XML-S

Our reference: JVAL 1528 P-authorquery-vx

AUTHOR QUERY FORM

ELSEVIER	**Journal: JVAL** **Article Number: 1528**	**Please e-mail your responses and any corrections to:** **E-mail: a.rodenmeyer@elsevier.com**

Dear Author,

Please check your proof carefully and mark all corrections at the appropriate place in the proof (e.g., by using on-screen annotation in the PDF file) or compile them in a separate list. Note: if you opt to annotate the file with software other than Adobe Reader then please also highlight the appropriate place in the PDF file. To ensure fast publication of your paper please return your corrections within 48 hours.

For correction or revision of any artwork, please consult http://www.elsevier.com/artworkinstructions.

Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof. Click on the Q link to go to the location in the proof.

Location in article	Query / Remark: click on the Q link to go Please insert your reply or correction at the corresponding line in the proof
Q1	Please confirm that given name and surname have been identified correctly.
Q2	Author: • If there are any drug dosages in your article, please verify them and indicate that you have done so by initialing this query. • Please review and confirm the accuracy and completeness of any affiliations.
Q3	AU: Please note that as per the journal style, the Abstract needs to be set in sections (e.g., Background, Objectives, Methods, Results, and Conclusions). Kindly make suitable changes to conform to the journal style.
Q4	AU: Please provide a few keywords for your article.
Q5	AU: Please provide the dates of access for Refs. 5, 6, 8, and 9.
Q6	AU: Please include the location of the publisher for Ref. 13.

Thank you for your assistance.

Please check this box or indicate your approval
if you have no corrections to make to the PDF file

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/jval

Short Communication

Results from a Well-Being Survey in the North West of England: Inequalities in EQ-5D–Derived Quality-Adjusted Life Expectancy Are Mainly Driven by Pain and Mental Health

Brendan Collins[1,2,*]

[1]Wirral Borough Council, Birkenhead, UK; [2]Department of Public Health and Policy, University of Liverpool, Liverpool, UK

ABSTRACT

There is a growing body of evidence that once quality-of-life decrements are factored in, health inequalities become more prominent than using life expectancy alone. This study has confirmed this with the EuroQol five-dimensional questionnaire data from a large survey from the North West of England (N = 11,500), which when combined with population and mortality data found that the gap in quality-adjusted life expectancy between the most and least deprived quintiles was 16.8 years in males and 14.5 years in females. The gap in health-related quality of life between the rich and the poor was most prominent in males and in the age group of 55 to 64 years. People who live in the least deprived areas are less likely to show any level of problems across all five domains of the EuroQol five-dimensional questionnaire than those who live in the most deprived areas. People from the least deprived areas are less likely to have severe problems on two domains: pain/discomfort (odds ratio = 0.45 [95% confidence interval 0.33–0.62]) and anxiety/depression (odds ratio = 0.3 [95% confidence interval 0.19–0.47]).

Introduction

There has been a debate about how to factor health and social inequalities into the prioritization process for provision of health and other public services. A challenge with health policies and interventions is to understand whether they are reducing health inequalities as well as improving the health of the population as a whole. Marmot [1] recommended proportionate universalism, in which resources are targeted in proportion to health inequalities across the spectrum, but for this to happen, we need to know more about the spread of health within the population.

Distributional cost-effectiveness analysis has been presented as a method to understand whether an intervention is having this desired effect [2]. One of the inputs for a distributional cost-effectiveness analysis is the difference in quality-adjusted life expectancy (QALE) across different population groups, which may be by deprivation or by other groups such as ethnicity.

The EuroQol five-dimensional questionnaire (EQ-5D) is a multicomponent, generic health-related quality-of-life (HRQOL) questionnaire. It does not measure nonhealth outcomes such as well-being and has been purported to have some limitations, such as not being sensitive to health problems with a pattern of exacerbations, and not picking up sensory impairments [3]. A five-level version has been developed that may be more sensitive to small changes in functioning than the original three-level version. The EQ-5D is the criterion standard tool recommended by the National Institute for Health and Care Excellence for measuring utility that is used to calculate quality-adjusted life-years (QALYs). Utility scores were calculated using population-based preference scores that were derived using the time trade-off method and so represent modeled estimates of the relative preference for one health state over other health states [4]. QALYs are calculated as estimated utility multiplied by time in years.

