Different dimensions of health inequalities: An empirical analysis *

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Abstract
This paper provides a new approach to ranking health distributions in Spain based on stochastic dominance, health polarization and inequality indices. Using the latest data from the European Health Survey (EHIS) and the European Union Statistics on Income and Living Conditions (EU-SILC), we find that stochastic dominance can be applied when ranking social welfare (first order stochastic dominance), but not when ranking inequality (second order stochastic dominance). We also show inequality and polarization indices are empirically different and do not behave similarly. Thus, using axiomatic foundation for new measures of polarization by Apouey (2007) that can be applied to ordinal distributions such as Self-Assessed Health (SAH) data, it is worth mentioning, regarding Spanish regions, that several movements and polarization are larger on the Canary Islands, Castile and Leon, and Aragon than in Balearic Islands or Cantabria. Also, large regional differences in polarization are found but not regarding inequality. This analysis is also completed with that information related with individuals who report they are hampered in daily activities.

JEL Codes: I1, I3

Keywords: Inequality; Bi-polarization; Ordinal variables; Self-assessed health

Acknowledgements
(*) The authors thank to the Spanish Institute of Fiscal Studies (Project 2015-16 "Statistical models of economic evaluation for public policies on health expenditure: Analysis of health care resources") for the partial support of this work.

1 Introduction

In relation to health, a wide range of literature is focused on analysing health capital as a determinant of economic growth (Zhang and Kanbur 2001). Reducing health inequalities between the rich and poor, and studying their causes are two main objectives of health policies. This issue explains why the measurement of income-related health dispersion and the decomposition of measures into factors are very important.

Hence, we know that inequalities are ethically undesirable in the face of the existing wide inequality differences in responsiveness across the health systems for each country (Ziebarth 2010; Jones et al. 2011). This is consequently why over the last decades, many researchers have focused their attention on the relationship between society's income distribution and the individuals' welfare, thus social polarization refers to the measurement of the distance between different social groups, defined on the basis of variables such as race, religion or ethnicity (Zheng 2011; Lazar and Silber 2013, Rosa Dias et al. 2013; Fusco and Silber 2014).

Precisely, the purpose of this paper is two-fold. Firstly, we apply the measurement of the polarization theory for Health Economics. In this case, the relevant distributions are described by density functions and following Duclos et al. (2004) we concentrate on the axiomatics and estimates of "pure health polarization", that is, indices of polarization for which regions or countries identify themselves only with those with similar health levels. Secondy, this paper applies the axiomatic foundation for the new measures of polarization proposed by Apouey (2007) that can be applied to ordinal distributions such as Self-Assessed Health (SAH) data. Therefore, the major aim of this study is to test directly if health polarization, as measured by the most popular polarization indices of Wolfson (1994), Esteban and Ray (1994) and Duclos et al. (2004) can be applied to health distributions (cardinal and ordinal ones).

However, empirical evidence in health economics is largely based on ordinal data. Thus, one of the most commonly used indicators of individuals' health status is SAH, which is traditionally classified into five categories reflecting negative health rating (bad or very bad health) versus positive or neutral health ratings (very good, good or fair health) (Hildebrand and Kerm 2009). There is not full standardisation of the measurement of perceived health status across OECD Countries. In Europe, it is recommended to measure this variable through the following question: "How is your health in general? With response categories: Very good; good; fair; bad; very bad. Not all countries have adopted this standardised instrument, so it is possible to find differences among countries in the questions or response categories.

The importance of studying polarization is related to the harms it may generate (Amiel et al. 2010; Kobus and Milo's 2012; Wang 2015): (i) polarization is closely linked to different forms of social unrest (in general, it cannot happen without notions of group identity); (ii) polarization means less social mobility; (iii) the ruthless effect of polarization on economic growth; (iv) polarization implies health hazards.

Generally, health evaluation requires assessment of effects on health dispersion (primarily, inequality or polarization) within a population. However, some authors have pointed out the difficulties in applying several tools of inequality measurement to ordinal data such as the previously defined SAH. That is, the traditional approach to measuring dispersion requires cardinality of the variable whose dispersion is studied, while the most widely used comprehensive health measure (SAH) is ordinal. Therefore, it might be highlighted that even though several measures of health inequality (when the variables are ordinal) have been proposed, less attention has been devoted to the concept of health polarization, in spite of its relevance.

The application of Stochastic Dominance (SD) rules has been developed for the last years, and much progress has have been made in many directions. Spector et al. (1996) studied SD rules by applying SD techniques to ordinal variables. They used several transformations to define ordinal preferences of first and second order.

Zheng (2008) investigated the applicability of SD (Lorenz dominance) to variables of ordinal measurement. In fact, he focused his research on the impossibility result for relative Lorenz dominance in which only two health statuses are considered. In this case, the two relative Lorenz curves must be either cross or identical, and there is no possibility of dominance. From another point of view, Apouey (2007) proposed new polarization measures that can be applied not only to cardinal data but also to ordinal distributions. Moreover, in 2010, the same author suggested two original measures to quantify bivariate polarization. In doing so, French data on women was used to study polarization in the probability of reporting excellent or very good health across income levels. In this line, Apouey and Silber (2013) developed two approaches from Kobus (2012), embedded in different definitions of minimal inequality and bi-polarization, to quantify inequality and bi-polarization in income and health using data on 24 countries from the European Union Statistics on Income and Living Conditions (EU-SILC) for 2004-2006 and 2011.

This study provides a new approach to ranking health distributions based on SD, health polarization and health inequalities for the Spanish case. The methods used are applied rigorously and explain why and how the data support the conclusions. Besides, our research clearly demonstrates that it is possible to use alternative techniques to explore a phenomenon of interest such as health inequalities.

To the best of our knowledge, empirical evidence for Spain is not very extensive. Now, this paper represents a new contribution in this field doubly. In any case, we can quote the paper of Gradín (2002) which analyzes Spanish expenditure and income distribution during the recovery of democracy in the middle 1970s through two perspectives: the Lorenz criterion and polarization. He observed a declining trend in polarization from 1973 to 1991. Meanwhile, focusing on health, Blanco-Pérez and Ramos (2010) examine the effect of income polarization on individual health with panel data for Spain. These authors point out that polarization has a detrimental effect on health and that regional polarization is not significant.

The paper is organized as follows. In the next section, Section 2, we present the general methodology. Section 3 describes the data. Section 4 shows the empirical results and the final section makes some concluding remarks and policy implications.

2 Metohodology: stochastic dominance, inequality and polarization

Although there is a huge literature on the parametric conditions of Lorenz orderings there is not much work on the SD for discrete random variables. However, it is an important statistical instrument used in economic data analysis, and enables to present rankings in the context of many distributions. In fact, there are dimensions other than income that must be allowed in making welfare judgments (Atkinson and Bourguignon (1982). In this section, we introduce the basic results for SD, health inequality and health polarization.

Let us consider the following notations which will be used in the rest of this paper.

- H is a discrete random variable (SAH).
- h_i is the cardinal value of health level i, i=1,2,..., k (K categories).
- $n=(n_1,...,n_k)$ with n_i representing the number of people in the kth category.
- $N_k = \sum_{i=1}^{k} n_i$ is the number of people who are in the first kth categories.
- The proportion of people in each health class is denoted as p_i with $\sum_{i=1}^{n} p_i = 1$.
- The cumulative proportions are given by $F=(F_1, F_2, ..., F_{k-1}, 1)$.
- Me is the median category of the distribution.

2.1 Stochastic Dominance conditions

The application of SD rules has been developed for the last years and advances have been made in many directions. Spector et al. (1996) studied different rules by applying SD techniques to ordinal variables. They used transformations to define ordinal preferences of first and second order.

Let H be a discrete random variable (SAH) and h_i the cardinal value of health level i, i=1,2,...,n. We assume health status is defined in increasing order, from the poorest to the best health $h_1 \leq h_2 \leq \cdots \leq h_n$ and only takes positive values $h_i > 0$. Therefore, the alternative outcomes can be ranked in order of preference but it is not possible to rank the differences between the alternative outcomes.

The proportion of people in each health class is denoted as p_i with $\sum_{i=1}^{n} p_i = 1$. The average health level of the distribution is given by $\bar{h} = \sum_{i=1}^{n} p_i h_i$. Furthermore, let H_1 and H_2 be two random variables with range $h_1,..,h_n$, probabilities $(p_1,...,p_n)$ and $(q_1,..,q_n)$ and cumulative distributions $F(x)$ and $G(x)$, respectively. We are interested in capturing the technical properties of these distributions that enable broad ranking of health. In fact, we are going to focus our research on these following questions: When can we say that everyone will prefer H_1 to H_2? and When can we say that anyone who is risk averse will prefer H_1 to H_2?

