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Abstract

Objectives. This paper explores the use of regression models for estimating health status of schizophrenic patients, from a Bayesian perspective. Our aims are:
1- To obtain a set of values of health states of the EQ-5D based on self-assessed health from a sample of schizophrenic patients.
2- To analyse the differences in the health status and in patients' perceptions of their health status between four mental-health districts in Spain.

Methods. We develop two linear models with dummy variables. The first model seeks to obtain an index of the health status of the patients using a VAS as a dependent variable and the different dimensions of EQ-5D as regressors.
The second model allows to analyse the differences between the self-assessed health status in the different geographic areas and also the differences between the patients' self-assessed health states, irrespective of their actual health state, in the different geographic areas.
The analysis is done using Bayesian approach with Gibbs sampling (computer program WinBUGS 1.4).
Data concerning self-assessed EQ-5D with VAS from four geographic areas of schizophrenic patients were obtained for the purposes of this analysis.

Results. We obtained the health status index for this sample and analysed the differences for this index between the four geographic areas. Our study reveals variables that explain the differences in patients' health status and differences in their health states assessment. We consider four possible scenarios.

Key Words
Schizophrenia, Bayesian analysis, effectiveness, quality of life, EQ-5D.

INTRODUCTION

Clinical decisions cannot be made without a prior analysis of the cost and effectiveness of treatment, particularly for disorders with a high morbidity rate, such as schizophrenia. According to the 1993 World Bank report [1], although neuropsychiatry disorders constitute the second most prevalent non-infectious disease, they receive a disproportionately small allocation of resources in countries with a consolidated market economy. In Spain, the PSICOST group has contributed to developing a methodology to evaluate services and the costs arising from chronic mental illness in Spain [2-6].

In this work, which is part of a wider research on cost and effectiveness of treatment of schizophrenia carried out in Spain [7], we deal with the effectiveness side of the economic approach to the treatment of schizophrenia. We focus on the measurement of effectiveness through health indexes, with a specific concern on the appropriateness of using a single health index at national level, or if regional differences in the index, would they exist, should be taken into account when designing health care policy. We check for these interregional differences, and more specifically, for those in the health states valuations assigned by patients of different regions.

The main finding of the paper is the verification not only of the existence of regional differences in health status of schizophrenic patients in our representative sample of the selected samples in 4 mental health care districts, but also in the

health states valuations that patients give to their health states. The relevance for policy making is that such differences should be taken into account in resource allocation and health care development in the treatment of schizophrenia.

In this paper we use regression models to build up a value set of health states of the EQ-5D using Bayesian methods. Bayesian methodology allows to introduce previously obtained information in the parameters of the coefficients distributions. In our case, we use information from previous years to estimate the coefficients distributions, means and standard deviations. Our aims are, firstly, to obtain a set of values of health states of the EQ-5D based on self-assessed health from a sample of schizophrenic patients and, secondly, to analyse the differences in the health status and in patients' perceptions of their health status between four mental-health districts in Spain.

MATERIALS AND METHODS

Health measurement

For measurement of health purposes, we use a well established health instrument, the EQ-5D [8]. The EQ-5D questionnaire is a standardised, generic instrument concerning health-related quality of life for describing and valuing health that was designed by the EuroQol Group. It is a two part instrument. Part 1 records self-reported problems for each of five domains: mobility (MO), self-care (SC), usual activities (UA), pain/discomfort (PD) and anxiety/depression (AD). Each domain

is divided into three levels of severity corresponding to no problem, some problem, and extreme problem. The combination of these levels defines a total of 243 health states. Part 2 records the subject's self-assessed health on a Visual Analogue Scale (VAS), with a vertical 20 cm line on which the best and worst imaginable health states score 100 and 0, respectively.

The aim of the EQ-5D is to generate a cardinal health index, that can be used in economic evaluation. Currently, the most widely used value set of the 243 health states of the EQ-5D was developed by Dolan [9] and it is being used in cost utility analysis of health care technologies and has been recommended in the UK by the National Institute for Clinical Excellence (NICE), the office of technology assessment of the National Health Service [10].

Several models have been developed to obtain valuation sets for the health states of the EQ-5D. A functional form of dependence is specified that values the states of health of the individuals and the variables that compose the health index, obtained from the instrument of measure EQ-5D. The functional form is determined by a combination between the variables and an unknown set of coefficients. Regression models are used to assign values to those coefficients.

Dolan [11] pioneered the building of an index of health from EQ-5D. In his work, it is shown the linear relationship between the value of the index and dummy variables corresponding to the different levels of each dimension of the EQ-5D, and incorporating a dummy additional variable (N3) with takes the value 1 when any dimension is at level 3, what can be interpreted as reflecting the decrease in

utility associated to “severe problems”. The use of relationships between the index and the different dimensions through coefficients allows, once obtained the coefficients estimation, to interpolate the values of the health states not observed directly, thus obtaining the value set of the 243 health states of EQ-5D.

There are a great deal of studies in the literature that use the value set obtained by Dolan to get Quality Adjusted Life Years (QALYs), the health unit used in cost utility analysis. They usually not consider the possibility of existence of differences in the health states valuations between regions or countries, what could lead to bias in the analysis.