In this study, we have looked at QALE, which is based on an estimate of QALYs experienced. QALE comparisons are often used in cost-utility analysis, which is an economic method that allows the relative health benefits of interventions to be compared using a common currency. So, for instance, the QALYs gained from hip replacements can be compared with those from prescribing an antidepressant or with those from a vaccination program and thus the incremental cost per QALY can be compared. It can be argued that QALE tells a decision maker more about the spread of HRQOL because it is more sensitive than healthy life expectancy or disability-free life expectancy, which are often based on only binary variables, that is, whether individuals class their health as "good" or "bad" or whether they regard themselves as having a disability,

* *Address correspondence to:* Brendan Collins, Wirral Borough Council, Old Market House, Hamilton Street, Birkenhead CH41 5AL, UK. E-mail: brenc@liv.ac.uk.

1098-3015$36.00 – see front matter Copyright © 2016, International Society for Pharmacoeconomics and Outcomes Research (ISPOR). Published by Elsevier Inc.

http://dx.doi.org/10.1016/j.jval.2016.08.004

whereas the EQ-5D has 243 unique health states. It could, however, be argued that QALE is also slightly more complex and less intuitive because it is based on a preference-based numerical utility scale that is derived from a quality-of-life questionnaire. This utility scale is theoretically measured between 0 (worst possible health) and 1 (best possible health). The EQ-5D valuation, however, can produce utility scores that are less than 0, which can cause conceptual problems.

We hypothesize that people in deprived areas will have lower quality of life, shorter life expectancy, and lower QALE than do those in less deprived areas, and thus that the gap between the rich and the poor is greater for QALE than for life expectancy alone.

Methods

Data were obtained from the North West Mental Wellbeing Survey 2012-2013 (NWMWBS), which was administered to a representative sample of people 16 years and older living in households in the North West of England between September 2012 and March 2013. The survey methods are reported in more detail elsewhere [5]. In this survey, face-to-face interviews were carried out with a household member using computer-assisted personal interviewing. This survey was completed for 11,500 people and included the five questions from the three-level EQ-5D. There were no missing EQ-5D data. The standard UK value set was used to calculate health state utility scores [4]. The survey did not include the EQ-5D visual analogue scale because the survey was primarily a well-being survey and was computer-administered, and the survey was mainly interested in the health profile and the EQ-5D index value and their relationship with subjective well-being. Apart from the local authority-level EQ-5D data, the mortality [6], deprivation [7,8], and population data [9] used in this study are available in the public domain.

For the North West, EQ-5D utility scores from the NWMWBS were matched up to the mortality data and population estimates by age group and deprivation quintile. The mortality and population data were aggregated up from lower layer super output area (LSOA) level. LSOAs are small geographical units used by the UK Office for National Statistics, each of which contains around 1500 people. National deprivation quintiles were derived from the Index of Multiple Deprivation (IMD) 2010, published by the UK Department for Communities and Local Government in 2011 [7], which was the most recent at the time of the NWMWBS (a 2015 version of the IMD has since been published). The IMD is based on seven domains: income deprivation (22.5% of total IMD score); employment deprivation (22.5%); education, skills, and training deprivation (13.5%); health deprivation and disability (13.5%); crime (9.3%); barriers to housing and services (9.3%); and living environment deprivation (9.3%).

To match up LSOAs to deprivation quintiles, a spreadsheet was used that contained 2011 LSOA geographies matched up to IMD 2010 scores by the Knowledge and Intelligence Teams of Public Health England in London and the East Midlands on the basis of scores produced by the Department for Communities and Local Government in 2011 [8]. There are several different deprivation indices but the IMD are the only indices that are calculated at the LSOA level, which was the level of granularity for the other data.

Life expectancy was calculated using the Chiang 2 method [10] and QALE was calculated using the Sullivan method [11]. These measures were calculated by sex using the broad age groups that the survey data were collected for; the age groups were as follows: younger than 16, 16 to 24, 25 to 39, 40 to 54, 55 to 64, and 65 years and older. Because the NWMWBS did not include people younger than 16 years, it was assumed that all individuals younger than 16 years had the same EQ-5D utility score as did individuals aged 16 to 24 years. The average life expectancy and QALE were compared across the five deprivation quintiles and by sex.

