

Impact of educational level on health-related quality of life (HRQL): results from Germany based on the EuroQol 5D (EQ-5D)

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Background: To date, there is hardly any study focussing on the question how the concept of HRQL could deepen our understanding of health inequalities. The study aims at describing this potential by analysing data for adults from Germany. **Methods:** The analyses are based on three national, representative surveys conducted from 2006 to 2008. HRQL was assessed by the EuroQol-5D (EQ-5D), the descriptive part (problems in five dimensions) and the valuation of health by visual analogue scale (VAS) rendering a value between '0' (worst) and '100' (best imaginable). The major independent variable is educational level (high vs. low). Four other variables were included (i.e. age, sex, per capita income and chronic disease). Multivariate analyses were performed by logistic and linear regression. **Results:** Data were available for 5676 persons aged ≥ 20 years (response rate 73%). The prevalence of 'moderate or severe problems' is especially high in the dimension 'pain/discomfort' (low resp. high educational level: 46.3% resp. 25.0%). The mean VAS-value is 79.8 (low resp. high educational level: 75.3 resp. 83.6). Bivariate and multivariate analyses show that similar differences in VAS-values can be seen even after restricting the analyses to participants with a chronic disease. **Conclusion:** Empirical analyses concerning HRQL could further our understanding of health inequalities. They indicate that low status groups are faced with a double burden, first by increased levels of health impairments, and second by lower levels of HRQL once health is impaired. Thus, the extent of health inequalities could be underestimated if measures of HRQL are not taken into account.

Introduction

The discussion on health-related quality of life (HRQL) has increased considerably in recent years. HRQL has often been assessed by the EuroQol 5D (EQ-5D), a generic measure developed by an international study group.¹ Meanwhile, the EQ-5D has been translated into more than 150 languages (<http://www.euroqol.org>), and it has been applied to numerous health problems. A recent update lists about 2300 publications using the EQ-5D. Measures of socio-economic status (SES) are included in some of these studies (see below), but the association between SES and HRQL has rarely been discussed in any detail. Many of these studies have been conducted by health economists, including SES primarily as a potential confounder. Some studies do not even mention the associations between SES and HRQL, although they are reported in the tables. Other studies discussing these associations do this primarily in order to demonstrate the construct validity of their instrument.

Thus, differences in HRQL by SES are rarely discussed in their own right. Studies including HRQL and SES consistently show that low SES is associated with low HRQL. This may not be very surprising, but systematically including HRQL in studies on health inequalities could be important, for example, for assessing the full extent of health inequalities. Taking the example of a chronic disease such as diabetes mellitus: if among patients with diabetes, those with low SES value their health condition to be worse than those with high SES, health inequalities would be underestimated if they would not take into account this valuation. Also, health inequalities are widely discussed by social epidemiologists, but this discussion is rarely cited by health economists. There seems to be a significant gap between these two disciplines, even though they share a wide range of issues including differences by SES. The concept of HRQL is very important in economic evaluation; by including the concept in their studies social epidemiologists could move towards reducing this gap.

Our study aims at describing the potential of HRQL for health inequalities research, based on a dataset for adults in Germany. As the prevalence of chronic disease has been found related to low SES in a

number of studies,² it would further be important to find that even among persons with chronic disease there are differences in HRQL related to SES. Accordingly, we focus on the following hypothesis: Low SES is associated with low HRQL, even if the analysis is restricted to persons with specific chronic diseases. The hypothesis is based on the well-known fact that morbidity usually increases with decreasing SES,³ and the assumption that the methods for assessing morbidity often do not capture the whole extent of these health inequalities.