Data

Data analysed in this study were obtained from 4 small areas, selected as being representative of different socio-economic contexts and of different kinds of organization and availability of services. The four areas analysed in the study were in the provinces of Barcelona, Granada, Madrid and Navarre [12].

For each centre, we selected a representative sample of cases of schizophrenia, determined by the prevalence of cases treated. Criteria for inclusion in the study were: diagnosis of schizophrenia (DSM-IV diagnosis) [13], aged 18-65 years and having been in contact with the mental health treatment services in one of the selected areas within the six-month period designated for inclusion. After excluding patients with a primary diagnosis of neurological disorder or mental handicap, a sample of 356 patients was obtained. The patients were evaluated at

three instants: at the beginning of the study, after one year, and after two years. Because of the characteristic instability of the population, the number of patients for whom EQ-5D data were obtained was lower than the original sample, and this decreased further over time. We analysed only the observed data.

Table 1. Healthcare area data of the four mental health care areas studied.

Healthcare area	Province	Inhabitants	Nº of patients	Source data record
Gavá	Barcelona	135,000	86	Gavá mental health centre
Loja	Granada	63,490	73	Schizophrenia cases in the South Granada area
Salamanca	Madrid	142,001	105	Psychiatric cases in the Madrid region
Burlada	Navarre	65,000	92	Navarre health information system (SISNA)
Total	-	*405,491*	*356*	-

Table 2. Sampling Description. Mean (Standard Deviation) or Percentage (%).

	Gavá	Loja	Salamanca	Burlada	*TOTAL*
Female	31.4	21.9	33.3	37.0	31.5
Age	37.5 (11.7)	37.8 (8.5)	36.8 (7.9)	40.4 (11.5)	37.9
Age at onset	22.5 (6.3)	22.8 (6.4)	22.5 (6.5)	26.3 (6.5)	23.5
Partner	20.9	9.6	10.5	14.1	13.8
Employment	12.8	17.8	24.8	25.6	20.6
Household Family	66.3	76.7	69.5	69.5	70.2
TOTAL	86	73	105	92	356

Table 3. Patients of the sample responding to EQ-5D questionnaire.

Nº of patients	**Province**	**Year 1**	**Year 2**	**Year 3**
Gavá	Barcelona	71	68	60
Loja	Granada	56	52	49
Salamanca	Madrid	72	46	38
Burlada	Navarre	78	69	64
Total	-	***277***	***235***	***211***

Bayesian modelling

This paper uses regression models to build up a value set of health states of the EQ-5D using Bayesian methods. Bayesian methodology allows to incorporate in the coefficients distributions information on the parameters previously obtained, through mean and standard deviation. In our study, we use information from previous periods.

In Bayesian methodology, *prior* information on the parameters can be combined with data. Parameters are assumed to be random variables described by their probability distributions. The distribution that combines the *prior* distribution with data is known as *posterior* distribution. Browne and Draper (2000) [14] offer a detailed comparison of both types of models, classical and Bayesian.

In this work, we use non-informative *prior* distributions as a first approach to the problem for the first instant. We then use the *posterior* information from the first instant as the *prior* for the second. The same procedure is followed to obtain the *posterior* of the third. So, we adopt a bayesian sequential analysis to obtain the true value of the parameters.

Bayesian estimation is done using Markov Chain Monte Carlo (MCMC) simulation techniques [15]. With MCMC simulation techniques, when the *posterior* distribution conditioned for a group of parameters has a known format, then it is possible to derive values for it directly. This process is known as Gibbs sampling and is used in the simulations in this work [16].

All computation and simulation was conducted with Gibbs sampling, implemented using the computer program WinBUGS1.4 [17]. We used there parallel chains and a single long chain for diagnostic assessment (checked using CODA software). A total of 100000 iterations were carried out (after a burn-in period of 10000), taking only a few minutes on a Pentium personal computer.

Modelling

We present two linear models with dummy variables. The aim of the first model is to obtain an index of the health status of the patients using a VAS as a dependent variable and the different dimensions of EQ-5D as regressors.

The second model concerns, firstly, to the differences between the self-assessed health states in the different geographic areas. For this purpose, we used the index obtained from Model 1 as the dependent variable, and dummies to represent the different geographic areas as regressors (Model 2.1). The second purpose of this model is to test the differences by geographic area in the patients' self-assessed health states, irrespective of their actual health state. To do this, we used as the dependent variable the difference between the VAS and the index obtained in Model 1; the regressors, again, were dummies representing the different geographic areas (Model 2.2).