Answers to the individual questions in the EQ-5D (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) were compared across the five quintiles and were compared using odds ratios between the most and least deprived quintiles to ascertain whether people in less deprived areas were less likely to have problems around particular elements of HRQOL.

Results

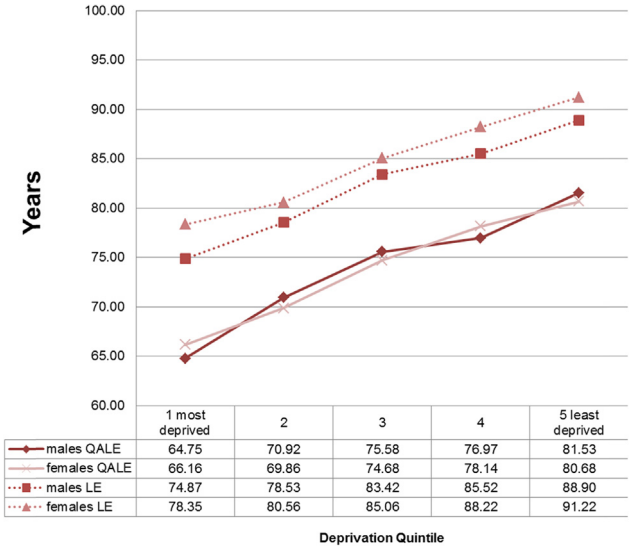
Both life expectancy and QALE showed a clear gradient across deprivation quintiles (Fig. 1). The gap in life expectancy was 14.03 years for males (95% confidence interval [CI] 13.49–14.57) and 12.88 years for females (95% CI 12.42–13.34), whereas the gap in QALE was 16.23 years for males (95% CI 15.74–16.71) and 14.19 years for females (95% CI 13.79–14.60). Interestingly, although life expectancy was consistently higher in females than in males, QALE was similar for males and females; introducing the element of quality of life eliminates the gap between males and females.

There was a clear gradient in the proportion of survey respondents with any problems on the five EQ-5D domains, in particular self-care, in which 8.2% of people in the most deprived quintile had problems compared with 4.4% of people in the least deprived quintile. There was some gradient in the proportion of survey respondents with severe problems, which was most pronounced (and statistically significant) in pain/discomfort and anxiety/depression and was approaching significance for usual activities (Table 1).

Discussion

Main Findings

Statistically significant differences were seen across all five domains of the EQ-5D across the five deprivation quintiles. The main drivers of inequalities in HRQOL were pain/discomfort and anxiety/depression. Previous studies have suggested that, internationally, pain/discomfort is the biggest driver of inequalities in HRQOL as measured by the EQ-5D [12]. This finding, however, does not mean that these are also



	1 most deprived	2	3	4	5 least deprived
males QALE	64.75	70.92	75.58	76.97	81.53
females QALE	66.16	69.86	74.68	78.14	80.68
males LE	74.87	78.53	83.42	85.52	88.90
females LE	78.35	80.56	85.06	88.22	91.22

Fig. 1 – LE and QALE by sex and deprivation quintile, North West of England, 2013. LE, life expectancy; QALE, quality-adjusted life expectancy.

Table 1 – Proportion of survey respondents with any problems (level 2 or 3) or severe problems (level 3) on EQ-5D domains, North West of England, 2013 (shown with odds ratios of least vs. most deprived [quintile 5 vs. quintile 1]).

IMD quintile	% with any problems on the EQ-5D domain					% with severe problems on the EQ-5D domain				
	Mobility	Self-care	Usual activities	Pain	Anxiety/ depression	Mobility	Self-care	Usual activities	Pain	Anxiety/ depression
5 least deprived	25.5	4.4	18.6	41.1	18.6	0.07	0.14	1.25	3.06	1.46
4	24.7	4.4	19.1	46.2	15.7	0.00	0.13	1.24	3.84	1.37
3	28.9	6.3	19.9	46.4	14.9	0.13	0.31	2.07	3.46	2.14
2	28.5	6.9	21.9	44.1	18.2	0.24	0.29	1.92	5.58	2.55
1 most deprived	29.9	8.2	25.1	48.6	24.8	0.27	0.41	2.02	6.55	4.74
Total	28.2	6.7	22.1	46.2	20.1	0.18	0.30	1.81	5.15	3.12
Odds ratio of least vs. most deprived (95% CI)	0.85 (0.74–0.99)*	0.53 (0.4–0.7)*	0.74 (0.63–0.87)*	0.85 (0.74–0.96)*	0.75 (0.64–0.88)*	0.26 (0.03–1.99)	0.34 (0.08–1.44)	0.62 (0.37–1.02)	0.45 (0.33–0.62)*	0.3 (0.19–0.47)*

CI, confidence interval; EQ-5D, EuroQol five-dimensional questionnaire; EQ-5D-3L, three-level EQ-5D; IMD, Index of Multiple Deprivation.

