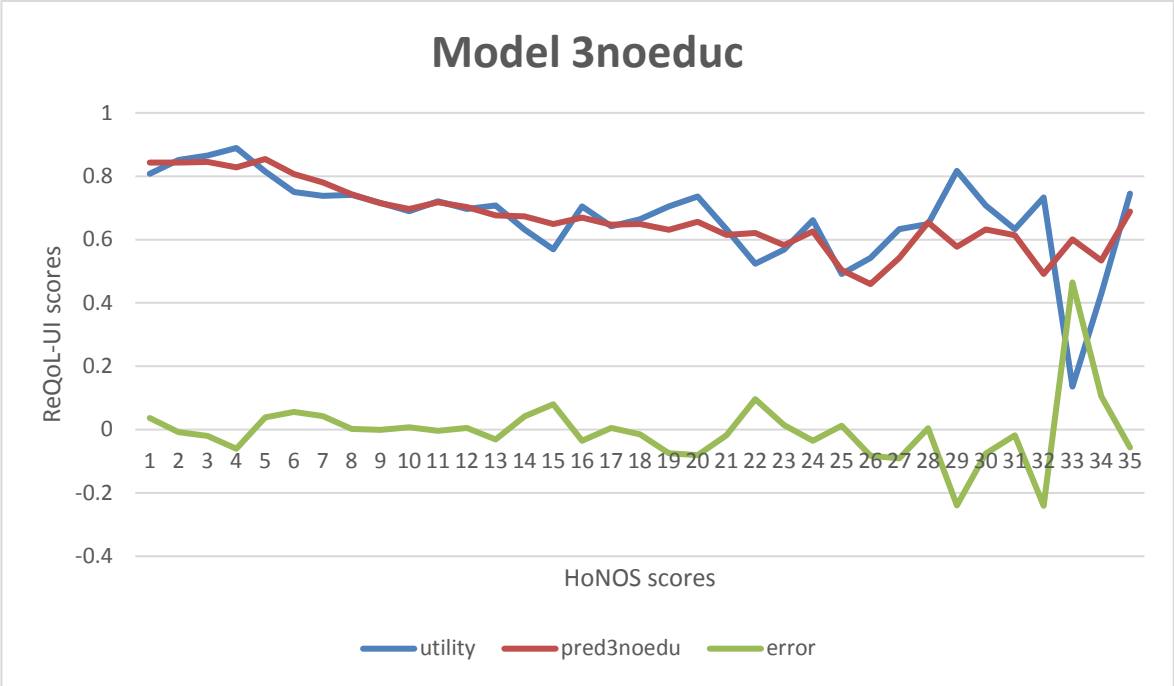


Figure 9b Model 3noedu by HoNOS score (mean level)



4 Discussion

We have empirically established that there is little conceptual overlap between ReQoL-UI (and ReQoL-10) and HoNOS through the low correlations between the items and total score of the two measures. The HoNOS and ReQoL measures seem to be measuring very different things and it can also be argued that the service users and clinicians have very different perspectives. Under these circumstances, caution is recommended when applying these estimates (see for example, Longworth & Rowen 2013).

The mean OLS models had the lowest MAE (0.046) and RMSE (0.056) although these are estimated using mean level data with only 35 and 29 observations only. The OLS models using HoNOS items had high MAE (ranging from 0.129 to 0.173) and high RMSE (0.222 to 0.272). The errors were highest for the response mapping models that are not presented here. The high errors may be due not only to the lack of conceptual overlap but also because response mapping has been shown to perform better in large datasets (Dakin et al., 2013). The models were computationally demanding and took hours to run. The R-squared is higher for OLS models with some additional sociodemographic dummies (Model 2j) which suggest that age, general physical and mental health, interaction between physical and mental health, life satisfaction and education level were more important predictors of ReQoL-UI than HoNOS scores. Since mapping models are usually applied to external datasets to estimate utility values where the preference-based measure has not been included, this mapping model is unlikely to be feasible as many of these variables are unlikely to be included in the external dataset. The percentage of observations with MAE >0.1 is very high for all the individual level models, ranging from 48% to 64%, compared with 6% and 7% for the mean level models.

The figures plotting the predicted and observed utility for the various HoNOS scores clearly highlight the inability to predict on the high end of the HoNOS scale (representing severe scores) for all model specifications. This is a general issue that has been reported in the literature (Brazier et al., 2010). In this case, the high errors observed at the high severity end is mainly due to the low

number of participants with HoNOS scores between 28 and 35. No extrapolation was carried out for HoNOS scores between 35 and 48. Hence, the preferred model is presented with the HoNOS scores from 28 to 35 merged into one category. However, it is expected that this pattern of fewer participants scoring >= 28 on the HoNOS is likely to be observed across several datasets with similar populations.

5 Conclusions

If a mapping model is required, we recommend the use of the mean level OLS model 2. Caution is recommended when applying these estimates due to the limited conceptual overlap between HoNOS and ReQoL-UI and the difference in perspective given that ReQOL-UI is patient-reported and HONOS is clinician-reported. .

