A Method for Adjusting US Health State Utilities for Use in the UK

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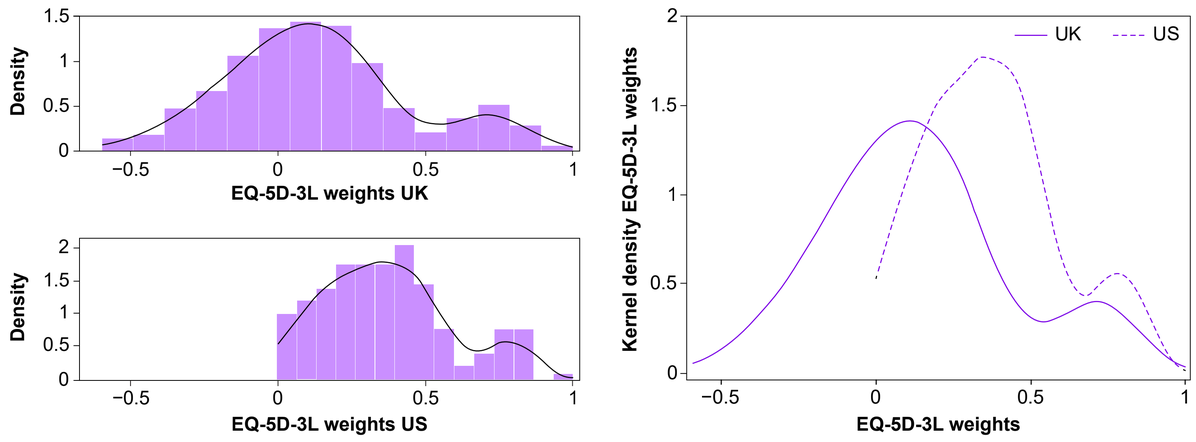
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INTRODUCTION

- The EuroQol-5 Dimension 3-Level (EQ-5D-3L) of health questionnaire serves as an instrumental tool in assessing health-related quality of life, with its unique descriptive system that encapsulates five dimensions of health.[1]
- Given the variation of health preferences across geographical locales (**Figure 1**), a critical realisation emerges: the non-transferability of EQ-5D-3L published utility data between regions without adjusting them.[2]
- This study aimed at formulating an approach for adjusting EQ-5D-3L utilities from the United States[3] (US) for their applicability within the United Kingdom[4] (UK), especially when devoid of patient-level data.

Figure 1: EQ-5D-3L weights in the United Kingdom and the United States



EQ-5D-3L, EuroQol-5 Dimension 3-level of health questionnaire; UK, United Kingdom; US, United States.

OBJECTIVES

- This study outlines a method to adapt EQ-5D-3L mean utilities, which were originally based on US data, for use in the UK when there is no patient-specific data available.

METHODS

- A targeted literature review was conducted in PubMed, EMBASE and Google Scholar to identify publications reporting EQ-5D-3L responses from patients/general population and estimate of the utility applying the EQ-5D-3L health states utility weights (HSUW) in the US and UK.
- HSUW (also known as tariff) is a value set that reflects the preference for different health states of a country-specific population for preference-based health-related quality-of-life instrument.
- The HSUW estimates were incorporated into ordinary least squares linear regression model (1) and polynomial regression non-linear (2) model using UK $HSUW_j$ for each EQ-5D-3L state as a dependent variable, and the corresponding US $HSUW_j$ as regressor (j = 1→243 EQ-5D-3L states)

$$HSUW_j^{UK} = \beta_o + \beta_1 \times HSUW_j^{US} \quad (1)$$

$$HSUW_j^{UK} = \beta_o + \beta_1 \times (HSUW_j^{US})^{\wedge 2} + \beta_2 \times HSUW_j^{US} \quad (2)$$