* Statistically significant odds ratio.

the causes of the life expectancy gap because causes of morbidity and mortality may overlap but will be different.

People from more deprived areas had statistically significant lower life expectancy and QALE. If quintiles 1 to 4 were to experience the same QALE as the least deprived quintile, then this would mean around 60 million more QALYs experienced in the North West across the whole population. If the QALYs lost were valued at ß20,000 per year (the National Institute for Health and Care Excellence's threshold of willingness to pay for new public health interventions), they would be valued at ß1.2 trillion in total, or around ß13 billion per year if spread over 90 years (not discounted). To put this into context, the spend on the National Health Service in England was around ß113 billion in 2014-2015 [13], and the areas in the North West make up around 13% of the England population. So the spend in the North West would be around ß15 billion, although the true spend figure is most likely higher than this because the North West has greater health needs than England on average. This is only a very crude analysis but demonstrates the magnitude of health inequalities when a financial value is attached to them. Health inequalities are caused by a range of factors that go beyond public health and health care, and so it does not imply that spending this type of money on interventions around health inequalities would change this.

Comparison with Other Relevant Studies

This study found a life expectancy gap of 14.0 years in males and 12.9 years in females, with a QALE gap of 16.8 years in males and 14.5 years in females. These results are in the same direction as previous studies such as by Love-Koh et al. [14] who found that the gap for England for the period 2010 to 2012 in life expectancy was 7.4 years, whereas that in QALE was 12.5 years. For the present study, however, most of the QALE gap is through differences in years of life lost, and not through differences in quality of life. A study using the Global Burden of Disease methodology for England found that the leading cause of years of life lost was ischemic heart disease, whereas the leading cause of years lived with disability was low back and neck pain [15]. A proportion of the gap may be due to an earlier onset of disease. A large-scale cross-sectional study from health records in Scotland found that the onset of multimorbidity occurred 10 to 15 years earlier in people living in the most deprived areas compared with the most affluent [16]. Across the North West, the biggest gradient in EQ-5D utility by age is seen in the 55 to 64 years age group, in which the gap was 0.123 (14.1%) in females and 0.154 (17%) in males. The fact that the gap is the largest in the 55 to 64 years age group and not in the 65 years or older age group may be partly indicative of a healthy survivor effect whereby a greater proportion of the people with the poorest health in the most deprived group have died before they are surveyed in the 65 years or older age group.

Strengths and Weaknesses of This Study

The survey used for this study had a large sample size (11,500) that was not calculated specifically for QALE but was large enough to see a statistically significant difference between deprivation quintiles in quality-of-life scores. At individual local authority level, some areas had a sample size of 1,000, which may have been large enough to look at the distribution of QALE in local authority geographies but we were not certain whether the sample was representative at this level. The survey included only people in private residences and so would most likely underestimate the quality-of-life decrements across the population because this would not include quality of life experienced by people in hospitals and care homes or by homeless people. The QALE calculation used the broad age groups from the survey rather than the 5-year age bands that are traditionally used to calculate life expectancy and so this may give less precise results.

The distribution of EQ-5D-3L scores is often skewed with significant ceiling effects; in this case, 59% of respondents had an EQ-5D score of 1, which equates to full health. Although the questions in the EQ-5D are quite functional and less subjective than in other surveys, there may be some biases. For example, people from deprived communities may more likely be in physically demanding routine and manual occupations in which ill health affects their ability to carry out their daily activities [17]. But conversely, people from more deprived communities may have lower health expectations and so report fewer health problems than do people from less deprived areas with equivalent health status; for instance, Kinge and Morris [18] found that obesity impacts less on HRQOL in people from deprived areas.