Linear model with dummy variables (Model 1)

Dummy variables are included to evaluate the move between levels 1 and 2 as compared to the move between levels 2 and 3. Two dummy variables are used for each dimension. In addition, a variable N3 is included. A similar model was used by Dolan and Greiner *et al.* [11, 18] Model 1:

$$\boldsymbol{m}_i = \beta_0 + \mathbf{MO2}_i\beta_1 + \mathbf{SC2}_i\beta_2 + \mathbf{UA2}_i\beta_3 + \mathbf{PD2}_i\beta_4 + \mathbf{AD2}_i\beta_5 + \mathbf{MO3}_i\beta_6 + \mathbf{SC3}_i\beta_7 + \mathbf{UA3}_i\beta_8 + \mathbf{PD3}_i\beta_9 + \mathbf{AD3}_i\beta_{10} + \mathbf{N3}_i\beta_{11}$$

Model 1

$$VAS_{score\,i} \sim N(\boldsymbol{m}_i, \Omega_\mu) \quad \Omega_\mu \sim Ga(a, b) \qquad \beta_j \sim N(\beta, \Sigma^{-1}), \; j = 0,\ldots,11$$

The variables used in this model take the following values:

MO2, **SC2, UA2, PD2, AD2** = 1 if the score is 2; 0 otherwise.

MO3, **SC3, UA3, PD3, AD3** = 1 if the score is 3; 0 otherwise.

N3=1 if the score is 3 in one of the dimensions; 0 otherwise.

When this model implies a lack of initial knowledge from non-informative *prior* distributions, this information is described by the following parameters:

$$\beta = (0,0,...,0), \qquad \Sigma^{-1} = \begin{pmatrix} 0.0004 & 0 & \cdots & 0 \\ 0 & 0.0004 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0.0004 \end{pmatrix}$$

a=0.01 and b=0.01

The main diagonal of the matrix Σ^{-1} represents the precision of the parameters. This precision is defined by the inverse of the variance [17]. In the present study, a non-informative *prior* variance is taken as one for which there is a 95% probability that the value of the parameter lies in the range [-100, 100]. This is because the regressors are dummy variables (0, 1). Therefore, a variation of one unit in the latter should not increase (decrease) the dependent variable above (below) 100 units.

In order to incorporate the *prior* information, we transfer the *posterior* information from one regression as the *prior* information to another. The information is obtained by means of estimations of the mean and of the variance of the parameters, as follows:

$$\beta = \left(\hat{\beta}_0, \hat{\beta}_1, ..., \hat{\beta}_{11} \right), \qquad \Sigma^{-1} = \begin{pmatrix} 1/\hat{sd}_0^{\,2} & 0 & \cdots & 0 \\ 0 & 1/\hat{sd}_1^{\,2} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 1/\hat{sd}_{11}^{\,2} \end{pmatrix}$$

where $\hat{\beta}_j$ represents the estimated mean of parameter j with the information from the preceding periods, and where $1/\hat{sd}_j^{\,2}$ represents the estimated precision associated with the parameter j.

Linear Model with EQ_{index}, and VAS_{score} less EQ_{index} as dependent variables (Model 2)

The dependent variable in Model 2.1 is EQ_{index} and this is represented by:

$\boldsymbol{m}_i = \beta_0 + \mathbf{B}_i\beta_1 + \mathbf{G}_i\beta_2 + \mathbf{M}_i\beta_3$

Model 2.1

$EQ_{index\,i} \sim N(\boldsymbol{m}_i, \Omega_\mu)$ $\Omega_\mu \sim Ga(a, b)$ $\beta_h \sim N(\beta, \Sigma^{-1})$, h =0,…,3

Where **B** = 1 if the patient is from Barcelona; otherwise 0.

G = 1 if the patient is from Granada; otherwise 0.

M = 1 if the patient is from Madrid; otherwise 0.

Dummy's reference category **N:** (Navarre).

We define EQ_{index} as the dependent variable explained in Model 1 ($\hat{VAS}$).

Model 2.1 shows the differences in health status of the patients in the different areas, independently of whether the self-assessment of the patients in a given area by VAS is above (or below) the mean value. This is so because the index EQ_{index} was calculated for all the patients with the estimations obtained for the whole sample. Thus, the estimated parameter $\hat{\beta}_i$ represents the fact that the area i has patients who present a better health status (if it is positive), or a worse one (if it is negative) with respect to the reference area.

Model 2.2 differs from Model 2.1 in the dependent variable, which is now $VAS_{score\ i}$ - $EQ_{index\ i}$. This model shows the differences between areas between the health state and the value assigned to it. We can see whether the patients in a given area have different subjective perceptions of a given health state. Therefore, the estimated parameter $\hat{\beta}_i$ represents the fact that a mean health state has a greater value, if positive (or a lesser one, if negative) for the patients in area i with respect to the assessment of the patients in the reference area.

The dependent variable in Model 2.2 is what we are unable to explain from the VAS of the patients' health status (Model 1).

The *prior* information used in the estimation of Models 2.1 and 2.2 is included in the same way as in Model 1, as described above.

Models 2.1 and 2.2 present four possible scenarios:

Scenario 1. There are differences between the communities in Model 2.1, but not in Model 2.2. This is an index that is robust to regional changes. The different health states perceived are assessed equally, irrespective of the geographic area under study, and the index provides a good reflection of the relationship between health states and the assessment made by individuals by their VAS.

Scenario 2. No differences between the areas are observed in Model 2.1, but they are in Model 2.2. This implies that individuals assess themselves differently in different areas. The same health states receive different assessments depending on the geographic area. For policy purposes, it seems that the index should include regional weights to compensate for this difference in assessments.