From another point of view, Zheng (2008) investigated the applicability of SD (Lorenz dominance) to variables of ordinal measurement. In fact, he focused his research on the impossibility result for relative Lorenz dominance in which only two health statuses are considered. In this case, the two relative Lorenz curves must be either cross or identical and there is no possibility of dominance.

Therefore, H_1 first-order stochastically dominates H_2 if $F(x) \leq G(x)$ for all x, where F and G are the distribution functions of H_1 and H_2, respectively, and a strict inequality holds for at least some x. Thus, for any k=1,..,n,

$$\sum_{i=1}^{k} p_i \leq \sum_{i=1}^{k} q_i. \quad (1)$$

All individuals with utility functions $u' \geq 0$ prefer $F(x)$ to $G(x)$ if $F(t)$ dominates $G(t)$ by first SD. Furthermore, $E_F \geq E_G$.

On the other hand, H_1 second-order stochastically dominates H_2 if $F(x) \leq G(x)$ for all x, where F and G are the distribution functions of H_1 and H_2, respectively, and a strict inequality holds for at least some x. Thus, for any k=1,..,n,

$$\sum_{i=1}^{c} F(x) \leq \sum_{i=1}^{c} G(x) \quad (2)$$

for all c with a strict inequality over some interval. Thus, all risk averse individuals (with utility functions $u' \geq 0$ and $u'' \leq 0$) prefer $F(x)$ to $G(x)$ if $F(t)$ dominates $G(t)$ by second stochastic dominance. Then, $E_F \geq E_G$.

It means that health is better in distribution H_1 than in distribution H_2 four each category of health status. Thus, the share of the population with “Very bad health” is lower for H_1 than H_2 as well as the share of the population in the lowest two categories, and the lowest three categories, and so on.

2.2 Health inequality

The World Health Organization (WHO) defines health inequalities as differences in health status or in the distribution of health determinants between different population groups. Accordingly, when comparing health distributions, it is often useful to calculate the corresponding inequality index which takes the value of zero for a perfectly equal distribution and unity for a distribution in which inequality is maximal. Obviously, if we summarize health inequality by a single number, we obtain complete ordering of health distributions. But the SD approach provides only a partial ordering.

From another point of view, the United Nations Convention on the rights of persons with disabilities states that "persons with disabilities include those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others".

As defined by the WHO, disability is conceptualized as being a multidimensional experience for the persons involved. In fact, three dimensions of disability are recognized in the International Classification of Functioning, Disability and Health (ICF): body structure and function (and impairment thereof), activity (and activity restrictions) and participation (and participation restrictions).

Obviously, there are many statistics about the number of disabled persons as well as on their involvement in the society (living conditions, social inclusion, labour market, health or education). However, most of the national surveys include questions describing health status and about those individuals who consider they are hampered in their daily activities by a physical or mental health problem, illness or disability. Thus, in the last years there has been a great interest in well-being and health and on those aspects related with justice and equality. Precisely, the purpose of this paper is two-fold. First, we apply the measurement of the polarization. Therefore, we focus our attention on the relationship between SAH and self-perceived disability. Thus, this paper applies the axiomatic foundation for the new measures of polarization proposed by Apouey (2007) that can be applied to ordinal distributions such as SAH data.

Health economists have proposed different methodologies to measure inequality. However, as SAH is widely used in economic studies and it is well known as an important predictor of morbidity, mortality and health services utilization (Grosssman 1972), we are going to focus our attention on those measures obtained by a cardinal scale. Thus, when measuring health inequality using ordinal data as SAH, we have to choose between indices specifically based upon ordinal data, and more standard indices using ordinal data which has been transformed into cardinal data (Wagstaff and Van Doorslaer 2000; Madden 2009).

The different measures of dispersion for ordinal data should not be mean based (imposing a cardinal scale values). In fact, under certain conditions (Allison and Foster 2004), if the cumulative distribution function of an ordinal variable H_1 (F_{H1}) displays more inequality than the cumulative distribution function of a H_2 (F_{H2}), then H_1 can be obtained from H_2 through a series of median preserving spreads. In this case, H_2 first order dominates H_1 below the median, and H_1 first order dominates H_2 above the median. Following this principle, Abul Naga and Yalcin Abul and Yalcin (2008) proposed a parametric family of inequality indices for ordinal data. In fact, their results have been broadly.

Therefore, the Abul Naga-Yalcin inequality index is defined as:

$$I_{\alpha,\beta} = \frac{\sum_{k<\mathrm{Me}} F_k^{\alpha} - \sum_{k\geq \mathrm{Me}} F_k^{\beta} + (K+1-\mathrm{Me})}{k_{\alpha,\beta} + (K+1-\mathrm{Me})}$$

where $\alpha, \beta \geq 1$

and $k_{\alpha,\beta} = (\mathrm{Me}-1)\left(\frac{1}{2}\right)^{\alpha} - \left[1-(K-\mathrm{Me})\left(\frac{1}{2}\right)^{\beta}\right]$.

This index lies in the interval [0,1]. When $\alpha=\beta$, inequality is at a minimum if everyone is in the same category and at a maximum when half of the population lies in the lowest category and half in the highest category. Thus, different calibrations of the parameters α and β allow us to give different weights to inequalities above and below the median of the responsiveness distribution.

2.3 Health Polarization

In general, polarization can be defined as the fact of people or opinions being divided into two opposing groups. Hence, in our case, there is no polarization when everybody's health is the same and polarization is the maximum when the population is divided into two halves with one half being in the lowest category and the other half being in the top category.

Based on the axiomatic foundation for new measures of polarization applied to ordinal data and proposed by Apouey (2007), we will calculate two polarization measures $P_1(N)$ and $P_2(F)$, and the bounds of α which represent the importance that is given to the median category. The two polarization measures satisfy the following axioms: Spread away from the median, normalization and compatibility. In fact, it is assumed that when there is the same number of individuals in the K categories, then polarization is medium. Thus, the uniform distribution could represent an intermediate polarization between minimum and maximum polarization. The indices are given by:

$$P_1(N) = K_1\left[\left(\frac{N_K}{2}\right)^{\alpha} - \frac{1}{K-1}\sum_{k=1}^{K-1}\left|N_K\left(\frac{N_k}{N_K}\right)-\frac{1}{2}\right|^{\alpha}\right]$$

and

$$P_2(F) = K_2\left[\left(\frac{1}{2}\right)^{\alpha} - \frac{1}{K-1}\sum_{k=1}^{K-1}\left|F_k-\frac{1}{2}\right|^{\alpha}\right]$$

where $K_1=K_2=2^{\alpha}$ and α reflects the importance that is given to the median category. In fact, intermediate polarisation is defined as the polarization exhibited by a uniform distribution which is in an intermediate position between minimum and maximum polarization levels.

These indices proposed by Apouey (2007) are median based and hence they do not require us to impose cardinal scaling to the categories and they depend on the number of responsiveness categories (K), the cumulative proportion of category k in the population (F_k) and the weight given to the median category (α). It is important to note that as α approaches zero, the relative given to the median category increases and the relative contribution of the other categories is reduced.

3 Data

This paper uses data from the European Health Survey System (EHSS) and the European Union Statistics and Living Conditions (EU-SILC). In 2002, Eurostat launched the EHSS in order to obtain health data by means of official surveys and meet the demand for information on health and health determinants. The European Health Survey (EHIS) is a five-yearly research addressed to all people aged 15 and over who reside in family dwellings throughout the national territory. It includes data of health services and health determinants, and it is harmonized and comparable at a European level. And the first wave for Spain was published in 2009.

The EHIS 2014 sample (the most recent information) is approximately 23,000 dwellings distributed in 2,500 census tracts. Another point of interest is that this survey provides national results and by Autonomous Communities. Also, the information is divided into four modules: health status, health care use, health determinants and socio-economic background variables. The European Health Interview Surveys are foreseen to be run every 5 years.

The information that we are going to use is based on the subjective perception that the person has regarding her/his state of health and limitations in basic activities of daily living. Indeed, we are going to base our results on the following questions:

- Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem? “Strongly limited”, “To some extent” or “Not limited at all”.
- How is your health in general? “Very good”, “Good”, “Fair”, “Bad” or “Very bad”.

In our analyses, individuals are characterised as having a disability when they report they are hampered ‘a lot’ or ‘to some extent’. Because the rather small sample size (at the regional level), we have distinguish between persons who are just to some extent hampered and those who are hampered a lot.

Data used in this study also comes from the EU-SILC. The main advantage of this survey is that information is homogeneous among countries since the questionnaire is similar across them. Thus, the EU-SILC is an annual, EU-wide, survey which allows us to obtain information on the income and living conditions of different types of households and individuals in the European Union. It has been established to provide data to be used for the structural indicators of social cohesion. EU-SILC includes rich information about income, education, employment, health, etc. Also, it is designed to insure the comparability between the European Union countries. Therefore, we are going to analyse individuals’ SAH in Spain from 2004 to 2014.