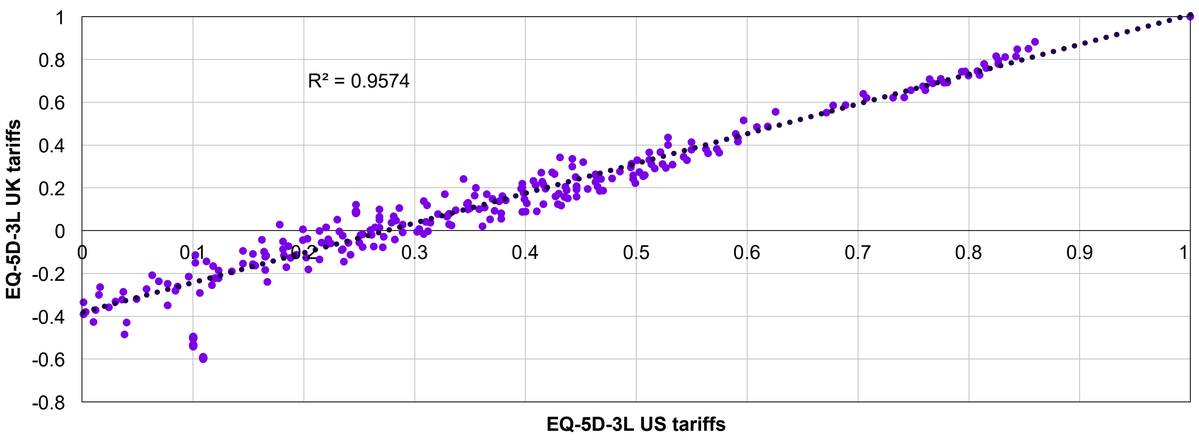
- Goodness of fit was evaluated by visual inspection and R-squared.
- Model coefficients were validated using previously published articles containing mean utilities obtained from both US and UK EQ-5D-3L value sets.
- In addition, model was also validated by predicting the UK utility based on published US utility values.

RESULTS

- A linear relationship was observed between the HSUWs in both countries by regressing the published US and UK tariffs-based utilities into the UK-utility formula (**Figure 2**).

$$U^{UK}\ (Utility) = -0.3813 + 1.3904 \times U^{US}\ (Utility)\ (HSUW\text{-}based\ algorithm)$$

Figure 2: UK linear model



EQ-5D-3L, EuroQol-5 Dimension of health questionnaire; UK, United Kingdom; US, United States.

- The non-linear model did not fit the data better than the linear model at both visual inspection and the R-squared (0.9574 vs. 0.9576, linear and non-linear models, respectively). The model is presented in **Table 1**.

Table 1: Comparison of OLS linear and polynomial non-linear regression models for data fit

OLS regression – linear model						
Number of observations	**F(1, 241)**	**Prob > F**	**R-squared**	**Adj R-squared**	**Root MSE**	
243	5409.87	0.0000	0.9574	0.9572	0.06439	
$HSUW_j^{UK}$	**Coefficient**	**SE**	**t**	**P>t**	**95% CI**	
$HSUW_j^{US}$	1.390439	0.018904	73.55	0.000	1.353201	1.427678
Constant	−0.38129	0.008165	−46.7	0.000	−0.39738	−0.36521
Polynomial regression – non-linear model						
Number of observations	**F(2, 240)**	**Prob > F**	**R-squared**	**Adj R-squared**	**Root MSE**	
243	2708.54	0.000	0.9576	0.9572	0.06436	
$HSUW_j^{UK}$	**Coefficient**	**SE**	**t**	**P>t**	**95% CI**	
$(HSUW_j^{US})^{\wedge 2}$	0.081006	0.072042	1.12	0.262	−0.06091	0.222922
$HSUW_j^{US}$	1.321271	0.06435	20.53	0.000	1.194507	1.448034
Constant	−0.37064	0.012508	−29.63	0.000	−0.39527	−0.346