Scenario 3. No differences are observed in either of the models. There are no regional changes in health states or in their assessment. We cannot affirm or deny the robustness of the index, because the health states that are assessed in the different areas are, on average, the same.

Scenario 4. There are differences between the two models. This is a scenario that is complex to interpret, because we must consider the signs of these differences. For example, if there is a positive difference in Model 2.1 and a negative one in Model 2.2 for a given area, this means that the area has, on average, better health states than the reference area, but that nevertheless, the patients, on their VAS, give themselves a worse assessment than do the patients in the reference area.

RESULTS

Table 4 shows the estimations made using non-informative *prior* information, during the 3 years, with Model 1, for the sample of patients with schizophrenia. The model relates the VAS scale with the dimensions of the EQ-5D. Note that some of the estimated parameters have positive values, which could lead to inconsistencies on the EQ-5D index for worse health states with a higher score.

Table 5 shows the estimations made, with Model 1, using the *posterior* information from year 1 as the *prior* information for year 2 and the *posterior* information from year 2 as the *prior* information for year 3. The final two columns, for year 3, contain full regression information, as they use the information from the three periods. In these columns, note that all the slopes, except two associated with the MO3 and UA3 dummies, are negative. The parameters associated with the MO3 and UA3 dummies are the only ones that are positive, but their mean values are practically zero and, moreover, they have the lowest absolute value. It should be taken into account that whenever these dummies have a value of one, so does the N3 dummy.

Table 4. Model1. Simple linear model, VAS_{score} as the dependent variable for each of the years with non-informative *prior* information. Posterior mean (standard deviation in parenthesis) and Bayesian credible Interval (BI).

	Year 1		Year 2		Year 3	
	Mean (sd)	**BI (95%)**	**Mean (sd)**	**BI (95%)**	**Mean (sd)**	**BI (95%)**
CTE	70.35 (2.01)	(66.42 , 74.28)	69.82 (2.23)	(65.5 , 74.19)	73.52 (1.77)	(69.99 , 76.96)
MO2	-0.50 (3.30)	(-6.96 , 5.97)	-1.13 (3.74)	(-8.55 , 6.27)	-8.48 (3.09)	(-14.52 , -2.41)
SC2	-7.03 (3.36)	(-13.63 , -0.35)	-7.35 (3.78)	(-14.61 , 0.30)	-5.02 (3.32)	(-11.50 , 1.47)
UA2	-7.37 (2.73)	(-12.84 , -2.02)	-6.45 (3.11)	(-12.52 , -0.37)	2.10 (2.79)	(-3.40 , 7.73)
PD2	-5.56 (2.72)	(-10.89 , -0.24)	-6.27 (3.06)	(-12.37 , -0.24)	-5.36 (2.53)	(-10.45 , -0.40)
AD2	-5.52 (2.71)	(-10.70 , -0.22)	-4.96 (2.99)	(-10.95 , 0.99)	-9.10 (2.46)	(-13.97 , -4.27)
MO3	4.14 (6.54)	(-8.42 , 17.02)	6.35 (7.48)	(-8.36 , 20.84)	-13.82 (8.10)	(-29.92 , 1.86)
SC3	3.42 (8.54)	(-13.33 , 20.43)	3.96 (9.46)	(-14.63 , 22.45)	-11.58 (8.92)	(-29.34 , 5.96)
UA3	0.72 (6.47)	(-11.85 , 13.26)	2.31 (7.36)	(-12.44 , 16.64)	2.01 (7.07)	(-11.82 , 15.84)
PD3	-10.40 (6.65)	(-23.36 , 2.68)	-13.11 (7.39)	(-27.79 , 1.43)	3.36 (7.76)	(-11.80 , 18.85)
AD3	-8.61 (6.11)	(-20.72 , 3.37)	-8.73 (6.90)	(-22.37 , 4.70)	-22.05 (6.85)	(-35.59 , -8.52)
N3	-11.31 (6.31)	(-23.74 , 0.92)	-11.57 (7.19)	(-25.68 , 2.47)	-6.71 (7.00)	(-20.57 , 7.07)

Table 5. Model1. Simple linear model, VAS_{score} as the dependent variable for each of the years with informative *prior* information for years 2 and 3. Posterior mean (standard deviation in parenthesis) and Bayesian credible Interval (BI).