EU-SILC survey contains a small module on health, divided into 3 variables on health status and 4 variables on unmet needs for health care.

The variables on health status represent the so called Minimum European Health Module (MEHM), and measures 3 different concepts of health: Self-perceived health; Chronic morbidity (people having a long-standing illness or health problem); Activity limitation – disability (self-perceived long-standing limitations in usual activities due to health problems).

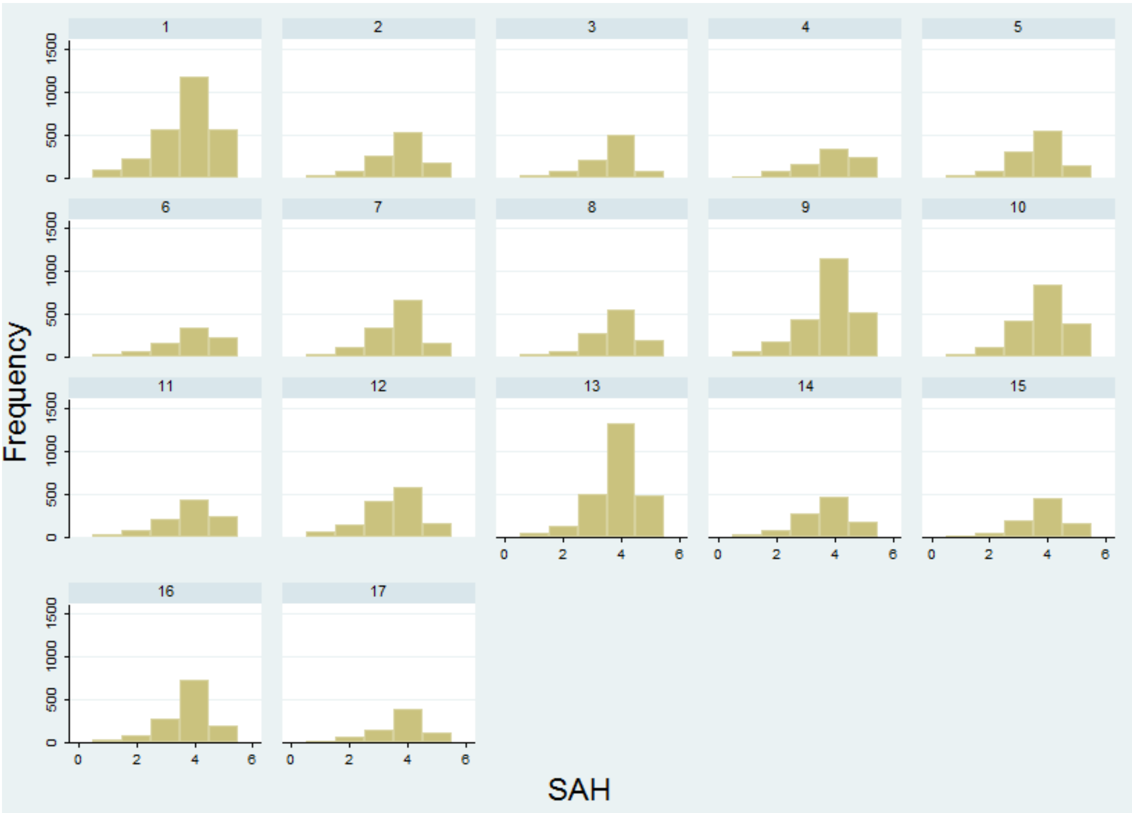
Self-perceived health is operationalized by a question on how a person perceives his/her health, in general, using one of the answer categories very good/ good/ fair/ bad/ very bad. In particular, we explore individual-level data to measure and compare inequalities in responsiveness across Spanish Autonomous Communities and over the period 2004-2014. It also is important to notice that in both surveys, our results are based on the categorical and ordinal nature of the 5-point scale used to measure responsiveness which ranges from very bad to very good.

4 Empirical results

In order to apply the different measures of stochastic dominance, polarization and inequality, we firstly use the EHIS (2014). Our results also show that inequality and polarization are empirically different.

The key variable, SAH, represents health status over the last 12 months, and it is recorded in five categories: 5" (very good), "4" (good), "3" (fair), "2" (bad) and "1" (very bad). Fig. 1 plots the frequencies of responsiveness across the seventeen Spanish regions. These plots illustrate variability in levels of responsiveness. In any case, responses are concentrated on "good health", that is, category 4. Furthermore, before analysing both polarisation and inequality indices, the cumulative frequencies of reporting each of the five categories are presented in Table 1.

Figure 1 Responsiveness across Spanish regions for SAH, EHIS 2014



Notes: Andalusia (1), Aragon (2), Asturias (3), Balearic Islands (4), Canary Islands (5), Cantabria (6), Castile and Leon (7), Castile-La Mancha (8), Catalonia (9), Valencian Community (10), Extremadura (11), Galicia (12), Madrid (13), Murcia (14), Navarre (15), Basque Country (16), and La Rioja (17).
Source: Author's elaboration.

Let us begin by looking at some actual health distribution data. Table 1 shows the SAH distribution for each Autonomous Community in tabular form. Let H be a random variable with range $h_1,\ldots,h_n$, probabilities $(p_i,\ldots,p_n)$ and $F(i)$ the corresponding distribution function. The cumulative probability is given by $F(i) = \Pr[h_i \leq i]$ and the survival probability is $\overline{F(i)} = \Pr[h_i \geq i]$.

As we have pointed out before, the variable we use as a proxy of individual's health status is the SAH that each individual reports of their own health status and the possible responses are ordered qualitatively. Thus, SAH variable is a subjective response to the question "How is your heath in general?" and it takes the values "5" (very good), "4" (good), "3" (fair), "2" (bad) and "1" (very bad).

Let us consider$\Delta W = W^t - W^{t+n}$, where W is the corresponding welfare function. Assuming that individual welfare function reacts positively to higher values of health (increasing monotonicity), it is clear that in 2014 individuals fared better in Madrid than in Galicia. In fact, we can notice a higher proportion of people with good and very good health, and a lower proportion with bad or very bad health. Indeed, average health is better in Madrid than in Galicia. However, in the same way, there are other Autonomuos Communities in which comparisons are not possible.

Nevertheless, using first-stochastic dominance over these probability distributions, and assuming that outcome h_i=5 is preferred to h_i=4, h_i=4 is preferred to h_i=3, h_i=3 is preferred to h_i=2 and h_i=2 is preferred to h_i=1, we can conclude that first-order dominance does exist. Consequently, as we can not assume that a shift from h_i=1 to h_i=2 is ranked higher than a shift from h_i=2 to h_i=3 or a shift from h_i=4 to h_i=5, we can not apply ordinary second stochastic dominance. So H_t does not dominate H_{t+n} and it is not preferred by all risk averters.

