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TRENDS IN HEALTH POVERTY: A DECOMPOSITION ANALYSIS FOR SPAIN, 2008-2016

TENDENCIAS EN LA POBREZA EN SALUD: ANÁLISIS PARA ESPAÑA, 2008-2016

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ABREVIATIONS

ACI: Absolute Concentration Index

BHPS: British Household Panel Survey

CHU: Clark, Hemming and Ulph

CI: Concentration Index

CN: Continuity

CU: Consumption Unit

ECHP: European Community Household Panel

ENS: *Encuesta Nacional de Salud*

ESS: European Statistical System

EU-SILC: EU Statistics on Income al Living Conditions

EUROSTAT: Statistical Office of the European Communities

FGT: Foster-Greer-Thorbecke

GE: Generalized Entropy

HILDA: Household, Income and Labour Dynamics in Australia

MDGs: Millennium Development Goals

MN: Monotonicity

MTP: Multidimensional Transfer Principle

NHIS: National Health Interview

OECD: Organisation for Economic Co-operation and Development

OLS: Ordinary Least Squares

OTP: One Dimensional Transfer Principle

PG: Poverty Gap

QALYs: Quality-Adjusted Life-Years

QoL: Quality of Life

SAH: Self-Assessment Health

SD: Subgroup Decomposability

SF-6D: Short-Form Six-Dimension

SoFIE: Survey of Family, Income and Employment

WHO: World Health Organization

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ABSTRACT

The aim of this study is to analyse the trend in health poverty in Spain from micro-data that come from the European Union Statistics on Income and Living Conditions. This survey provides the individual self-assessment health variable, on which this paper is focused. This variable has five traditional levels of health, ranging from “very good” to “very poor”. The data, used in this project, provide information on approximately 30,000 individuals each year. In addition, it has been selected for a nine-year period, from 2008 to 2016.

The analysis of the trend in health poverty by means of self-assessment health is carried out by the poverty index developed by Foster-Greer-Thorbecke: FGT index. In addition, it is made statistical inference. Finally, this index is decomposed to obtain the contributions of health inequality determinants. Thus, it is possible to make comparisons across years.

The results show a negative growth of health poverty in Spain, whether a poor self-reported health status is chosen as a poverty threshold. Meanwhile, all the indices point out a positive growth of the health poverty in Spain, when a fair self-assessed health status is selected as a poverty threshold.

Furthermore, in terms of determinants, health inequalities can be explained, to some extent, by some determinants such gender, age, education level or income, among others. The results suggest inequalities in health, favouring male population, younger age groups, individuals with high education level and high income as well as employed and no single population.

In conclusion, it can be affirmed that the results are consistent with the period studied. This is because this paper analyses the whole period of the Spanish economic crisis.

Key words: self-assessment health, inequality in health, health poverty, FGT index, Spain.

RESUMEN

El objetivo de este estudio es analizar la tendencia de la pobreza en salud en España a partir de microdatos que provienen de la Encuesta de Condiciones de Vida. Dicha encuesta provee la variable de autoevaluación de la salud del individuo, en la cual se centra este trabajo. La variable cuenta con cinco niveles, que van desde “muy buena” hasta “muy mala” salud. Los datos utilizados en este estudio proporcionan información acerca de, aproximadamente, 30.000 individuos cada año. Además, se han seleccionado para un periodo de 9 años, concretamente, desde 2008 hasta 2016.

El análisis de la tendencia de la pobreza en salud a través de la autovaloración de salud se realiza mediante el índice de pobreza desarrollado por Foster-Greer-Thorbecke. Además, se realiza inferencia estadística. Por último, se procede a la descomposición de dicho índice para obtener la contribución de los determinantes de desigualdad en salud. Así, es posible realizar comparaciones a lo largo de los años.

Los resultados muestran un crecimiento negativo de la pobreza en salud en España si se elige un mal estado de auto-evaluación de la salud como umbral de pobreza. Mientras tanto, todos los índices calculados señalan un crecimiento positivo de la pobreza en salud cuando se supone un estado de salud normal como umbral de pobreza.

Además, los hallazgos indican que las desigualdades en salud, en cierta medida, son explicadas por determinantes como el género, la edad, el nivel de educación o los ingresos, entre otros. Estos resultados sugieren desigualdades en salud, favoreciendo a los hombres, a los grupos de menor edad, a los individuos con alto nivel de educación y altos ingresos, así como a aquellos que son asalariados y no están solteros.