Methods

Data set

The data for this study have been provided by the 'Wort & Bild Verlag'. The analyses are based on representative surveys of the German adult population from 2006, 2007 and 2008. Representativeness was assured by random selection of households and random selection of one person above 14 years of age per household. The overall response rate was 73%. A weighting factor (based on the distribution of age and sex) has been used in all analyses to account for potential selection bias. Each sample includes about 2,000 persons (age group 14 years or above). We restricted the analyses to participants with at least 20 years of age, as school education (our main independent variable) should be finished by this age. All questions were answered in a face-to-face-interview, but a self-administered questionnaire was taken for the EQ-5D. The survey has been restricted to German. Thus, adults having problems with the German language are hardly included. Earlier analyses of the data have been used to describe the general distribution of HRQL in Germany in 2006,⁴ and to develop a new method for estimating a value set for the EQ-5D.⁵

Variables

Our main independent variable is 'educational level'. Two groups can be differentiated in Germany: low (in German: 'Hauptschule') and high

(‘Mittlere Reife, Fachhochschulreife, Abitur’). The percentage of adults with ‘low’ educational level is rather high in Germany (for example about 30% in the age group 30–35 years and 60% in the age group 60–65 years), but the German school system does not allow for a more narrow definition of low SES. Age, sex, per capita income and morbidity have been included in the analyses as well. Per capita income (i.e. net household income divided by the number of persons in the household) was categorized into five groups of approximately the same size (quintiles): up to 600/ 600–799 / 800–999 / 1000–1349/1350 Euro or more. The survey did not include a question on self-rated health, but a question on chronic diseases. The participants were asked for chronic diseases in the past 3 months. For further analyses, we selected the seven diseases mentioned most often (i.e. musculoskeletal system, diabetes mellitus, heart disease, rheumatism, headache or migraine, arthrosis, asthma). The variable ‘any chronic disease’ was then defined as reporting at least one of these chronic diseases.

The dependent variables are provided by both parts of the EQ-5D. The first part reads ‘Please indicate which statements best describe your own health state today.’⁶ Five dimensions are listed (mobility, self-care, usual activities, pain/discomfort, anxiety/depression), and three potential answers are given each. For each dimension, the first answer is coded ‘1’ (‘no problem’), the second ‘2’ (‘moderate problem’) and the third ‘3’ (‘severe problem’). In the second part, the text reads: ‘To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0’. The respondents were asked to make a mark on this ‘visual analogue scale (VAS)’. The analyses are based on logistic regressions for the dichotomous-dependent variables and linear regression for the continuous-dependent variable. All analyses have been conducted with the software package SAS[®] version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results

The total sample comprises 5676 participants (mean age men 50.8, women 49.7 years). About 43% of all men and 47% of all women have a low educational level. As already mentioned above, this high percentage is commonly seen among adults in Germany. There are no missing values for age, sex and educational level, and only 2.9% for per capita income. About 25% (men) resp. 28% (women) report to have at least one of the seven diseases selected here. Looking at respondents with moderate or severe problems in one of the five dimensions, $n=77$ different states could be found. None of the 10 most frequent states includes the code ‘3’ (i.e. ‘severe problem’). The number of participants with at least one ‘severe problem’ is small ($n=195$).

The distribution by educational level shows (table 1): in all five dimensions, the prevalence of moderate or severe problems is higher in the low as compared with the high level group. All these differences are statistically significant and substantial, ranging between 1.7-fold (anxiety/depression) and up to 3.8-fold (self-care). The outcome ‘moderate or severe problem in at least one of the five dimensions’ shows a 1.7-fold increase. A similar picture can be seen for the five most frequent states: The state ‘11111’ is more prevalent in the high educational-level group, whereas the other states indicating ‘moderate problems’ are more prevalent in the low-level group.

Health inequalities by educational level can also be assessed by the question: How many of those with a chronic disease say that they have a ‘moderate or severe problem’ in at least one of the EQ-5D dimensions? The percentages differ by educational level (not shown in table). For all chronic diseases except arthrosis higher prevalences of ‘problems’ are seen in the low (as compared with the high) level group; these differences are statistically significant for heart disease (85.8 vs. 72.2%; $P=0.049$) and for headache/migraine (87.1 vs. 63.9%; $P=0.004$).