Table 1 Analysis of cumulative distributions, EHIS 2014

		Health Status (*p* and *F*)				
		Very Bad (h_i=1)	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**
Spain	**$p(i)$**	**0.0257**	**0.0739**	**0.2271**	**0.489**	**0.1843**
	$F(i)$	0.0257	0.0996	0.3267	0.8157	1
	$\overline{F(i)}$	1	0.974	0.9004	0.6733	0.1843
Andalusia	**$p(i)$**	**0.0376**	**0.0863**	**0.2137**	**0.4501**	**0.2122**
	$F(i)$	0.0376	0.1239	0.3377	0.7878	1
	$\overline{F(i)}$	1	0.9624	0.8761	0.6623	0.2122
Aragon	**$p(i)$**	**0.02**	**0.0656**	**0.2443**	**0.5048**	**0.1654**
	$F(i)$	0.02	0.0856	0.3298	0.8346	1
	$\overline{F(i)}$	1	0.98	0.9144	0.6702	0.1654
Asturias	**$p(i)$**	**0.0334**	**0.0911**	**0.2307**	**0.564**	**0.0807**
	$F(i)$	0.0334	0.1246	0.3552	0.9193	1
	$\overline{F(i)}$	1	0.9666	0.8754	0.6448	0.0807
Balearic Islands	**$p(i)$**	**0.0148**	**0.0873**	**0.187**	**0.4133**	**0.2977**
	$F(i)$	0.0148	0.1021	0.2891	0.7023	1
	$\overline{F(i)}$	1	0.9852	0.8979	0.7109	0.2977
Canary Islands	**$p(i)$**	**0.0219**	**0.0766**	**0.2808**	**0.4995**	**0.1212**
	$F(i)$	0.0219	0.0985	0.3792	0.8788	1
	$\overline{F(i)}$	1	0.9781	0.9015	0.6208	0.1212
Cantabria	**$p(i)$**	**0.038**	**0.0761**	**0.1975**	**0.4147**	**0.2736**
	$F(i)$	0.038	0.1141	0.3117	0.7264	1
	$\overline{F(i)}$	1	0.962	0.8859	0.6883	0.2736
Castile and Leon	**$p(i)$**	**0.0317**	**0.0816**	**0.26**	**0.5042**	**0.1224**
	$F(i)$	0.0317	0.1134	0.3734	0.8776	1
	$\overline{F(i)}$	1	0.9683	0.8866	0.6266	0.1224
Castile-La Mancha	**$p(i)$**	**0.0279**	**0.0657**	**0.2457**	**0.4887**	**0.1719**
	$F(i)$	0.0279	0.0936	0.3393	0.8281	1
	$\overline{F(i)}$	1	0.9721	0.9064	0.6607	0.1719
Catalonia	**p(i)**	**0.0265**	**0.0777**	**0.1862**	**0.4876**	**0.222**
	F(i)	0.0265	0.1042	0.2904	0.778	1
	$\overline{F(i)}$	1	0.9735	0.8958	0.7096	0.222
Valencian Community	**p(i)**	**0.0217**	**0.063**	**0.2323**	**0.4685**	**0.2145**
	F(i)	0.0217	0.0847	0.317	0.7855	1
	$\overline{F(i)}$	1	0.9783	0.9153	0.683	0.2145
Extremadura	**p(i)**	**0.0207**	**0.0757**	**0.2127**	**0.4471**	**0.2438**
	F(i)	0.0207	0.0965	0.3091	0.7562	1
	$\overline{F(i)}$	1	0.9793	0.9035	0.6909	0.2438
Galicia	p(i)	**0.0402**	**0.1058**	**0.313**	**0.4247**	**0.1162**
	F(i)	0.0402	0.1461	0.459	0.8838	1
	$\overline{F(i)}$	1	0.9598	0.8539	0.541	0.1162
Madrid	**$p(i)$**	**0.0151**	**0.0481**	**0.204**	**0.5398**	**0.193**
	$F(i)$	0.0151	0.0632	0.2672	0.807	1
	$\overline{F(i)}$	1	0.9849	0.9368	0.7328	0.193
Murcia	**$p(i)$**	**0.0237**	**0.077**	**0.2705**	**0.459**	**0.1698**
	$F(i)$	0.0237	0.1007	0.3712	0.8302	1
	$\overline{F(i)}$	1	0.9763	0.8993	0.6288	0.1698
Navarre	**$p(i)$**	**0.0179**	**0.0526**	**0.2213**	**0.5311**	**0.177**
	$F(i)$	0.0179	0.0706	0.2919	0.823	1
	$\overline{F(i)}$	1	0.9821	0.9294	0.7081	0.177
Basque Country	**$p(i)$**	**0.0174**	**0.0633**	**0.2073**	**0.5649**	**0.1472**
	$F(i)$	0.0174	0.0807	0.288	0.8528	1
	$\overline{F(i)}$	1	0.9826	0.9193	0.712	0.1472
La Rioja	**$p(i)$**	**0.0203**	**0.0767**	**0.1925**	**0.563**	**0.1476**
	$F(i)$	0.0203	0.097	0.2894	0.8524	1
	$\overline{F(i)}$	1	0.9797	0.903	0.7106	0.1476

Source: Authors' elaboration.

As pointed out by Yalontzky (2013), even though the actual choices of scales are arbitrary in the context of ordinal variables, there are cases in which we can make unambiguous comparisons about relative well-being between different groups based on the cardinal scales.

In this study, we contrast the Abul Naga-Yalcin inequality index (in the case of symmetry $\alpha=\beta$, and in the case in which a greater weight is given to inequalities below the median responsiveness value $\alpha=1$, $\beta=4$) with two different polarization measures (P_1 and P_2).

To measure polarization, we simply use the given SAH distributions and compute it for different values of α (α = 0.1; 0.5; 0.9 and the calibrated value proposed by Apouey (2007) is α^*= 0.73).

Table 2 presents the inequality indices for each of the seventeen regions considered, using EHIS (2014). Values are around 0.67 and 0.79, respectively. However, due to the indices being comparable share the same median category (Me=4), we can rank across Autonomous Communities in inequality. Inequality in responsiveness in SAH for the 17 Autonomous Communities ranges from 0.6729 (Balearic Islands) to 0.6739 (Galicia) considering $\alpha=\beta=1$. In the case we consider $\alpha=1$, $\beta=4$, it ranges from 0.7915 (Galicia) to 0.7919 (Madrid). Obviously, differences are very small.

If we turn attention to the polarization indices (Table 3), we find greater disparity in the results. In fact, one key point of polarization is mass relocation form the middle of the distribution to the poles (spreads away from the median).

We can notice several movements and polarization seems to be frequent in Spanish regions. Polarization indices (P_2) are larger on the Canary Islands, Castile and Leon, and Aragon than in Balearic Islands and Cantabria. In addition, the ranking of the distributions depends on the value of parameter α.

We also present these results by sex and educational levels (Appendix). In fact, women are more likely to report worse SAH than men. In fact, using first-stochastic dominance over these probability distributions, and assuming again that outcome h_i=5 is preferred to h_i=4, h_i=4 is preferred to h_i=3, h_i=3 is preferred to $h_i=2$ and h_i=2 is preferred to $h_i=1$, we can conclude that first order dominance exists between males and females for all the years considered.

In addition, people with lower educational attainment have poorer self-reported health. Thus, we can confirm that there are huge differences by sex and education levels.

Moreover, in order to illustrate all the previous formulations over the period 2004-2014, we have used individuals' SAH of Spain for eleven years using the EU-SILC. We observe that again polarization and inequality measures do not behave similarly. Table shows the corresponding polarization and inequality measures which range, for example, from 0.0518 in 2004 to 0.1389 in 2006 when $\alpha=1$.

However, it is very important to point out that higher inequality is not always linked with greater polarization although the rankings obtain do not differ very much.

Table 2 Inequality measures, Spain 2014, EHIS 2014

	Inequality	
	α=β=1	**α=1, β=4**
Spain	**0.6734**	**0.7917**
Andalusia	0.6732	0.7916
Aragon	0.6735	0.7918
Asturias	0.6737	0.7916
Balearic Islands	0.6729	0.7917
Canary Islands	0.6738	0.7917
Cantabria	0.6730	0.7916
Castile and Leon	0.6737	0.7916
Castile-La Mancha	0.6735	0.7917
Catalonia	0.6731	0.7917
Valencian Community	0.6733	0.7918
Extremadura	0.6732	0.7917
Galicia	0.6739	0.7915
Madrid	0.6733	0.7919
Murcia	0.6736	0.7917
Navarre	0.6734	0.7918
Basque Country	0.6735	0.7918
La Rioja	0.6734	0.7917

Source: Authors' elaboration.

Table 3 Polarization and inequality measures, Spain, EHIS 2014

	Polarization (P_1)				Polarization (P_2)			
	α=0.1	**α=0.5**	**α*=0.73**	**α=0.9**	**α=0.1**	**α=0.5**	**α*=0.73**	**α=0.9**
Spain	0.2705	46.4365	529.9157	3003.9679	0.0432	0.1870	0.2528	0.2953
Andalusia	0.1926	14.7072	104.7643	418.7089	0.0717	0.2640	0.3333	0.3734
Aragon	0.2144	10.4326	57.9185	192.9170	0.1136	0.3188	0.3701	0.3982
Asturias	0.1670	7.7149	40.6231	128.4441	0.0682	0.2595	0.3316	0.3739
Balearic Islands	0.2278	10.2421	55.3795	182.5387	0.0571	0.2247	0.2909	0.3307
Canary Islands	0.1963	9.5583	52.6105	173.1146	0.1497	0.3520	0.3981	0.4251
Cantabria	0.1831	8.9680	49.7173	165.6120	0.0588	0.2318	0.3004	0.3417
Castile and Leon	0.1802	9.8751	57.7151	197.9941	0.1187	0.3332	0.3882	0.4188
Castile-La Mancha	0.1981	10.2016	58.0813	196.6610	0.1001	0.3082	0.3664	0.3981
Catalonia	0.2217	15.7962	109.0308	427.1455	0.0942	0.2895	0.3440	0.3739
Valencian Community	0.2283	14.1194	90.2068	334.1883	0.0800	0.2761	0.3397	0.3751
Extremadura	0.2145	10.4477	58.4050	196.3994	0.0689	0.2541	0.3205	0.3587
Galicia	0.1487	8.1595	47.1151	158.9329	0.0745	0.2884	0.3700	0.4177
Madrid	0.2702	18.2116	123.0789	476.1566	0.0719	0.2532	0.3134	0.3470
Murcia	0.1950	9.4501	52.1124	172.4157	0.0794	0.2851	0.3556	0.3953
Navarre	0.2282	10.0766	53.1364	170.7578	0.0785	0.2690	0.3300	0.3636
Basque Country	0.2313	12.0054	69.2880	237.5242	0.0634	0.2394	0.3045	0.3423
La Rioja	0.2055	8.5324	43.1870	134.2092	0.0638	0.2403	0.3056	0.3438

Source: Authors' elaboration.