En conclusión, se puede afirmar que los resultados son coherentes con el periodo analizado. Es decir, se examina el periodo de tiempo que comprende la actual crisis económica española.

Palabras clave: autoevaluación de salud, desigualdad en salud, pobreza en salud, índice FGT, España.

1 INTRODUCTION

The right to health executes an important role in human rights. Originally, the idea of right to health is focused on the fact of curing the disease that the individual suffers, according to their demand. Nowadays, it is understood as the right to be healthy through the availability, efficiency and effectiveness of appropriate resources and, thus, achieving a health care of sufficient quality for all citizens. In other words, it is focused on the cure of the disease and it also tries to prevent it (Montiel, 2004; Ase and Burijovich, 2009). From the social point of view, the right to health can be considered as a method to include people in society. From the economic point of view, it enables the productive development of the territories (countries, regions, areas, etc). Meanwhile, from the ethic point of view, it stipulates the duty of being equitable, unless there is an unequal distribution that benefits the most vulnerable people (Acuña, 2005).

The main objective of the right to health is that the individual can obtain the best possible protection. This involves guaranteeing the full enjoyment of both physical and mental health at its highest level. This is achieved by analysing progress and difficulties in relation to mortality, disease and disability as well as the life-style of individuals and reproductive health (Acuña, 2005). In other words, the right to health aims to preserve the lives of all citizens as functional as possible. Besides, it includes the whole population for the simple reason that they were born and, therefore, they have right to health (De Currea-Lugo, 2005). The best way to do this, is by the universal health coverage. However, the vulnerable people, who are socially and economically marginalized and disadvantaged, are less likely to have this right. This population group has major difficulty in accessing and enjoying health services, as well as higher rates of mortality and morbidity. It can be interpreted as this group of the population is excluded from the use of essential services to attend to their health care needs. This denies them to enjoy the right to health and represents the existence of an inequality in the use and distribution of health services (Acuña, 2005; González Vélez, 2009).

No human being is, by nature, vulnerable. Nevertheless, the socio-economic level lead a person to that situation in terms of health. Every year, approximately, 100 million people around the world live below the poverty threshold because of health expenditure. Vulnerable and marginalized groups, generally, suffer more health problems than the rich (World Health Organization (WHO), 2015). Besides, persisting health problems are related with increases in the risk of unemployment and long-term poverty (Wilkinson, 1992; Smith, 1996; Danziger and Haveman, 2001; Blackwell et al., 2014). This involves a risk to people's health because it also implies a large range of health problems as a higher mortality (Alder and Newman, 2002). In this way, socio-economic inequalities are like a "social gradient", where those people with better socio-economic level have better health. Meanwhile, these inequalities leave poor people in a situation where they are more vulnerable in regarding health issues (Graham, 2006). The equitable health distribution can be defined as "*one where access to health has not been determined by socio-economic status or income*" (Bommier and Stecklov, 2002).

For hundreds of years, a relation between health and socio-economic level has been analysed. Health outcomes are often affected by socio-economic condition and vice versa. In addition, health status and poverty are negatively associated. In other words, living in poor health aggravate the economic situation that implies poverty and poverty implicates poor health. When talking about poverty, we refer to socio-economic level, which is measured for the most part by income, education, occupation or social class, among others. The economic situation of the households usually influences on several needs such as medical care or the reduction of their savings as well as educational attainment level or physical and emotional well-being, even if it is short or long-term.

A way of studying the relationship between health and socio-economic status is through SAH, which is considered a subjective health measure. This is due to the state of health perceived by each individual depends on different aspects of health, objective and subjective, that combine in a general framework of their own perception (Brook et al., 1979). In order to analyse this topic, many general population surveys include a measure of SAH. This measure represents one of the most commonly used health indicator. It consists in asking the following question: how is your health in general? Respondents are asked to rate their own health. When respondents answer the survey question about SAH, they assess their true health and project it into a scale. The replies usually vary according to the different categories, ordered from 1 (very good) to 5 (very poor).