	Year 1		Year 2		Year 3	
	Mean (sd)	**BI (95%)**	**Mean (sd)**	**BI (95%)**	**Mean (sd)**	**BI (95%)**
CTE	70.35 (2.01)	(66.42 , 74.28)	70.18 (1.38)	(67.51 , 72.90)	71.68 (1.03)	(69.63 , 73.70)
MO2	-0.50 (3.30)	(-6.96 , 5.97)	-0.92 (2.41)	(-5.67 , 3.88)	-2.53 (1.86)	(-6.18 , 1.16)
SC2	-7.03 (3.36)	(-13.63 , -0.35)	-7.23 (2.44)	(-11.92 , -2.34)	-5.56 (1.92)	(-9.32 , -1.74)
UA2	-7.37 (2.73)	(-12.84 , -2.02)	-7.09 (1.98)	(-10.97 , -3.24)	-3.79 (1.57)	(-6.87 , -0.67)
PD2	-5.56 (2.72)	(-10.89 , -0.24)	-5.86 (1.94)	(-9.74 , -2.06)	-5.79 (1.47)	(-8.69 , -2.89)
AD2	-5.52 (2.71)	(-10.70 , -0.22)	-5.41 (1.88)	(-9.17 , -1.70)	-5.69 (1.41)	(-8.44 , -2.95)
MO3	4.14 (6.54)	(-8.42 , 17.02)	5.23 (4.81)	(-4.27 , 14.55)	2.11 (3.912)	(-5.57 , 9.70)
SC3	3.42 (8.54)	(-13.33 , 20.43)	4.02 (6.22)	(-8.14 , 16.22)	-1.02 (5.03)	(-10.93 , 8.89)
UA3	0.72 (6.47)	(-11.85 , 13.26)	1.57 (4.43)	(-7.22 , 10.26)	0.91 (3.46)	(-5.811 , 7.78)
PD3	-10.40 (6.65)	(-23.36 , 2.68)	-11.90 (4.62)	(-21.04 , -2.89)	-9.74 (3.80)	(-17.11 , -2.31)
AD3	-8.61 (6.11)	(-20.72 , 3.37)	-8.91 (4.08)	(-16.96 , -0.94)	-11.22 (3.19)	(-17.61 , -4.81)
N3	-11.31 (6.31)	(-23.74 , 0.92)	-11.59 (3.81)	(-19.18 , -4.11)	-12.73 (2.86)	(-18.30 , -7.02)

The constant in these models represents the mean of the VAS of the patients whose health state is 11111. In comparison with other studies carried out with sample groups from the general population [11, 18, 19] note that the patients with schizophrenia in this health state assess themselves, on average, as worse off than do the general population.

Using the results from the model for year 3 with informative *prior* information, we obtain the values of the index EQ_{index} for the 243 health states and, therefore, for each of the patients. For example, the value of the index for the health state 11223 is obtained by CTE – UA2 – PD2 – AD3 – N3 = 71.68 – 3.79 – 5.79 – 11.22 – 12.73 = 38.15.

The Bayesian credible Intervals obtained through the marginal distributions of the coefficients, allow to know the range of variation from the value of the index with a probability of 95%. Thus, if variable MO2 takes value 1 and all other tangents take value 0, in the model for year 3 with informative *prior* information, the index would take a value of 69.15 and have a 95% probability of being between values 65.5 – 72.84.

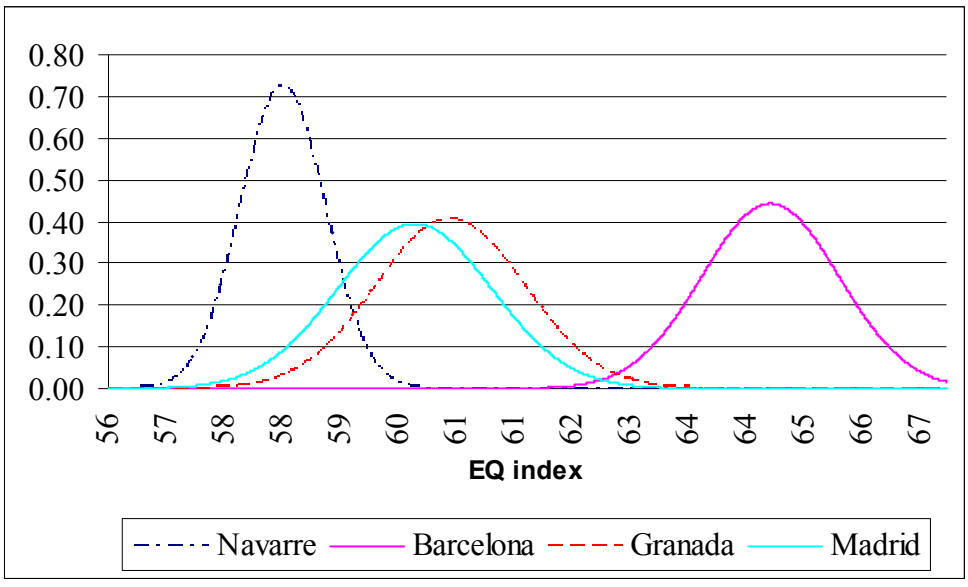
Table 6 shows the results of the estimation with Model 2.1 with non-informative *prior* information for year 1 and informative information for the other two years. The dependent variable for this estimation was the index EQ_{index}, obtained from the estimation of Model 1 in year 3 with *prior* information from the previous two years.

The constant represents the mean assessment of the index EQ_{index} for the patients in Navarre. The other estimated coefficients show the deviation from the mean in the assessment of the index with respect to that obtained for Navarre.

Table 6. Model 2.1. Regression Linear Model with EQ_{index} to compare four geographic areas with *prior* information to year 2 and year 3. Posterior mean (standard deviation in parenthesis) and Bayesian credible Interval (BI).