The overall VAS-value of participants with low educational level is 8.3 points below the score of those with high level (83.6 vs. 75.3; table 2). A similar difference can be seen in the analyses restricted to participants with a ‘moderate or severe problem’ in one of the five EQ-5D dimensions. The picture is less clear in the analyses restricted to participants with a

Table 1 Prevalence of problems and of chronic disease, by sex and educational level

All participants	Sex		Educational level	
	Men <i>n</i> (%)	Women <i>n</i> (%)	Low <i>n</i> (%)	High <i>n</i> (%)
Total	2674 (47.1)	3002 (52.9)	2559 (45.1)	3117 (54.9)
Moderate/Severe problem				
Mobility	367 (13.8)	522 (17.7)	621 (24.3)	269 (8.6*)
Self-care	95 (3.6)	160 (5.3*)	192 (7.5)	63 (2.0*)
Usual activities	298 (11.2)	411 (13.7)	483 (18.9)	227 (7.3*)
Pain/discomfort	900 (33.8)	1058 (35.4)	1181 (46.3)	778 (25.0*)
Anxiety/depression	218 (8.2)	471 (15.7*)	406 (15.9)	283 (9.1*)
At least 1 dimension	982 (37.1)	1248 (41.8)	1305 (51.5)	924 (29.9*)
Combinations ^a				
11111 (no problem)	1666 (62.9)	1735 (58.2*)	1230 (48.5)	2171 (70.2*)
11121	411 (15.5)	405 (13.6*)	429 (16.9)	388 (12.5*)
21121	105 (4.0)	122 (4.1)	156 (6.1)	71 (2.3*)
21221	87 (3.3)	92 (3.1)	125 (4.9)	55 (1.8*)
11122	60 (2.3)	99 (3.3*)	83 (3.3)	76 (2.5)
Chronic disease				
Muscul. system	190 (7.1)	202 (6.7)	236 (9.2)	156 (5.0*)
Diabetes mellitus	79 (3.0)	113 (3.8)	146 (5.7)	46 (1.5*)
Heart disease	84 (3.2)	77 (2.6)	118 (4.6)	42 (1.4*)
Rheumatism	65 (2.4)	72 (2.4)	93 (3.6)	44 (1.4*)
Headache/migraine	30 (1.1)	84 (2.8*)	65 (2.6)	49 (1.6*)
Arthrosis	37 (1.4)	58 (1.9)	69 (2.7)	26 (0.8*)
Asthma	45 (1.7)	49 (1.7)	67 (2.6)	28 (0.9*)
Any chronic disease	680 (25.4)	837 (27.9*)	899 (35.1)	618 (19.8*)

a: Combinations with a prevalence of $\geq 1\%$ (1 stands for ‘no problem’, 2 for ‘moderate’ and 3 for ‘severe problems’).

* $P<0.05$ (χ^2 test comparing men/women and low/high educational level)

specific combination of ‘problems’. In the group with state ‘11111’, the VAS-value is lower for those with low (as compared with those with high) educational level. A similar picture is seen after focusing on participants with a chronic disease. The difference by educational level is especially large for headache/migraine (12.1 points) and for asthma (10.3 points). Taken together, these results clearly indicate that HRQL (as assessed by the VAS) is especially low for participants with low educational level, even if the analysis is restricted to the subgroup of those having a chronic disease.

Logistic regressions with the dependent variable ‘moderate or severe problem in one of the five dimensions’ were first conducted for the total sample (not presented in table). Just controlling for age and sex, the results show that low educational level is always associated with increased risks: mobility [odds ratio (OR) 1.71; 95% confidence interval (CI) 1.44–2.04]; self-care (OR 2.00; 1.48–2.72); usual activities (OR 1.55; 1.29–1.86); pain/discomfort (OR 1.44; 1.26–1.63); anxiety/depression (OR 1.35; 1.14–1.61). A similar result was found after including the variables income and any chronic disease: For all five dimensions, low educational level is clearly and significantly associated with increased risk, especially for the dimension ‘self-care’ (OR 1.94). We then conducted the same analyses for the subsample of those with a chronic disease (table 3), and the results were again very similar: low educational level is always associated with an increased risk (although the odds ratio for ‘usual activities’ just misses the level of statistical significance).