Table 4 Polarization and inequality measures, Spain EU-SILC 2004-2014

Spain	Polarization (P_2)				Inequality	
	α=0.1	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**
2004	0.0518	0.2150	0.2852	0.3292	0.2350	0.4051
2005	0.0889	0.2954	0.3599	0.3961	0.2273	0.4054
2006	0.1389	0.3332	0.3777	0.4043	0.2174	0.3894
2007	0.0961	0.3034	0.3639	0.3973	0.2101	0.3704
2008	0.0631	0.2394	0.3053	0.3437	0.1791	0.3315
2009	0.0726	0.2610	0.3261	0.3630	0.1906	0.3506
2010	0.0753	0.2649	0.3282	0.3638	0.1905	0.3576
2011	0.0752	0.2590	0.3184	0.3515	0.1902	0.3741
2012	0.0879	0.2792	0.3345	0.3646	0.1980	0.3868
2013	0.0891	0.2852	0.3426	0.3741	0.1980	0.3779
2014	0.0695	0.2523	0.3163	0.3528	0.1878	0.3542

Source: Authors' elaboration.

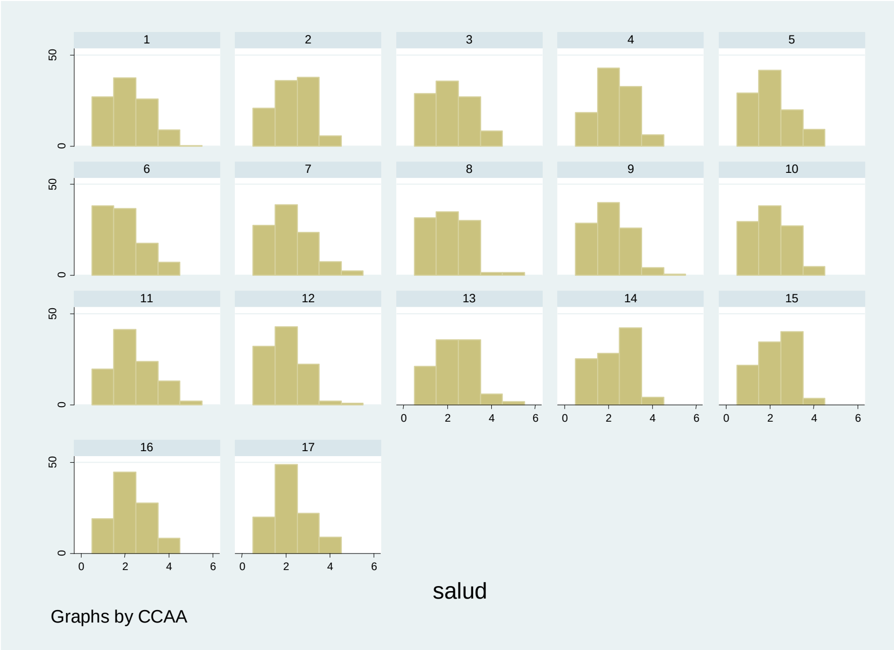
Disability is a multi-dimensional concept, not just related to a personal impairment but also to societal shortcomings in adapting to the needs of disabled persons (Burchardt 2003, Schädler et al. 2008).

The key variable, SAH, represents health status over the last 12 months, and it is recorded in five categories: 5" (very good), "4" (good), "3" (fair), "2" (bad) and "1" (very bad). Figure 2 plots the frequencies of responsiveness across the seventeen Spanish regions but only for those individuals who consider they are hampered strongly or to some extent in their daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem.

These plots illustrate variability in levels of responsiveness. In any case, responses are concentrated on "bad and very bad health" that is, categories 1 and 2. On the other hand, and as expected, very few individuals declare good or very good health. Furthermore, before analysing both polarisation and inequality indices, the cumulative frequencies of reporting each of the five categories are presented in Table 5. Also, those individuals who declare they are not limited at all for daily activities declare better health.

Figure 2

Responsiveness across Spanish regions for SAH and strongly limited or limited to same extent individuals, EHSS 2014



Notes: Andalusia (1), Aragon (2), Asturias (3), Balearic Islands (4), Canary Islands (5), Cantabria (6), Castile and Leon (7), Castile-La Mancha (8), Catalonia (9), Valencian Community (10), Extremadura (11), Galicia (12), Madrid (13), Murcia (14), Navarre (15), Basque Country (16), and La Rioja (17).

Source: Author's elaboration.

Table 5

Analysis of cumulative distributions, EHSS 2014

		Health Status (p and F)				
		Very Bad (h_i=1)	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**
Strongly Limited	$p(i)$	**0,27**	**0,38**	**0,28**	**0,06**	**0,01**
	$F(i)$	0,27	0,65	0,93	0,99	1,00
	$\overline{F(i)}$	1,00	0,73	0,35	0,07	0,01
Limited	$p(i)$	**0,03**	**0,18**	**0,50**	**0,26**	**0,03**
	$F(i)$	0,03	0,21	0,71	0,97	1,00
	$\overline{F(i)}$	1,00	0,97	0,79	0,29	0,03
Not Limited	$p(i)$	**0,00**	**0,01**	**0,14**	**0,60**	**0,25**
	$F(i)$	0,00	0,01	0,15	0,75	1,00
	$\overline{F(i)}$	1,00	1,00	0,99	0,85	0,25

Source: Authors' elaboration.

Table 6 shows the SAH distribution for each Autonomous Community in tabular form. Let H be a random variable with range $h_1,\dots,h_n$, probabilities $(p_i,\dots,p_n)$ and $F(i)$ the corresponding distribution function.

As we have pointed out before the variable we use as a proxy of individual's health status is the SAH that each individual reports of their own health status and the possible responses are ordered qualitatively. Thus, SAH variable is a subjective response to the question "How is your heath in general?" and it takes the values "5" (very good), "4" (good), "3" (fair), "2" (bad) and "1" (very bad). Obviously, we are going to focus our results on those individuals limited for daily activities by any longstanding illness, or disability, infirmity or mental health problem. In fact, we can notice a higher proportion of people with bad or very bad health if at the same time they declare they are strongly limited for daily activities.

In this study, we contrast the Abul Naga-Yalcin inequality index (in the case of symmetry $\alpha=\beta$ and in the case in which a greater weight is given to inequalities bellow the median responsiveness value $\alpha=1$, $\beta=4$) with a polarization measure (P_2). To measure polarization, we simply use the given SAH distributions and compute it for different values of α ($\alpha = 0.1$; 0.5; 0.9 and the calibrated value $\alpha^{*}= 0.73$).

Table 7 presents the inequality indices for each of the seventeen regions considered using EHIS (2014). Values are around 0.67 and 0.79, respectively. However, due to the indices being comparable share the same median category, we can rank across Autonomous Communities in inequality. Inequality in responsiveness in SAH for the 17 Autonomous Communities ranges from 0.12 (La Rioja) to 0.156 (Extremadura) for those individuals who are strongly limited for daily activities, considering $\alpha=\beta=1$. In the case we consider $\alpha=1$, $\beta=4$, it ranges from 0.314 (Galicia) to 0,447 (Madrid). Obviously, most of the differences are very small.

If we turn attention to the polarization indices, we find greater disparity in the results. In fact, one key point of polarization is mass relocation form the middle of the distribution to the poles (spreads away from the median).

We can notice not many movements and polarization seems not to be frequent in Spanish regions. Polarization indices (P_2) are very small in most of the regions.

Table 6

Analysis of cumulative distributions, EHSS 2014.