This paper focuses mainly on health poverty based on the individual's self-assessed health (SAH) status. In addition, health poverty is analysed by income as the most of the existing literature. In this way, health poverty can be defined from different points of view. In the case of SAH, it is understood that, an individual assesses their own health as poor if they believe that other person of the same gender, age, education level or income, is much healthier than them. On the other hand, in the case of income, it is understood that an individual is poor in health when their income is below the established poverty threshold.

In recent years, there has been an increase of attention in studying the issue of status of the population, as well as their changes over the time. This is due to the fact that, as explained earlier, socio-economic condition of an individual, among other factors, interferes in their health. Nevertheless, there is still not a lot of studies of SAH. The reason could be either the lack of relevant data or the poor quality of data.

Some authors are sceptical about the use of subjective health measures, as SAH, instead of objective measures and there has been a discussion about its validity. Supporting subjective health measures are Butler et al. (1987). They understand that health status is a valid indicator of real health. Likewise, Johnston et al. (2009) argue that self-rated health is a relevant predictor of mortality within countries. In general, this type of health measures has a great capacity to cover and to summarize a large part of health conditions (Hernández-Quevedo et al., 2004). Therefore, it should not disregard health data obtained through the individuals' self-assessment as it provides valuable information about their well-being. So, whether it is used with caution, SAH data are appropriate in health welfare and health economics research (Ahn, 2002).

However, other authors argue that the perceived health status does not have to agree with the current health status and, therefore, it is preferable a more objective health measure (Le Grand, 1987; Bound, 1991; Sen, 2002). As has already been said, this is a subjective measure and, so, it is strongly correlated with a set of clinical health conditions. Therefore, these health conditions can be appreciated differently by the population according to their own individual characteristics as well as the cultural and social context. However, this can cause measurement errors and several biasing factors (Knäuper and Turner, 2003; Van Doorslaer and Jones, 2003). In terms of these measurement errors, they can occur because of the current health of the respondents may vary according to their characteristics. In other words, response behaviour varies among population groups. Respondents, with the same real heath status, may have different response styles or different reference points when they evaluate their overall health. This also generates an identification problem, confusing the fact of making distinctions between the differences in true health and the differences in reporting behaviour. In this way, the measurement of social inequalities in health can be biased (Groot, 2000; Sadana et al., 2002; Crossley and Kennedy, 2002; Jürges, 2006).

So, it is necessary to analyse the socio-economic status of an individual to determine the causes that interfere with health. Similarly, it can be analysed the social, political and economic situation of a country, as well as the efforts of the governments to assess and

recognise health issues. The final objective should be the end of inequality between social groups. That could be achieved through a rational and equitable proposal in regard to socio-health care. This requires to make decisions and to act in ways that ensure the effective and equitable implementation of health strategies. These strategies should be based on the principles and rules laid on international human rights law (Ase and Burijovich, 2009; Flores Sandí, 2012).

As far as it is known, this is the first paper that analyses the trends in self-rated health for the case of Spain, using poverty indices. So, this is what distinguishes this paper from previous contributions.

The aim of this paper is twofold. The first purpose is to analyse trends on the individual health status in Spain measured subjectively (SAH). The period that has been analysed is between 2008, which is the first year in which data is available, and 2016. For this purpose, it is used data provided by the EU Statistics on Income al Living Conditions (EU-SILC). The EU-SILC includes a measure of SAH. In other words, among health variables, individuals are asked to assess their own health status and to arrange it on a five-category scale. This is the key health variable because it provides additional information concerning health. The second purpose is to decompose some socio-economic determinants of individuals to see how these affect health inequalities

The paper is organised as follows. In the following section, it is introduced a review of studies interested in analysing inequalities in health. Section 3 describes some methods proposed in literature to measure such inequalities. Next, it is provided a description of the data source used. Then, the main results of the analysis of health inequalities are presented, among the ones it could be highlighted those obtained with FGT index as well as with the subgroup decomposition. The paper ends with discussion and conclusions in the last two sections.

2 SELF-ASSESSMENT HEALTH & POVERTY: A SURVEY

The WHO comes to the conclusion that social determinants are responsible for the existence of health inequality. Some significant factors that influence health are education, socio-economic status, place of residence, race, marital status or ethnic origin (Van Doorslaer and Jones, 2003; Marmot, 2005; WHO, 2014).