	Year 1		Year 2		Year 3	
	Mean (sd)	**BI (95%)**	**Mean (sd)**	**BI (95%)**	**Mean (sd)**	**BI (95%)**
CTE	57.05 (1.23)	(54.59 , 59.42)	57.69 (0.75)	(56.17 , 59.16)	58.29 (0.55)	(57.19 , 59.36)
B	6.00 (1.77)	(2.52 , 9.48)	7.05 (1.18)	(4.71 , 9.34)	6.40 (0.90)	(4.65 , 8.19)
G	2.67 (1.90)	(-1.03 , 6.49)	1.49 (1.29)	(-1.04 , 4.04)	2.20 (0.98)	(0.24 , 4.14)
M	2.62 (1.78)	(-0.89 , 6.12)	1.51 (1.27)	(-1.01 , 4.01)	1.73 (1.01)	(-0.26 , 3.73)

Figure 1. *Posterior* probability distributions of the estimations associated with each of the areas in year 3 with *prior* information from the previous 2 years, in Model 2.1.



As the same weights were used to create the index, the differences found between the areas are caused by the patients' different health states.

The final column in Table 6 shows that the patients whose health states are the best are those of the patients from Barcelona. There is a 95% probability that their health states are between 4.65 and 8.19 points higher on the index EQ_{index} than health states in Navarra. It should be taken into account that the highest value on this index is 71.68 and the lowest, 26.11, the values not being rescaled between 0 and 100.

Figure 1 shows the *posterior* probability distributions of the parameters of Model 2.1 in year 3 with the *prior* information from the two previous years. The values of the estimations have been reconstructed for ease of interpretation.

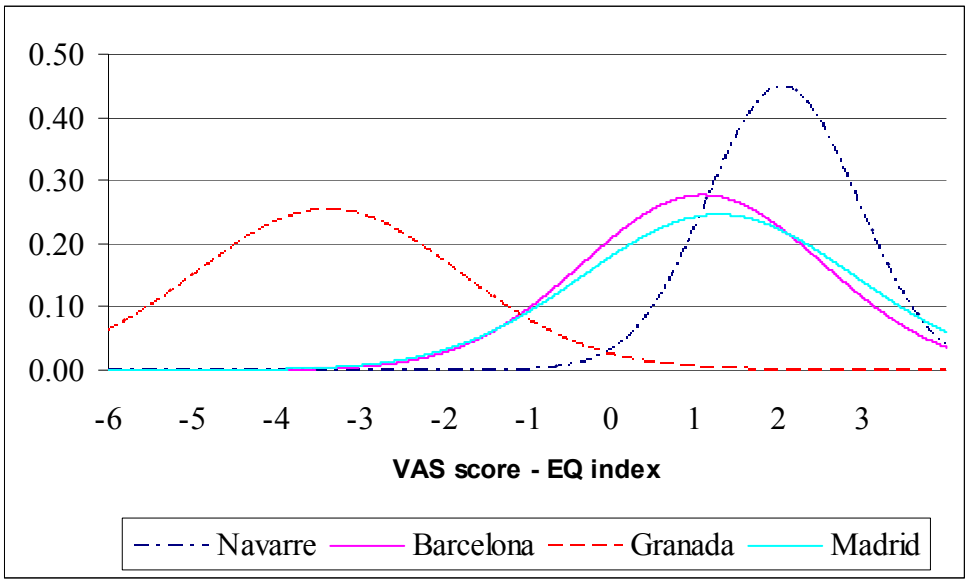
The overlapping of the distributions prevents us from stating that there are significant differences between health states in the geographic areas of Granada and Madrid. Note that in the area of Navarre health states are somewhat worse than in the other areas, while in Barcelona they are clearly superior.

Table 7 gives the results of the estimation by Model 2.2, with non-informative *prior* information in year 1 and informative information for the other two years. The dependent variable for this estimation was VAS_{score} - EQ_{index}.

Table 7. Model 2.2. Regression Linear Model with VAS without EQ_{index} to compare four geographic areas with *prior* information to years 2 and 3.

	Year 1		Year 2		Year 3	
	Mean (sd)	**BI (95%)**	**Mean (sd)**	**BI (95%)**	**Mean (sd)**	**BI (95%)**
CTE	0.765 (2.21)	(-3.66 , 5.02)	1.30 (1.20)	(-1.10 , 3.64)	2.04 (0.89)	(0.28 , 3.76)
B	-0.48 (3.19)	(-6.75 , 5.78)	-2.39 (1.87)	(-6.11 , 1.22)	-0.95 (1.44)	(-3.75 , 1.88)
G	-3.30 (3.43)	(-9.96 , 3.58)	-5.33 (2.04)	(-9.34 , -1.34)	-5.42 (1.57)	(-8.54 , -2.32)
M	-5.38 (3.22)	(-11.73 , 0.93)	-1.64 (2.04)	(-5.68 , 2.32)	-0.76 (1.62)	(-3.99 , 2.44)

Figure 2. *Posterior* probability distributions of the estimations associated with each of the areas in year 3, with *prior* information from the two previous years, in Model 2.2.



The final column of Table 7 shows that the patients in Granada assessed themselves below the mean value, at a 95% probability. As regards the other areas, no important differences were found in assessments of health status.