		Strongly limited individuals					Strongly (or to some extent) limited Individuals				
	Health Status	**Very Bad (h_i=1)**	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**	**Very Bad (h_i=1)**	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**
Andalusia	$\boldsymbol{p(i)}$	**0,27**	**0,38**	**0,26**	**0,09**	**0,00**	**0,11**	**0,25**	**0,42**	**0,20**	**0,03**
	$F(i)$	0,27	0,65	0,91	1,00	1,00	0,11	0,36	0,77	0,97	1,00
Aragon	$\boldsymbol{p(i)}$	0,21	0,36	0,38	0,06	0,00	0,07	0,21	0,51	0,19	0,01
	$F(i)$	0,21	0,57	0,94	1,00	1,00	0,07	0,28	0,80	0,99	1,00
Balearic Islands	$\boldsymbol{p(i)}$	0,18	0,43	0,33	0,06	0,00	0,05	0,31	0,43	0,19	0,01
	$F(i)$	0,18	0,61	0,94	1,00	1,00	0,05	0,37	0,79	0,99	1,00
Canary Islands	$\boldsymbol{p(i)}$	0,29	0,42	0,20	0,09	0,00	0,07	0,21	0,49	0,21	0,01
	$F(i)$	0,29	0,71	0,91	1,00	1,00	0,07	0,28	0,77	0,99	1,00
Cantabria	$\boldsymbol{p(i)}$	0,38	0,37	0,18	0,07	0,00	0,13	0,25	0,41	0,20	0,01
	$F(i)$	0,38	0,75	0,93	1,00	1,00	0,13	0,38	0,79	0,99	1,00
Castile and Leon	$\boldsymbol{p(i)}$	0,28	0,39	0,24	0,08	0,03	0,09	0,22	0,46	0,21	0,02
	$F(i)$	0,28	0,66	0,90	0,98	1,00	0,09	0,31	0,77	0,98	1,00
Cast.-La Mancha	$\boldsymbol{p(i)}$	0,32	0,35	0,30	0,02	0,02	0,10	0,22	0,52	0,15	0,01
	$F(i)$	0,32	0,67	0,97	0,98	1,00	0,10	0,32	0,84	0,99	1,00
Catalonia	$\boldsymbol{p(i)}$	0,29	0,40	0,26	0,04	0,01	0,13	0,37	0,05	0,41	0,04
	$F(i)$	0,29	0,69	0,95	0,99	1,00	0,13	0,50	0,55	0,96	1,00
Valencian Com.	$\boldsymbol{p(i)}$	0,30	0,38	0,27	0,05	0,00	0,09	0,24	0,48	0,17	0,02
	$F(i)$	0,30	0,68	0,95	1,00	1,00	0,09	0,33	0,81	0,98	1,00

Source: Authors' elaboration.

Table 6 (continue)

Analysis of cumulative distributions, EHSS 2014.

		Strongly limited individuals					**Strongly (or to some extent) limited Individuals**				
	Health Status	**Very Bad (h_i=1)**	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**	**Very Bad (h_i=1)**	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**
Extremadura	***p*(*i*)**	**0,20**	**0,40**	**0,24**	**0,13**	**0,02**	**0,08**	**0,24**	**0,45**	**0,20**	**0,03**
	F(*i*)	0,20	0,60	0,84	0,98	1,00	0,08	0,32	0,77	0,97	1,00
Galicia	***p*(*i*)**	**0,32**	**0,43**	**0,22**	**0,02**	**0,01**	**0,09**	**0,23**	**0,49**	**0,17**	**0,02**
	F(*i*)	0,32	0,75	0,97	0,99	1,00	0,09	0,32	0,81	0,98	1,00
Madrid	***p*(*i*)**	**0,21**	**0,36**	**0,36**	**0,06**	**0,02**	**0,06**	**0,17**	**0,46**	**0,28**	**0,04**
	F(*i*)	0,21	0,57	0,92	0,98	1,00	0,06	0,23	0,69	0,96	1,00
Murcia	***p*(*i*)**	**0,25**	**0,28**	**0,42**	**0,04**	**0,00**	**0,08**	**0,23**	**0,49**	**0,19**	**0,01**
	F(*i*)	0,25	0,54	0,96	1,00	1,00	0,08	0,31	0,80	0,99	1,00
Navarre	***p*(*i*)**	**0,22**	**0,35**	**0,40**	**0,04**	**0,00**	**0,06**	**0,17**	**0,46**	**0,29**	**0,03**
	F(*i*)	0,22	0,56	0,96	1,00	1,00	0,06	0,22	0,68	0,97	1,00
Basque Country	***p*(*i*)**	**0,19**	**0,45**	**0,28**	**0,09**	**0,00**	**0,06**	**0,22**	**0,44**	**0,25**	**0,04**
	F(*i*)	0,19	0,64	0,91	1,00	1,00	0,06	0,28	0,71	0,96	1,00
La Rioja	***p*(*i*)**	**0,20**	**0,49**	**0,22**	**0,09**	**0,00**	**0,06**	**0,24**	**0,40**	**0,26**	**0,04**
	F(*i*)	0,20	0,69	0,91	1,00	1,00	0,06	0,30	0,70	0,96	1,00

Source: Authors' elaboration.

Table 7

Polarization and inequality measures, EHSS 2014.

	Strongly limited individuals						Strongly (or to some extent) limited individuals					
	Polarization (P_2)				Inequality		Polarization (P_2)				Inequality	
	α=0.1	α=0.5	α*=0.73	α=0.9	α=β=1	α=1, β=4	α=0.1	α=0.5	α*=0.73	α=0.9	α=β=1	α=1, β=4
Andalusia	0,035	0,128	0,153	0,160	0,144	0,388	0,040	0,181	0,248	0,293	0,179	0,387
Aragon	0,045	0,143	0,158	0,155	0,140	0,356	0,034	0,153	0,211	0,250	0,142	0,320
Asturias	0,037	0,134	0,158	0,165	0,146	0,384	0,029	0,134	0,187	0,222	0,175	0,372
Balearic Islands	0,033	0,109	0,122	0,121	0,127	0,343	0,051	0,218	0,292	0,338	0,160	0,345
Canary Islands	0,030	0,110	0,132	0,138	0,135	0,370	0,028	0,127	0,178	0,212	0,149	0,334
Cantabria	0,038	0,131	0,152	0,155	0,141	0,360	0,048	0,209	0,283	0,331	0,184	0,376
Castile Leon	0,035	0,130	0,157	0,167	0,148	0,413	0,030	0,136	0,190	0,227	0,160	0,355
Cast.-La Mancha	0,037	0,129	0,150	0,152	0,140	0,353	0,035	0,156	0,216	0,255	0,145	0,304
Catalonia	0,030	0,109	0,128	0,130	0,131	0,346	0,044	0,194	0,263	0,307	0,281	0,541

Source: Authors' elaboration.

Table 7 (continue)

Polarization and inequality measures, EHSS 2014.

	Strongly limited individuals						Strongly (or to some extent) limited individuals					
	Polarization (P_2)				Inequality		Polarization (P_2)				Inequality	
	α=0.1	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**	**α=0.1**	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**
Valencian C.	0,032	0,115	0,134	0,136	0,133	0,344	0,039	0,174	0,238	0,279	0,156	0,338
Extremadura	0,041	0,145	0,174	0,186	0,156	0,447	0,043	0,190	0,258	0,302	0,163	0,365
Galicia	0,028	0,097	0,111	0,110	0,122	0,314	0,025	0,119	0,168	0,202	0,156	0,345
Madrid	0,047	0,152	0,171	0,172	0,147	0,392	0,042	0,180	0,242	0,281	0,160	0,388
Murcia	0,061	0,181	0,194	0,188	0,152	0,361	0,032	0,145	0,202	0,240	0,149	0,325
Navarre	0,046	0,145	0,157	0,153	0,138	0,340	0,038	0,167	0,227	0,266	0,158	0,380
Basque Coun.	0,029	0,103	0,119	0,121	0,128	0,359	0,037	0,162	0,220	0,258	0,165	0,390
La Rioja	0,023	0,084	0,099	0,102	0,120	0,349	0,038	0,167	0,227	0,266	0,175	0,406

Source: Authors' elaboration.

5 Conclusions

Our main aim in this paper has been to develop original measures to quantify and rank health distributions based on SD, health polarization and inequality indices by using data from the EHIS (2014) and the EU-SILC (2004-2014). The different approaches used are complementary as we are dealing with ordinal variables (SAH) and cardinalization is not necessary in the case of the different measures proposed.

Health inequality is based on the idea of how health is distributed in a country or region. On the other hand, health polarization describes a process in which health indicators (in our case SAH) are concentrated into two separate poles or groups, one healthy (good or very good health) and another one no-healthy (bad or very bad health). Often, this fact has important consequences because there are fewer people in the middle-health group and more in the high and low health groups.

Polarization increases when people shift away for the middle of the health distribution towards the extremes. In fact, polarization is based on the distance from the median value of the distribution. Our polarization index varies between zero and one, where 0 denotes no polarization at all (perfect equality) and 1 indicates absolute polarization. Inequality measures focus on the relative position of individuals within a health distribution. In fact, a coefficient of 0 denotes perfect equality among individuals whereas a coefficient of 1 shows perfect inequality. So, in this paper we show different results based on inequality and polarization measures. Both approaches are complementary to understand health distributions.