Implications for Policy and Future Research

The relationship between ill health and area deprivation is complex, and so people who are ill may be less able to work and therefore end up moving to cheaper accommodation in a more deprived area. Ill health is both a cause and a consequence of deprivation. This study has shown that in the North West of England, an area that is already more deprived than England on average, inequalities in HRQOL are mainly driven by differences in pain and anxiety/depression. This means that health policies and interventions to reduce inequalities in HRQOL should be targeted at illnesses associated with pain and mental health problems.

Conclusions

This study has reinforced findings from other studies that once quality of life is factored in, health inequalities become more pronounced. Furthermore, this study has found that on the basis of a sample from the North West of England, pain and anxiety/depression are two of the biggest drivers of the gap in quality of life.

Acknowledgments

I thank the people who carried out the North West Mental Wellbeing Survey and who shared the data with me. I also thank Christodoulos Kypridemos who directed me to the mortality data from the Office for National Statistics.

Supplemental Materials

Supplemental material accompanying this article can be found in the online version as a hyperlink at http://dx.doi.org/10.1016/j.jval.2016.08.004 or, if a hard copy of article, at www.valueinhealthjournal.com/issues (select volume, issue, and article).

REFERENCES

[1] Marmot M. Fair Society, Healthy Lives. London: UCL Institute of Health Equity, 2011.
[2] Asaria M, Griffin S, Cookson R. Distributional cost-effectiveness analysis: a tutorial. Med Decis Making 2015;36:8–19.
[3] Wailoo A, Davis S, Tosh J. The Incorporation of Health Benefits in Cost Utility Analysis Using the EQ-5D: A Report by the Decision Support Unit. Sheffield, UK: School of Health and Related Research, University of Sheffield, 2010.
[4] Dolan P, Gudex C, Kind P, Williams A. The time trade-off method: results from a general population study. Health Econ 1996;5:141–54.
[5] Jones A, Perkins C, Stansfield J, et al. North West Mental Wellbeing Survey 2012/13. 2013. Available from: http://www.nwph.net/Publications/NW%20MWB_PHE_Final_28.11.13.pdf. Q5
[6] Office for National Statistics. Number of deaths from all causes, by sex, age and LSOA 2001 and 2011, England and Wales, deaths registered 2001 to 2014. 2016. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/adhocs/005312numberofdeathsfromallcausesbysexageandlsoa2001and2011englandandwalesdeathsregistered2001to2014.
[7] McLennan D, Barnes H, Noble M, et al. The English Indices of Deprivation 2010: Technical Report. London: Department for Communities and Local Government, 2011.
[8] London Health Observatory. Index of Multiple Deprivation 2010: allocation of lower super output areas (LSOAs) to deprivation categories within upper tier local authorities in England. 2013. Available from: http://www.lho.org.uk/viewResource.aspx?id=17297.
[9] Office for National Statistics. Annual small area population estimates: 2013. 2014. Available from: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualsmallareapopulationestimates/2014-10-23.
[10] Eayres D, Williams ES. Evaluation of methodologies for small area life expectancy estimation. J Epidemiol Community Health 2004;58:243–9.
[11] Jagger C, Cox B, Le Roy S; European Health Expectancy Monitoring Unit. Health Expectancy Calculation by the Sullivan Method. (3rd ed.). EHEMU Technical Report. European Health Expectancy Monitoring Unit, 2006.
[12] Szende A. Measuring health inequalities. In: Szende A, Janssen B, Cabases J, eds., Self-Reported Population Health: An International Perspective Based on EQ-5D. London: Springer Open, 2014.
[13] Harker R. Health Expenditure: Social Indicators Page. SN/SG/2640. House of Commons Library, 2015. Q6
[14] Love-Koh J, Asaria M, Cookson R, Griffin S. The social distribution of health: estimating quality-adjusted life expectancy in England. Value Health 2015;18:655–62.
[15] Newton JN, Briggs AD, Murray CJ, et al. Changes in health in England with analysis by English region and areas of deprivation: findings of the Global Burden of Disease Study 2013. Lancet 2015;386:2257–74.
[16] Barnett K, Mercer SW, Norbury M, et al. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet 2012;380:37–43.
[17] Lacey EA, Walters SJ. Continuing inequality: gender and social class influences on self perceived health after a heart attack. J Epidemiol Community Health 2003;57:622–7.
[18] Kinge JM, Morris S. Socioeconomic variation in the impact of obesity on health-related quality of life. Soc Sci Med 2010;71:1864–71.