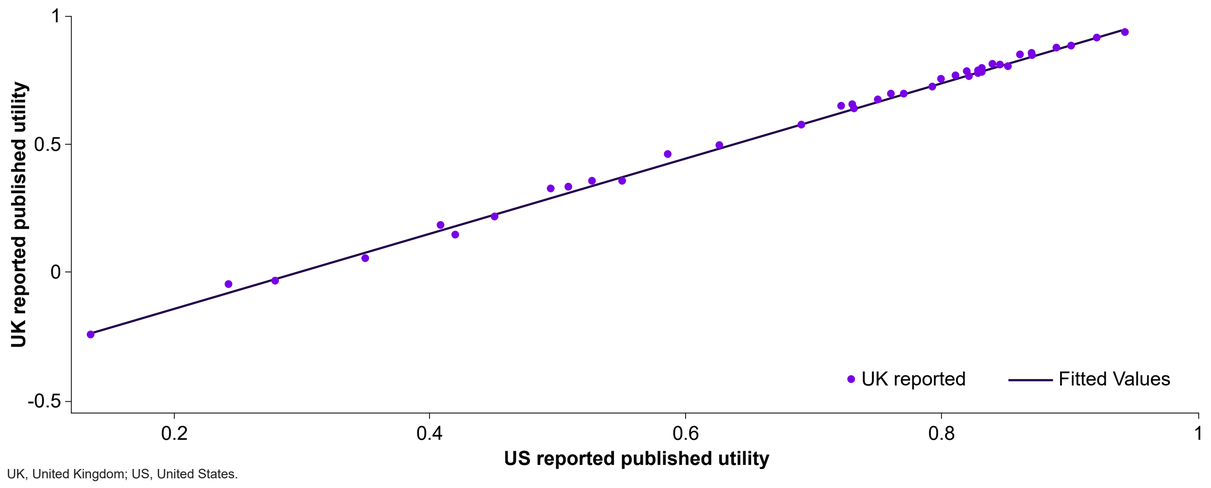
CI, confidence interval; F, f-test; HSUW, health states utility weights; MSE, mean square error; OLS, ordinary least squares; P, probability of obtaining a t-value; Prob, probability; SE, standard error; t, difference between the population means; UK, United Kingdom; US, United States

- Testing the relationship between the published utilities that we identified based on the US and UK tariffs confirmed the linear relationship.
- In the linear regression of UK utility based on the published US utility, the slope of the line was very close to the slope of the HSUW-based line (1.4738 vs. 1.3904).

$$U^{UK} = -0.4384 + 1.4738 \times U^{US}\ (published\ utility\text{-}based\ algorithm)$$

- The intercept of the line was very close to the intercept of the HSUW-based line (−0.44 vs. −0.38, respectively) (**Figure 3**).

Figure 3: Validity of EQ-5D index scores using UK and US preference weights



UK, United Kingdom; US, United States.

- The prediction power of the algorithm was enhanced by combining the two models (the *HSUW* based & the *U-based* one) (**equation below**), by doing so, the unexplained variation by the using the *HSUW*-based model could be captured (**Table 2**).

$$U^{UK}\ (enhanced) = \sum(U^{UK}\ (predicted\ based\ on\ HSUW\ algorithm) + U^{UK}\ (predicted\ based\ on\ published\ Utilities\ algorithm))/2$$

Table 2: EQ-5D-3L utility scores for UK predicted by applying linear model and algorithm