Figure 2 shows the *posterior* probability distributions of the parameters of Model 2.2 in year 3, with *prior* information about the two previous years. The values of the estimations have been reconstructed for ease of interpretation. A positive value on the ordinate axis means an over-assessment of the health states of the patients in a given area with respect to the mean, while a negative value implies a corresponding under-assessment.

Tables 6 & 7 and Figures 1 & 2 enable us to analyse the different scenarios that may occur in some areas with respect to others. This analysis is summarised in Table 8, which shows that 4 such scenarios are possible:

Scenario 1: Comparison of Navarre and Madrid with Barcelona. There are differences in health states, but not in individuals' assessments. This would indicate that our index is robust. This conclusion, however, cannot be generalised, because of the great diversity of scenarios found.

Scenario 2: The case of Granada vs. Madrid, in which health states, on average, are practically identical, and where, nevertheless, the assessments made by patients differ between the areas.

Scenario 3: This is the case we find on comparing Madrid with Navarre. The samples are homogeneous regarding both actual health states and their assessment by the patients.

Scenario 4: No conclusions can be drawn, because in one situation, the patients with better health status report higher assessments (as in the case of Barcelona vs. Granada), but the opposite is true in another, as is the case of Granada vs. Navarre.

Table 8. Differences between areas with a 95% probability.

Areas	Model 2.1	Model 2.2	*Scenarios*
B vs G	**Y**	**Y**	***Scenario 4***
vs M	**Y**	**N**	***Scenario 1***
vs N	**Y**	**N**	***Scenario 1***
G vs M	**N**	**Y**	***Scenario 2***
vs N	**Y**	**Y**	***Scenario 4***
M vs N	**N**	**N**	***Scenario 3***

Y = If differences exist at 95% probability

N = No differences at 95% probability

DISCUSSION

The differences by region or by country should be taken into account when EQ-5D is to be used as an index of quality of life. The present study shows that there are differences in the assessment of health states between different areas. Transferring the values of an index to another geographic area, or to another country, without taking into account such assessment differences could lead to erroneous conclusions being drawn.

From the annual development of Models 2.1 and 2.2, we can state that patients present great stability by geographic areas concerning variations in health states, and a great instability as regards their VAS assessment, independently of their actual health state.

For informative *prior* information, we used that from the previous period or periods. To include this information, it was only necessary to estimate the mean and the standard deviation. This procedure has been carried out to facilitate the use of all existing information from the sample, thus obtaining more robust results in the coefficients estimation.

The *prior* information used was that available for previous years, except for the first year, when non-informative *prior* distribution data were used. *Prior* non-informative distributions were used in this study due to the lack of initial knowledge about the distribution of the *prior* parameters in other studies.

There are several studies showing the use of the instrument EQ-5D in schizophrenic patients in Spain [20-22] and other countries [23-26]. But we lack an index specifically obtained for schizophrenia. This leads some authors to use indexes from general population, and even from general population of other countries. Looking at our results that confirm the existence of differences in valuation between regions, it seems that the results of those studies could not be adequate.

Limitations of the study

Some limitations should be mentioned. First, sample size is relatively small. Second, we do not discuss about variables that could affect the quality of life, such as sociodemographic characteristics or differences in service availability, which could be different between the different areas and thus affect the quality of life of the patients. It should be noted, though, that the sample is representative of every catchment area included in the analysis. This is particularly relevant in Spain, where mental health care is provided by sectors. Furthermore, every case included in the study was re-assessed by an external researcher previously standardised in the assessment battery used in this study.

CONCLUSION

Our results could have important implications for health policy. The knowledge of geographical differences in the health status of schizophrenic patients, as well as in the assessment of the health states can contribute to a better assessment of need and to a better policy design.

It may be more reliable for the purpose of economic evaluations an index that measures quality of life through EQ-5D obtained for a specific geographical zone, even when using a smaller sample, than doing the analysis using the value set of a different population.

As a reflection for further research, it might be interesting to analyse whether the effect of each of the explicative variables on health status varies between geographic areas.

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Key issues

* The EQ-5D questionnaire is a standardised, generic instrument concerning health-related quality of life for describing and valuing health aiming at obtaining a health unit, useful in economic evaluation.

* A Bayesian approach can incorporate prior knowledge on parameters through specification of prior distribution or incorporating prior empirical evidence on the parameters, thus getting more robust results.

* There are differences in the health status of schizophrenic patients and in patients' valuations of their health status between four mental-health districts in Spain.

* The relevance for policy making is that such differences should be taken into account in resource allocation and health care development in the treatment of schizophrenia.

References

[1] World Bank. World Development Report 1993: Investing in Health. Washington D.C., (1993).

[2] Cabasés JM, Haro JM, Martínez-Larrea A, Muñoz PE, Salvador-Carulla L, Torres F. Impacto del tratamiento en la esquizofrenia en España. *Actas Esp Psiquiatr* **30**(3), 43-51 (2002).