Linear regressions with the dependent variable ‘VAS-value’ were first conducted for the total sample (not presented in table). Just controlling for age and sex, the VAS-values are lower in the low (as compared with the high) educational group (parameter estimate -2.04 ; $P<0.001$). After including the additional variables (i.e. income, any chronic disease, moderate/severe problems in at least 1 dimension), the parameter estimate for educational level is still negative, but not any more statistically significant on the 5% level. In the model including ‘any chronic disease’ and ‘moderate/severe problems in at least 1 dimension’, for example, it is just borderline significant (-0.657 ; $P=0.075$). We then

Table 2 Mean VAS-values by problem and disease status, by sex and educational level

All participants	n	VAS-value (mean)				
		Overall	Sex		Educat. level	
			Men	Women	Low	High
Total	5676	79.8		81.0	78.9*	75.3
Moderate/Severe probl.						
Mobility	890	56.1		56.9	55.6	55.2
Self-care	255	51.0		55.2	48.5*	48.8
Usual activities	710	54.2		55.3	53.4	53.4
Pain/Discomfort	1959	64.8		65.9	63.9*	62.7
Anxiety/Depression	689	61.6		59.5	62.5	58.1
At least 1 dimension	2229	66.3		66.8	65.9	63.9
Combinations						
11111 (no problem)	3401	88.8		89.4	88.2*	87.3
11121	816	75.3		75.4	75.2	74.2
21121	227	63.0		63.3	62.8	61.0
21221	179	57.1		57.4	56.9	57.6
11122	159	66.6		65.0	67.5	66.1
Chronic disease						
Muscul. system	392	62.8		63.9	61.8	60.8
Diabetes mellitus	192	60.5		59.3	61.4	59.1
Heart disease	160	58.1		60.6	55.4	54.7
Rheumatism	137	62.0		61.3	62.6	59.7
Headache/migraine	114	73.4		69.3	74.8	68.2
Arthrosis	95	61.3		61.4	61.3	61.4
Asthma	94	64.0		64.3	63.8	61.0
Any chronic disease	1517	65.4		65.8	65.2	62.8

* $P < 0.05$ (t-Test comparing men/women and low/high educational level).

Table 3 Reporting of problems in the EQ-5D by socio-economic variables: logistic regression in a subsample of participants with a chronic disease

Independent variables	Odds Ratio (95% confidence interval)				
	Moderate or severe problem concerning				
	Mobility	Self-care	Usual activities	Pain/Discomfort	Anxiety/Depression
Age (per year)	1.06* (1.05–1.07)	1.07* (1.05–1.09)	1.05* (1.04–1.07)	1.04* (1.03–1.05)	1.01* (1.00–1.01)
Sex ^a					
Women	1.44* (1.14–1.82)	1.89* (1.30–2.75)	1.41* (1.11–1.80)	0.97 (0.75–1.24)	1.93* (1.50–2.49)
Educ. level ^b					
Low	1.55* (1.20–1.99)	2.10* (1.34–3.28)	1.27 (0.98–1.66)	1.32* (1.02–1.71)	1.30* (1.00–1.71)
Income ^c					
4	1.09 (0.76–1.55)	0.82 (0.47–1.42)	0.97 (0.68–1.41)	1.13 (0.78–1.63)	0.78 (0.53–1.13)
3	1.16 (0.83–1.63)	1.03 (0.61–1.72)	1.06 (0.75–1.52)	1.40 (0.98–2.01)	0.93 (0.65–1.32)
2	1.64* (1.11–2.41)	1.31 (0.74–2.32)	1.71* (1.16–2.53)	1.74* (1.16–2.62)	1.04 (0.71–1.54)
1 (low)	1.44 (0.96–2.16)	1.23 (0.65–2.34)	1.19 (0.77–1.82)	1.82* (1.18–2.80)	0.66 (0.42–1.03)

Comparison group:

a: Men.

b: High.

c: (just as in table 4): Group 5 (i.e. high).