Authors	Population	US reported	UK reported	Δ[a]	Results		
					UK predicted	UK predicted (enhanced algorithm)	Δ[b]
	Swedish rheumatoid arthritis patients						
Karlsson et al (2011)	Baseline	0.55	0.35	0.2	0.38	0.38	0.028
	12 m	0.73	0.63	0.1	0.63	0.64	0.006
Kiadalir et al (2015)	Swedish type 2 diabetes patients	0.83	0.77	0.06	0.77	0.78	0.009
Mozzi et al (2016)	Crohn's disease patients	0.69	0.57	0.12	0.58	0.58	0.008
Wang et al (2020)	Chinese rural population	0.943	0.93	0.013	0.93	0.94	0.011
Lien et al (2015)	Metastatic pancreatic cancer patients						
	Nausea and vomiting	0.526	0.352	0.174	0.350	0.343	0.009
	Diarrhea	0.508	0.328	0.18	0.325	0.318	0.010
	Hand-foot syndrome	0.409	0.179	0.23	0.187	0.176	0.003
	Stomatitis	0.279	−0.038	0.317	0.007	−0.010	0.028
	Febrile neutropenia	0.586	0.454	0.132	0.434	0.429	0.025
	Fatigue	0.243	−0.053	0.296	−0.043	−0.062	0.009
	Rash	0.626	0.487	0.139	0.489	0.487	0.000
	Neuropathy	0.494	0.32	0.174	0.31	0.30	0.022
	Stable disease	0.72	0.643	0.077	0.620	0.62	0.022
	Supportive care	0.136	−0.25	0.386	−0.192	−0.22	0.035
Bansback et al (2012)	Canadian general population	0.85	0.8	0.05	0.80	0.80	0.007
Noyes et al (2007)	Parkinson disease patients	0.83	0.79	0.04	0.77	0.78	0.011
	With severe usual activities problems	0.45	0.21	0.24	0.24	0.24	0.025
	Without usual activities problems	0.9	0.88	0.02	0.87	0.88	0.001
	With severe anxiety/depression	0.42	0.14	0.28	0.20	0.19	0.052
	Without anxiety/depression	0.89	0.87	0.02	0.86	0.87	0.005
	With severe pain/discomfort	0.36	0.05	0.31	0.11	0.106	0.056
	Without pain/discomfort	0.92	0.91	0.01	0.90	0.91	0.002
Huang et al (2007)	HIV patients	0.87	0.84	0.03	0.83	0.84	0.004
	CD4 count <200	0.86	0.83	0.03	0.81	0.82	0.008
	CD4 count ≥200	0.88	0.86	0.02	0.84	0.85	0.010
	Viral load <median	0.87	0.85	0.02	0.83	0.84	0.014
	Viral load ≥median	0.86	0.84	0.02	0.81	0.82	0.018
	PHS <median	0.79	0.75	0.04	0.72	0.72	0.028
	PHS ≥median	0.93	0.93	0	0.91	0.92	0.008
	MHS <median	0.8	0.75	0.05	0.73	0.74	0.014
	MHS ≥median	0.93	0.92	0.01	0.91	0.92	0.002
Sakthong et al (2008)	Type 2 diabetic in Bangkok, Thailand	0.81	0.76	0.05	0.75	0.75	0.010
	HbA1c <7%	0.83	0.79	0.04	0.77	0.78	0.011
	HbA1c ≤7%	0.8	0.75	0.05	0.73	0.74	0.014
	Neuropathy (No)	0.84	0.81	0.03	0.79	0.79	0.017
	Neuropathy (Yes)	0.77	0.69	0.08	0.69	0.69	0.003
	Retinopathy (No)	0.82	0.78	0.04	0.76	0.77	0.015
	Retinopathy (Yes)	0.76	0.69	0.07	0.68	0.68	0.011
	Nephropathy (No)	0.82	0.77	0.05	0.76	0.77	0.005
	Nephropathy (Yes)	0.75	0.67	0.08	0.66	0.66	0.006
	Cardiovascular (No)	0.83	0.78	0.05	0.77	0.78	0.001
	Cardiovascular (Yes)	0.73	0.65	0.08	0.63	0.64	0.014
Sullivan et al (2016)	Diabetes patients	0.792	0.719	0.07	0.72	0.724	0.005

Data presented are means as reported in the publications. Δ[a], difference in means; Δ[b], difference between UK predicted enhanced algorithm and UK reported value; HbA1c, haemoglobin A1c; HIV, human immunodeficiency virus; MHS, mental health summary; PHS, physical health summary.

Conclusions

- **The study estimates a robust linear relationship with reliable predictive power for aligning US and UK health utilities.**
- **By combining the HSUW-based and U-based models, the algorithm accounts for differences, offering a more precise approach for health economic assessments.**

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DISCLOSURES
AJOA, **JM**, **EL** and **CN** are employees of and stockholders in Sanofi.

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