The most important findings obtained are the following ones. Firstly, SD can be apllied when ranking social welfare (first order SD) but not when ranking inequality (second order SD). The first analysis is based on cumulative frequencies of reporting health. Results are those expected either by Autonomous Community or by year (most of the individuals report good or very good health). Secondly, inequality and polarization indices are empirically different and do not behave similarly. In fact, higher inequality is not always linked with greater polarization.

We observe several movements and polarization seems to be frequent in Spanish regions. These indices are larger on Canary Islands, Castile and Leon, and Aragon than in Balearic Islands and Cantabria. Obviously, the ranking of the distributions depends on the value of parameter α. In this study, we contrast the Abul Naga-Yalcin inequality index (in the case of symmetry and in the case in which a greater weight is given to inequalities below the median responsiveness) with those polarization indices proposed by Apouey (2007).

Moreover, we have found large differences by Autonomous Communities in terms of polarization, but not in terms of inequality. These results make it clear that polarization measures convey additional information to that contained in social inequality (Kobus 2015; Permanyer and D'Ambrosio 2015). As a consequence, the use of polarization indices in health economics is empirically useful. Even if our findings were intended to show the use of the new measures, they shed some light on the reasons of the rise and decline of polarization for Spanish people.

Besides, using the most recent information from the European Health Survey System, we have obtained different inequality and polarization indices by Spanish Autonomous Communities. In this sense, it is very important to point out that higher inequality is not always linked with greater polarization and the rankings obtain do not differ very much. Undoubtedly, disability issues are linked with social exclusion. This fact implies the inability of individuals to participate in the social or economic political activities of the society in which live. By this way, social exclusion becomes a multidimensional concept that includes situations of poverty, relative privation, unemployment, lack of health care, illiteracy, etc.

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Appendix

Table A1 Polarization and inequality measures by sex

Region	Sex	Health Status					Polarization (P_2)				Inequality	
		Very Bad (h_i=1)	Bad (h_i=2)	Fair (h_i=3)	Good (h_i=4)	Very Good (h_i=5)	α=0.1	α=0.5	α*=0.73	α=0.9	α=β=1	α=1, β=4
Spain	*Male*	1.91	5.98	19.85	52.04	20.23	0.0373	0.1656	0.2267	0.2669	0.6733	0.7918
	Female	3.14	8.6	25.17	46.2	16.89	0.0497	0.2079	0.2769	0.3203	0.6735	0.7916
Andalusia	*Male*	2.62	5.58	18.02	49.41	24.37	0.1048	0.2939	0.3401	0.3653	0.6730	0.7918
	Female	4.71	11.17	24.16	41.36	18.61	0.0649	0.2581	0.3357	0.3827	0.6734	0.7914
Aragon	*Male*	1.41	6.02	20.68	54.02	17.87	0.0726	0.2568	0.3185	0.3531	0.6734	0.7919
	Female	2.53	7.04	27.8	47.29	15.34	0.0878	0.2999	0.3675	0.4048	0.6737	0.7917
Asturias	*Male*	2.87	6.27	19.58	62.4	8.88	0.0495	0.2040	0.2696	0.3102	0.6736	0.7917
	Female	3.72	11.36	25.83	51.65	7.44	0.0981	0.3205	0.3888	0.4270	0.6738	0.7915
Balearic Islands	*Male*	1.54	5.9	14.62	43.59	34.36	0.0588	0.2193	0.2775	0.3112	0.6726	0.7918
	Female	1.42	11.35	22.46	39.24	25.53	0.0571	0.2323	0.3048	0.3492	0.6732	0.7916
Canary Islands	*Male*	2.01	5.84	24.14	54.33	13.68	0.0743	0.2668	0.3326	0.3697	0.6736	0.7918
	Female	2.33	9.17	31.33	46.33	10.83	0.0871	0.3095	0.3840	0.4253	0.6739	0.7917
Cantabria	*Male*	3.44	5.16	20.34	42.12	28.94	0.0594	0.2302	0.2961	0.3352	0.6729	0.7917
	Female	4.08	9.44	19.31	40.99	26.18	0.0586	0.2333	0.3039	0.3468	0.6730	0.7915
Castile and Leon	*Male*	2.06	6.97	19.02	58.16	13.79	0.0579	0.2255	0.2907	0.3295	0.6734	0.7918
	Female	4.19	9.25	32.37	43.35	10.84	0.0777	0.2954	0.3760	0.4225	0.6739	0.7915

Table A1 (continue) Polarization and inequality measures by sex

Region	Sex	Health Status					Polarization (P_2)				Inequality	
		Very Bad (h_i=1)	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**	**α=0.1**	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**
Castile-La Mancha	*Male*	1.9	6.29	21.71	51.24	18.86	0.0954	0.2936	0.3486	0.3783	0.6734	0.7918
	Female	3.58	6.83	27.13	46.76	15.7	0.0842	0.2941	0.3635	0.4022	0.6736	0.7916
Catalonia	*Male*	1.78	6.1	17.18	50.33	24.6	0.1131	0.2974	0.3389	0.3618	0.6730	0.7918
	Female	3.37	9.16	19.81	47.45	20.2	0.0834	0.2819	0.3453	0.3809	0.6732	0.7916
Valencian Community	*Male*	1.9	5.48	19.76	49.17	23.69	0.1002	0.2923	0.3415	0.3681	0.6731	0.7918
	Female	2.41	7.02	26.28	44.82	19.48	0.0737	0.2717	0.3422	0.3824	0.6735	0.7917
Extremadura	*Male*	0.88	6.39	19.16	44.93	28.63	0.0668	0.2428	0.3043	0.3392	0.6730	0.7919
	Female	3.14	8.63	23.14	44.51	20.59	0.0709	0.2645	0.3352	0.3762	0.6733	0.7916
Galicia	*Male*	2.91	8.56	28.92	46.69	12.92	0.0863	0.3031	0.3752	0.4154	0.6738	0.7916
	Female	4.98	12.31	33.33	38.87	10.51	0.0705	0.2834	0.3694	0.4210	0.7554	0.9689
Madrid	*Male*	0.98	4.29	17.86	56.16	20.71	0.0608	0.2252	0.2842	0.3179	0.6732	0.7920
	Female	1.95	5.26	22.54	52.14	18.11	0.0859	0.2814	0.3402	0.3721	0.6734	0.7918
Murcia	*Male*	2.56	6.4	24.31	47.97	18.76	0.0894	0.2935	0.3553	0.3893	0.6734	0.7917
	Female	2.21	8.82	29.41	44.12	15.44	0.0753	0.2825	0.3579	0.4011	0.6737	0.7917
Navarre	*Male*	1.25	5.25	21.5	56	16	0.0648	0.2413	0.3050	0.3416	0.6735	0.7919
	Female	2.29	5.28	22.71	50.46	19.27	0.1122	0.3107	0.3591	0.3856	0.6734	0.7918
Basque Country	*Male*	1.39	5.55	19.06	59.62	14.38	0.0533	0.2115	0.2745	0.3124	0.6734	0.7919
	Female	2.04	6.99	22.13	53.86	14.99	0.0755	0.2672	0.3318	0.3682	0.6735	0.7918
La Rioja	*Male*	1.18	7.96	15.93	59.29	15.63	0.0530	0.2096	0.2719	0.3095	0.6733	0.7918
	Female	2.84	7.39	22.44	53.41	13.92	0.0788	0.2755	0.3409	0.3778	0.6735	0.7917

Source: Authors' elaboration from EHSS (2014).

Table A2 Descriptive Statistics: Analysis of Health Status by education level and region

Region	Educational Level	Health Status				
		Very Bad (h_i=1)	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**
Spain	*Primary*	4.84	13.46	34.4	38.89	8.41
	Secondary_lower	1.53	5.39	19.8	52.64	20.64
	Tertiary	1.04	3.03	13.15	55.89	26.89
Andalusia	*Primary*	7.24	15.54	30.50	36.00	10.71
	Secondary_lower	1.84	5.68	19.66	48.69	24.12
	Tertiary	1.13	2.27	10.96	52.55	33.08
Aragon	*Primary*	3.38	10.70	38.03	39.72	8.17
	Secondary_lower	1.72	5.17	23.71	56.03	13.36
	Tertiary	1.15	3.07	11.88	54.79	29.12
Asturias	*Primary*	5.85	12.57	33.04	43.86	4.68
	Secondary_lower	2.75	11.01	14.68	64.22	7.34
	Tertiary	0.89	5.33	13.78	67.11	12.89
Balearic Islands	*Primary*	1.43	21.90	32.38	34.29	10.00
	Secondary_lower	2.50	7.00	15.50	45.50	29.50
	Tertiary	0.46	2.30	11.98	45.62	39.63
Canary Islands	*Primary*	4.26	13.62	38.94	39.57	3.62
	Secondary_lower	0.65	3.90	23.38	57.79	14.29
	Tertiary	0.73	2.55	18.91	57.09	20.73
Cantabria	*Primary*	7.01	12.42	27.39	40.13	13.06
	Secondary_lower	2.33	6.20	16.28	39.53	35.66
	Tertiary	1.75	4.39	12.28	41.23	40.35
Castile and Leon	*Primary*	4.31	12.35	36.27	41.37	5.69
	Secondary_lower	2.21	5.90	22.51	55.72	13.65
	Tertiary	2.13	4.26	18.54	56.84	18.24
Castile-La Mancha	*Primary*	5.04	10.66	35.27	39.73	9.30
	Secondary_lower	0.47	2.82	16.43	55.87	24.41
	Tertiary	1.61	3.76	15.05	54.30	25.27

Source: Authors' elaboration from EHSS (2014).