*Significant on the 5%-level; joint control of all independent variables (see bold values).

conducted the same analyses for the subsample of those with a chronic disease (table 4), again receiving similar results: The parameter estimate for 'low educational level' is negative and clearly significant after controlling for age and sex (Model 1), and it does not change very much after inclusion of income (Model 2). The 2-point (Model 2)

Table 4 VAS-valuation of health states by socioeconomic variables: multivariate linear regression in a subsample of participants with a chronic disease

Independent variables	Model 1		Model 2	
	Estim.	P-value	Estim.	P-value
Age (per year)	−0.453*	<0.001	−0.475*	<.001
Sex ^a (women)	−1.617	0.090	−1.737	0.073
Educational level ^b (low)	−2.532*	0.012	−2.055*	0.049
Income ^c				
4			−1.820	0.220
3			−2.473	0.085
2			−1.435	0.369
1 (low)			−3.956*	0.019
R ²	0.143		0.151	

Comparison group:

a: Men.

b: High.

c: Group 5 (i.e. 'high').

*Significant on the 5%-level; joint control of all independent variables (see bold values).

resp. 2.5-point (Model 1) effect for low educational level equals the decline in VAS scores between subjects differing in age by 4 resp. 5.5 years. Further analyses (data not shown in table) have been conducted for subgroups of participants with only one of these seven chronic diseases. Just controlling for age and sex, for example, the most significant associations for educational level could be found for heart disease (−11.261; $P = 0.005$), headache or migraine (−6.808; $P = 0.035$) and rheumatism (−6.017; $P = 0.075$), and no associations for musculo-skeletal system (−1.836; $P = 0.349$), diabetes mellitus (−3.863; $P = 0.256$), arthrosis (1.238; $P = 0.765$) and asthma (−4.424; $P = 0.300$). These disease-specific analyses are restricted by small sample size, though.

Discussion

The EQ-5D is clearly able to detect differences by educational level. After controlling for age and sex, all five dimensions of the EQ-5D show higher prevalences in the low status group. Very similar associations are seen if HRQL is assessed by the VAS. Looking at subgroups of adults with a chronic disease, those with low educational level usually report lower levels of HRQL than those with high educational level. Thus, the results indicate that health inequalities could be underestimated if they were just assessed by the presence of chronic diseases, that the burden of a given state of health is especially high for low status groups.

A number of studies have already shown that the EQ-5D reflects health inequalities.⁷ There are three studies from Germany, for example, all of them pointing into the same direction.^{4,8,9} A study from Sweden confirms that 'moderate or severe problems' are most prevalent in the low status groups.¹⁰ Similar results have also been reported from the USA,^{11–17} the UK,^{18–21} Denmark^{22,23} and Greece.²⁴ There is a study from The Netherlands with the EQ-6D (adding a dimension addressing 'cognitive abilities'), and all six dimensions show high prevalences especially in the low status group.²⁵ The study by Burström *et al.*¹⁰ includes a summary score for the five EQ-5D dimensions developed in the UK by the time trade-off (TTO) method; and again the HRQL-score is lowest in the low status group. Another study from Sweden has looked at changes of quality-adjusted life years (QALYs) between 1980 and 1997 by SES, calculating QALYs with data derived from the EQ-5D. The analyses show that QALYs increase with increasing SES, and that these health inequalities have been greater in 1997 than in 1980.²⁶ It is worth stressing that all these analyses have been published fairly recently. The EQ-5D has attracted much interest in recent years, and measures of SES have been included in some of these studies. The primary reason for this inclusion is not to assess health inequalities, though, but to assess the construct validity of the EQ-5D. This is why differences by SES are often

not discussed in any detail (and why it is difficult to find these analyses by just looking at the title of a paper).