[3] Haro JM, Salvador-Carulla L, Cabasés JM, Madoz V, Vázquez-Barquero JL, PSICOST Group. Utilisation of mental health services and costs of patients with schizophrenia in three areas of Spain. *Br J Psychiatry* **173**, 334-340 (1998)

[4] Salvador-Carulla L, Haro JM, Cabasés JM, Madoz V, Sacristán JA, Vázquez-Barquero JL. Service utilisation and cost of first-onset schizophrenia in two widely differing health service areas in North-East Spain. *Acta Psychiatr Scand* **100**, 335-343 (1999).

[5] Salvador-Carulla L, Romero C, Martínez A, Haro JM, Bustillo G, Ferreira A, Gaite L, Johnson S and Psicost Group. Assessment instruments: standardization of the European Service Mapping Schedule (ESMS) in Spain. *Acta Psychiatr Scand* **102**(405), 24-32 (2000).

[6] Martínez A, Nadal S, Beperet M, Mendióroz P. The schizophrenic patient and his/her relatives: a process of deep change. *An Sist Sanit Navarra* **23**(1), 101-10 (2000).

[7] Vazquez-Polo FJ, Negrin MA, Cabases JM, Sánchez E, Haro JM, Salvador L. An Analysis of the Costs of Treating Schizophrenia in Spain: a Hierarchical Bayesian Approach. *J Men Health Policy Econ*, **8**, *In press* (2005).

[8] Brooks R. EuroQol: the current state of play. *Health Policy*. **37**, 53-72 (1996).

[9] Dolan P. Modelling valuations for EuroQol health states. *Medical Care*, **35** (11), 1095-108 (1997).

[10] Roberts J, Dolan P. To what extent do people prefer health status with higher values? A note on evidence from the EQ-5D valuation set. *Health Economics* **13**, 733-737 (2004).

[11] Dolan P. Modelling valuation for health status: the effect of duration. *Health Policy*, **38**, 189-203 (1996).

[12] Salvador-Carulla L, Cabasés JM, Haro JM, *et al*. Economic impact of schizophrenia in Spain. *Sixth Workshop on Costs and Assessment in Psychiatry. Mental Health Policy and Economics*. Venice, March, 28-30 (2003).

[13] American Psychiatric Association (1994). Diagnostic and Statistical Manual of Mental Disorders (4th edn) (DSM–IV). Washington, DC, APA. (1994).

[14] Browne W, Draper D. Implementation and performance issues in the Bayesian and likelihood fitting of multilevel models. *Computational Statistics*, **15**, 391-420 (2000).

[15] Gilks WR, Richardson S, Spiegelhalter DJ. *Markov chain Monte Carlo in practice*. London, Chapman and Hall, (1996).

[16] Geman S, Geman D. Stochastic relaxation, Gibbs distributions and the Bayesian restoration of images. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, **45**, 721-741 (1984).

[17] Spiegelhalter S, Thomas A, Best N, Lunn D. WinBUGS user manual. Biostatistic Unit: Cambrige. UK. http://www.mrc-bsu.cam.ac.uk/bugs. (2003).

[18] Greiner W, Weijnen T, Nieuwenhuizen M, *et al*. A single European currency for EQ-5D health states. Results from a six-country study. *Eur J Health Econom*, **4**, 222-231 (2003).

[19] Badía X, Roset, M, Montserrat S, Herdman M, Segura S. La Versión Española del EuroQol: Descripción y aplicaciones. *Medicina Clínica*, **112**, 79-86 (1999).

[20] Prieto L, Sacristan JA, Hormaechea JA, Casado A, Badia X, Gomez JC. Psychometric validation of a generic health-related quality of life measure (EQ-5D) in a sample of schizophrenic patients. *Curr Med Res Opin.* Jun; **20**(6), 827-35 (2004).

[21] Prieto L, Sacristan JA. What is the value of social values? The uselessness of assessing health-related quality of life through preference measures. *BMC Med Res Methodol.* Apr **29**, 4:10 (2004).

[22] Prieto L, Novick D, Sacristan JA, Edgell ET, Alonso J, SOHO Study Group. A Rasch model analysis to test the cross-cultural validity of the EuroQoL-5D in the Schizophrenia Outpatient Health Outcomes Study. *Acta Psychiatr Scand* Suppl. **416**, 24-9 (2003).

[23] Almond S, Knapp M, Francois C, Toumi M, Brugha T. Relapse in schizophrenia: costs, clinical outcomes and quality of life. *Br J Psychiatry*. Apr,**184**, 346-51 (2004).

[24] Dernovsek MZ, Prevolnik Rupel V, Rebolj M, Tavcar R. Quality of life and treatment costs in schizophrenic outpatients, treated with depot neuroleptics. *Eur Psychiatry*. Dec;**16**(8), 474-82 (2001).

[25] Boelscher, J. What do we mean by quality of life and how do we measure it in patients with schizophrenia*? Int Journal of Psychiatry in Clinical Practice*, **2**(Suppl 2), S65-S71 (1998).

[26] Patterson, TL, Kaplan RM, Jeste DV. Measuring the effect of treatment on quality of life in patients with schizophrenia - focus on utility-based measures. *CNS Drugs*, **12**(1), 49-64 (1999).