Differences in health status as well as inequalities in health by socio-economic condition have been studied for a long time. Below, some evidence regarding the literature is described in detail, divided into three large blocks. On the first place, it is described those articles that revolve around the relationship of inequality between health and income in general. Secondly, it is specified the studies related to mortality and morbidity. Finally, the essays concerning the main determinants of SAH are collected. This literature is detailed in Table 2.1.

In respect of the studies based on the inequalities between income and health in general, there are some essays, which prove that health tends to be worse in those societies with greater income differences (Subramanian and Kawachi, 2004; Wilkinson and Pickett, 2006; Thoits, 2011; Pickett and Wilkinson, 2015). The study conducted by Van Doorslaer et al. (1997) makes a breakthrough in the research on this topic. They examine the relative income-related inequalities in health in nine countries around the world: Finland, Germany (West and East), the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States. Such a purpose, they use SAH as a health measure. The number of response varies between three and five categories, depending on the survey selected for each country. Moreover, individual respondents are classified by equivalent household income. As a result, they obtain that in all nine countries there are statistically significant inequalities, favouring the groups with higher income. The Nordic countries (Sweden and Finland) have the smallest degree of health inequality. To these countries, may be added other such as Germany, the Netherlands, Switzerland and Spain. Meanwhile, the highest income-related health inequality is found in the United States, followed by the United Kingdom. In order to complement the analysis, they add other variables to the regression. They do this to explain a part of the variation in health inequality, which cannot be explained by income inequality. Although these variables are not significant.

In the same thematic line, it is found the study carried out by Lawson (2004). He examines the connection between poor health and other characteristics of poverty for the case of Africa, in particular for Uganda. He makes reference to the Millennium Development Goals (MDGs), which aim is to reduce extreme poverty, among others. His results shows that, between 2002 and 2011, 61 percent of the countries of sub-Saharan Africa do not have adequate data to control poverty trends. In the last decade, in that region, poverty rate has reduced. Nevertheless, by 2015, more than 40% of its population still live in extreme poverty. As other authors emphasize, Lawson says that low income is associated with higher levels of poor health and long-term illness. Moreover, the poor health of a household man has negative and significant effects on the welfare of the rest of the household.

Extending their previous study, Van Doorslaer and Koolman (2004) analyse health inequality related to income in thirteen European countries. To this end, they collect data from the European Community Household Panel (ECHP) for the year 1996. They use respondents' SAH as the measure of general health status. The results suggest the existence of inequalities between income and health, which favour the rich population in all countries. Besides, lower income inequality helps to reduce health inequalities. Some European countries (Austria, Belgium, Germany, Ireland, Italy, the Netherlands and Spain) achieve much lower degrees of health inequality than others. By contrast, they are higher in Denmark, Portugal and the United Kingdom. They also made the subgroup

decomposition, demonstrating that income is the most important factor. In addition, demographic variables, education, employment status and region are the main contributors to health inequality.

According to Jack Jr (2007), he focuses his study in the rural area of Mississippi because it is one of the poorest states. On the basis of his results, Jack Jr find out that poverty affects both education and health. Besides, the population of this state suffers an important loss of employment. This is the reason why the annual income is smaller and, therefore, less people is able to get medical insurance. He affirms that the poor population is more prone to not have medical insurance than the rich as well as to have a worse Quality of Life (QoL). However, it is not so clear that the poors' health gets worse as the gap between rich and poor population increases.

Meanwhile, Tubeuf (2008) uses three appropriate indicators to measure health inequalities related to income in France in 2004. In the first place, he uses the measurement approach developed by Van Doorslaer and Jones (2003), which will be discussed later for the case of France. Second, a method adapted to this approach based on a health distribution for the French population. Specifically, he uses the Short-Form Six-Dimension (SF-6D[1]) utility algorithm to estimate a health measure based on the French Short-Form (SF-36[2]) Questionnaire. Finally, he considers the continuous health index used by Tubeuf and Perronnin (2008), making an analysis decomposition of the inequality in health. The results indicate that both, a high education level and a high socio-economic status, imply that health inequality is related to income. That is why the analysis presents these inequalities to the detriment of the socially poorer groups.