HRQL is not just assessed with the EQ-5D, and health inequalities have also been reported in studies using other measures. Inequalities in HRQL are shown in analyses based on the SF-36, for example.^{9,27} The European SHARE study uses a short version of the CASP-19. The results indicate that HRQL increases with increasing SES in all ten European countries included in this study.²⁸ All studies mentioned above focus on adults. Other measures for HRQL have been developed for younger age groups, and some of these papers also report differences by SES.^{29,30}

Some limitations of our analyses need to be considered. The survey includes only adults who are able to read and understand German. Probably, those who are excluded often belong to the group of adults with low SES and low HRQL, but it is difficult to assess the potential bias introduced by this limitation. All information is based on self-report, including the information on chronic disease. It would be important to have more objective measures for health than self-reported information. A number of studies have shown that the perception of health (as assessed, for example, by self-rated health) is a good predictor even for mortality.^{32,33} The question remains, though, if the association between self-rated health and objective measures differs by SES. Some analyses include tables indicating that the association between self-rated health and mortality is similar in different educational groups,³² but we are not aware of a study focusing on this question. Sample size is quite small for analyses restricted to one specific chronic disease; and the survey does not include a variable on self-rated health.

We believe that the analyses presented here could be an important contribution. Studies on HRQL have rarely analysed the association with SES in any detail, and those who have rarely restricted the analyses to persons with a chronic disease. A recent study from the UK has shown that the decrease of HRQL due to obesity, hypertension and diabetes is most pronounced for adults with low occupational status.³¹ A study from Finland assesses HRQL by EQ-5D and 15D, showing for both measures that low SES is associated with low HRQL even after controlling for a number of chronic conditions.³⁴ Previous studies have included SES primarily as a potential confounder, though, and differences in HRQL by SES are rarely discussed as an important issue in its own right. Also, self-reported HRQL differs considerably between countries,³⁵ results of empirical analyses from one country should not be applied directly to another country, and to date from Germany there is hardly any study on the association between HRQL and SES among adults with a chronic disease. Focussing on persons with a chronic disease is important for demonstrating that low status groups could be faced with a double burden, first by increased levels of health impairments, and second by lower levels of HRQL once health is impaired.

Further analyses trying to disentangle the associations between SES, chronic disease and HRQL could focus, for example, on the following hypothesis: among patients with a specific chronic disease those with low SES are faced with more comorbidity and/or more problems concerning coping in everyday life. Research investigating in-depth socioeconomic status and its relationship with preference-based measures of HRQL such as the EQ-5D are still hard to find. In health economics, these measures are used in economic evaluation, where they function as a measure of the effectiveness of a health intervention. Accordingly, major research tracks have developed on the valuation process—focusing on the relationship between the problem levels and the valuation of the health state—and on high-quality measurement of HRQL in disease areas of interest. Social epidemiologists on the other hand, focus on methods for understanding the ‘web of causation’ between SES and morbidity. While HRQL serves as a major outcome of socio-economic determinants at work for the social epidemiologist, it is the result of a health intervention for the health economist, the latter in economic evaluation studies typically disregarding any influences of socio-economic factors. Combining both perspectives could yet spawn new research questions. To name just three: Do patients with the same chronic disease value their own state of health differently according to their social background and their place of residence (e.g. rural/urban)? How is this evaluation influenced by individual coping resources (e.g. social support) and how do these

resources differ by social background and place of residence? If studies on HRQL neglect the potential role of SES, how could this influence public health policy in a way that (unintentionally) reduces or increases health inequalities?

A further debate between social epidemiology and health economics could contribute to the evidence base available for health care reform, deepening our understanding of how the overall goals of health care systems, efficiency and equity, are interrelated in the case of HRQL. As this article underlines, synergies may emerge from joint research groups with each discipline contributing its own methods: social epidemiology emphasizing the role of socio-economic determinants, health economics offering expertise on valuing health states in a preference-based, summary figure. HRQL thus functions as a focal point bringing together these two sub-disciplines, with the EQ-5D providing the empirical tool to assess differences by disease development, by severity, and also by SES.

Conflicts of interest: None declared.

Key points

- Health inequalities could be studied in more detail by using measures of HRQL such as the EQ-5D.
- Health inequalities are more pronounced if measures of HRQL are taken into account.
- Further cooperation between health economists and social epidemiologists may help to better assess and manage health systems with respect to efficiency and health equity, and the EQ-5D could be a good basis for this cooperation.

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