6 References

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Appendix 1 List of demographic questions

1. In general would you say your health is:
   Excellent
   Very Good
   Good
   Fair
   Poor

2. What is your gender?

   Male
   Female
   Transgender

3. What is your age? (in years)

4. Are you:

   Single
   Married / Partner
   Separated / Divorced
   Widowed
   Prefer not to say

5. Which of the following best describes your main activity? (Tick which is most applicable to you)

   In employment or self-employment
   Retired
   Housework
   Student
   Unemployed

6. Did you continue education after the minimum school leaving age?

   Yes
   No

7. Do you have a degree or equivalent professional qualification?

   Yes
   No

8. What is your ethnic group?
(Tick one option that best describes your ethnic group or background)

White
Asian/Asian British
Black / African / Caribbean / Black British Mixed / Multiple ethnic groups
Other ethnic group
Prefer not to say

9. Please list your mental health condition(s)?

10. Are you currently receiving care or treatment for your mental health?
Yes
No

If YES, please tick all that apply:

General Practitioner (GP)
Improving Access to Psychological Therapies (IAPT) – (e.g. Counsellor, CBT) Community Mental Health Teams (Nurses, Psychiatry outpatient, Home treatment)
As an Inpatient
Voluntary Sector
Child and Adolescent Mental Health Services (CAMHS)

11. Overall, how satisfied are you with your life nowadays? (Please circle the number that best corresponds to you)

Not at all satisfied										Completely satisfied
0	1	2	3	4	5	6	7	8	9	10

12. In general, would you say your mental health is:

Excellent
Good
Fair
Poor
Very Poor

Understanding the correlations

H1 (overactive aggressive behaviour) includes irritability, quarrels (leve1),

HoNOS	Meaning of different levels	Expected correlation with ReQoL items
H1 Overactive aggressive	L1 irritability, quarrels L2 aggressive gestures – pushing pestering, lesser damage to property L3 Physically aggressive to others or animals L4 At least one serious physical attack on others or animals, destructive property	We expect **low** correlations with the ReQoL items.
H2 Non-accidental self-injury	L1 Fleeting thoughts – no self-harm L2 Mild risk (e.g. wrist scratching) L3 Moderate to serious risk – prep acts collecting tablets L4 Serious suicidal attempt/ serious self-injury	We expect **moderate correlation** with the ReQoL items mainly reqol6, reqol5, reqol3
H3 Problem Drinking/Drug taking	L1 some over-indulgence but within social norm L2 Loss of control L3 marked craving/dependency L4 incapacitated by alcohol/drug	We expect **some correlation** with reqol9 (lonely) as there is some connection between drinking problem and loneliness.
H4 Cognitive problems	L1 minor problems with memory or understanding L2 Mild but definite problems (mixed up) L3 Marked disorientation L4 Severe disorientation	We expect **low** correlations
H5 Physical Illness	L1 Minor health problems L2 Imposing mild restriction on mobility and activity L3 Moderate degree of restriction L4 Severe or complete incapacity	We expect **high** correlation with reqolphy
H6 Hallucinations and Delusions	L1 Somewhat odd and eccentric beliefs L2 Delusions present but little distress L3 Marked preoccupations, much distress L4 Several impact on patient	We expect **moderation** correlation with the reqol items
H7 Problems with depressed moods	L1 Gloomy or minor changes in mood L2 Feelings of guilt , loss of self-esteem L3 Depressions with inappropriate self-blame, preoccupied with guilt L4 Severe/very separate depression	We expect **moderate** correlation with reqol5 reqol7 and reqol6
H8 Other mental and behavioural problems	L1 Minor problems L2 Mild level L3 Occasional severe attack/distress – loss of control L4 Severe problems	We expect **moderate** correlation with reqol3
H9 Problems with relationships	L1 Minor non-clinical problems L2 Definite problem/ sustaining supportive relationships	We expect **moderate** correlations with reqol3 reqol5 reqol7 reqol9

	L3 Persisting major problem L4 Severe and distressing social isolation due to inability to communicate socially	
H10 Problems with ADL	L1 Minor problems (e.g. untidy, disorganised) L2 Self-care adequate but major lack of performance L3 Major problem with one or more areas of self-care (eating, washing, toilet) L4 severe disability in nearly all areas of self-care	We expect **moderate** correlation with reqol3 and reqolphy
H11 Problems with living conditions	L1 Accommodation reasonably acceptable but minor issues L2 Significant problems L3 Distressing multiple problems L4 Accommodation is unacceptable	We expect **low** correlations
H12 Problems with occupation and activities	L1 Temporary problems L2 Limited choice of activities; lack of reasonable tolerance; handicapped by lack of a permanent address L3 Marked deficiency in skilled services – no opportunities to use skills or add new ones L4 Lack of any opportunity for daytime activities	We expect **low** correlations