Table A2 (continue) Descriptive Statistics: Analysis of Health Status by education level and region

Region	Educational Level	Health Status				
		Very Bad (h_i=1)	**Bad (h_i=2)**	**Fair (h_i=3)**	**Good (h_i=4)**	**Very Good (h_i=5)**
Catalonia	*Primary*	4.96	15.86	30.59	38.95	9.63
	Secondary_lower	2.28	5.19	16.18	53.53	22.82
	Tertiary	1.01	3.18	11.13	55.35	29.34
Valencian Community	*Primary*	4.43	9.48	38.69	38.23	9.17
	Secondary_lower	0.50	7.75	16.00	49.25	26.50
	Tertiary	0.71	3.07	10.38	54.72	31.13
Extremadura	*Primary*	2.41	11.67	29.38	41.25	15.29
	Secondary_lower	2.38	4.17	13.10	50.00	30.36
	Tertiary	0.61	3.07	9.20	52.15	34.97
Galicia	*Primary*	6.99	18.01	42.08	28.88	4.04
	Secondary_lower	1.57	5.49	25.88	54.51	12.55
	Tertiary	1.12	1.87	16.48	56.55	23.97
Madrid	*Primary*	3.57	10.36	35.71	42.68	7.68
	Secondary_lower	1.35	3.81	22.42	52.02	20.40
	Tertiary	0.57	2.26	12.10	60.07	25.00
Murcia	*Primary*	4.93	15.13	38.82	32.24	8.88
	Secondary_lower	0.73	5.49	29.67	50.18	13.92
	Tertiary	2.12	4.66	12.71	53.81	26.69
Navarre	*Primary*	4.13	8.26	34.86	44.50	8.26
	Secondary_lower	0.95	3.79	18.96	56.87	19.43
	Tertiary	0.40	3.56	16.60	54.15	25.30
Basque Country	*Primary*	2.39	14.85	31.83	44.30	6.63
	Secondary_lower	1.09	2.73	21.31	60.66	14.21
	Tertiary	1.52	2.39	13.45	61.61	21.04
La Rioja	*Primary*	4.50	14.86	27.93	47.30	5.41
	Secondary_lower	0.75	7.52	15.04	58.65	18.05
	Tertiary	0.46	2.76	15.21	58.99	22.58

Source: Authors' elaboration from EHSS (2014).

Table A3 Polarization and inequality measures by education level: PRIMARY

	Polarization (P_2)				Inequality	
	α=0.1	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**
Spain	0.0815	0.2772	0.3404	0.3761	0.7555	0.9689
Andalusia	0.0654	0.2728	0.3620	0.4174	0.7553	0.9686
Aragon	0.0776	0.3013	0.3859	0.4347	0.7557	0.9690
Asturias	0.0831	0.3156	0.4017	0.4515	0.7556	0.9688
Balearic Islands	0.0668	0.2776	0.3670	0.4216	0.7555	0.9688
Canary Islands	0.0813	0.3159	0.4048	0.4562	0.7558	0.9689
Cantabria	0.0673	0.2723	0.3566	0.4080	0.6736	0.7912
Castile and Leon	0.0798	0.3092	0.3960	0.4463	0.7557	0.9689
Castile-La Mancha	0.0739	0.2922	0.3776	0.4279	0.7555	0.9689
Catalonia	0.0696	0.2829	0.3708	0.4242	0.7554	0.9688
Valencian Community	0.0757	0.2961	0.3805	0.4295	0.7556	0.9690
Extremadura	0.0690	0.2721	0.3519	0.3993	0.6737	0.7916
Galicia	0.0774	0.3062	0.3972	0.4517	0.7558	0.9686
Madrid	0.0807	0.3072	0.3905	0.4379	0.6741	0.7915
Murcia	0.0708	0.2867	0.3749	0.4281	0.7556	0.9688
Navarre	0.0843	0.3116	0.3917	0.4366	0.6741	0.7916
Basque Country	0.0827	0.3113	0.3949	0.4428	0.6741	0.7914
La Rioja	0.0939	0.3277	0.4061	0.4505	0.6739	0.7913

Source: Authors' elaboration from EHSS (2014).

Table A4 Polarization and inequality measures by education level: SECONDARY LOWER

	Polarization (P_2)				Inequality	
	α=0.1	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**
Spain	0.0358	0.1596	0.2188	0.2578	0.6733	0.7919
Andalusia	0.0924	0.2841	0.3367	0.3651	0.6731	0.7918
Aragon	0.0668	0.2495	0.3157	0.3537	0.6736	0.7919
Asturias	0.0456	0.1928	0.2578	0.2991	0.6735	0.7916
Balearic Islands	0.0676	0.2418	0.3015	0.3354	0.6728	0.7917
Canary Islands	0.0600	0.2305	0.2946	0.3319	0.6736	0.7920
Cantabria	0.0503	0.2022	0.2642	0.3020	0.6726	0.7918
Castile and Leon	0.0675	0.2509	0.3171	0.3552	0.6736	0.7918
Castile-La Mancha	0.0597	0.2178	0.2728	0.3038	0.6731	0.7920
Catalonia	0.0717	0.2471	0.3036	0.3349	0.6730	0.7918
Valencian Community	0.0996	0.2847	0.3304	0.3550	0.6730	0.7919
Extremadura	0.2609	0.3019	0.3239	0.3394	0.6727	0.7918
Galicia	0.0747	0.2694	0.3361	0.3735	0.6737	0.7919
Madrid	0.0857	0.2772	0.3330	0.3630	0.6734	0.7919
Murcia	0.1324	0.3415	0.3893	0.4153	0.6738	0.7919
Navarre	0.0591	0.2224	0.2822	0.3167	0.6733	0.7920
Basque Country	0.0513	0.2049	0.2665	0.3034	0.6735	0.7920
La Rioja	0.0534	0.2084	0.2688	0.3048	0.6732	0.7918

Source: Authors' elaboration from EHSS (2014).

Table A5 Polarization and inequality measures by education level: TERTIARY

	Polarization (P_2)				Inequality	
	α=0.1	**α=0.5**	**α*=0.73**	**α=0.9**	**α=β=1**	**α=1, β=4**
Spain	0.0315	0.1406	0.1928	0.2273	0.6728	0.7920
Andalusia	0.0722	0.2312	0.2753	0.2981	0.6726	0.7920
Aragon	0.0611	0.2150	0.2653	0.2929	0.6727	0.7920
Asturias	0.0366	0.1569	0.2112	0.2459	0.6733	0.7919
Balearic Islands	0.0622	0.2150	0.2632	0.2891	0.6724	0.7921
Canary Islands	0.0576	0.2170	0.2752	0.3087	0.6732	0.7920
Cantabria	0.0501	0.1938	0.2490	0.2816	0.6723	0.7919
Castile and Leon	0.0597	0.2255	0.2868	0.3224	0.6733	0.7919
Castile-La Mancha	0.0659	0.2313	0.2856	0.3156	0.6729	0.7919
Catalonia	0.0584	0.2084	0.2585	0.2862	0.6727	0.7920
Valencian Community	0.0602	0.2102	0.2583	0.2844	0.6726	0.7920
Extremadura	0.0744	0.2317	0.2729	0.2937	0.6725	0.7920
Galicia	0.0573	0.2124	0.2676	0.2989	0.6730	0.7920
Madrid	0.0453	0.1773	0.2286	0.2588	0.6729	0.7921
Murcia	0.0675	0.2324	0.2850	0.3140	0.6728	0.7918
Navarre	0.0670	0.2337	0.2877	0.3174	0.6730	0.7920
Basque Country	0.0437	0.1757	0.2294	0.2619	0.6730	0.7920
La Rioja	0.0500	0.1936	0.2485	0.2808	0.6731	0.7921

Source: Authors’ elaboration from EHSS (2014).