On one hand, Buddelmeyer and Cai (2009) use the HILDA to examine the evolution and the causal relationship between health and poverty. Their results indicate that households headed by a person with poor health are more likely to be in poverty than the ones headed by a healthy person. A man, whose family is poor in a specific year, is more likely to be ill the following one than a man, whose family is well-positioned economically. On the other hand, they indicate that unobservable health determinants are negatively correlated with poverty factors. They also determine that there is persistence over time in both poverty and health, but the degree is greater in the first one than in the second. In conclusion, health and poverty are affected by other unobservable characteristics, making health endogenous to poverty.

In turn Carroll et al. (2011) analyse the New Zealand Values Survey, which supplies information of New Zealanders' sensations about socio-economic inequalities. It also provides information on the wishes of the citizens about what the government should do to improve that situation. They investigate specifically poverty and inequality as well as their implications in health in New Zealand. The majority of the survey respondent think that government must reduce income differences between poor and rich people and to guarantee a decent standard of living for old population. The results show that there are more poor people now than it was 10 years ago. In addition, this population is poor due to laziness and lack of willpower. On the other hand, they are disposed to pay a higher tax whether better health services and better quality of life for elderly and disabled people are achieved.

Ásgeirsdóttir and Ragnarsddóttir (2013) measure to what extent has been achieved the aim of public health care (to produce health and to decrease variation in health by socio-

[1] It is designed by Brazier et al. (2002) from the SF-36 questionnaire. It is composed by 6 dimensions (physical functioning, role limitations, social functioning, pain, mental health and vitality). Each dimension has different levels, reaching 18,000 possible health states.

[2] It is a questionnaire derived from 36 questions and gives scores in 8 areas of health. The ratings are transformed into a scale of 0-100, where 0 is very poor health and 100 is very good health. Some authors say it is a valid measure of health (Jenkinson et al., 1996; Ware et al., 2005).

economic status) in 26 countries of Europe. Data come from the EU Statistics on Income and Living Conditions (EU-SILC) collected in 2007. Such a purpose, they calculate the Concentration Index (CI) and the Absolute Concentration Index (ACI). In addition, CIs are decomposed and the determinants' contributions to health inequality are calculated. The results show that largest income-related health inequalities are found in Nordic countries. Meanwhile, the lowest inequalities are in North-Western and Southern Europe. In the majority of high-income countries, individuals value their health better, except Cyprus and Greece. Males usually report better health than females. In addition, health gets worse with age. Those countries with higher level of education report better health. Being unemployed, retired, disabled or part-time worker is positively related to poor health. Meanwhile, being at risk of poverty is associated with poor health in most countries. In short, the results indicate the existence of inequality in health related to income in all the European countries studied, favouring those with higher income.

On the other hand, Gunasekara et al. (2013) analyse the differences in income-related health inequalities between New Zealand and Australia. Besides, they examine the determinants of these inequalities by decomposing them. To this end, they used two panel surveys: The New Zealand Survey of Family, Income and Employment (SoFIE) for the years 2008 and 2009 as well as the Household, Income and Labour Dynamics in Australia (HILDA) for 2008. Differentiating by gender, the results show general health values that decrease with age in both men and women in HILDA and men in SoFIE. Meanwhile, mental health values increase with age in both surveys, in males as well as females. CIs generate positive results. This means that health inequalities favour high-income groups and disadvantage the poor. In addition, the Australian sample shows a greater inequality. In terms of decomposition analysis of general health, it is obtained that, the effect of living in deprived areas and being inactive, increases the inequality in health, favouring the rich. In respect of mental health, the determinants that contribute most to inequality are labour force status, income and area deprivation as well as marital status.

In addition, Simões et al. (2016) propose a specialized algorithm to transform the information suggested by the National Health Survey to EuroQol-5D[3] with data from Portugal. First of all, they evaluate the poverty, wealth and health inequality. Furthermore, they assess the determinants of health inequalities through an ordered probit model. His results suggest that there is an important level of health inequality, highlighting education and income as important determinants. The place of residence also influences. They emphasize the aging of the Portuguese population because age is negatively correlated with health, which generates more inequality.

Also, Coley et al. (2017) analyse the risks of poverty but focusing his study in American teenagers with an average age of 16 years old. This study ties in income, mental health and young people behaviour according to their school and family context. School income is the most prevalent indicator of mental health and behaviour problems. Also, it is negatively associated with depression and anxiety symptoms for both girls and boys. With regard to intoxication and property crime, they are positively correlated with family income and attendance at schools of higher social class. Meanwhile, depression, anxiety and violence symptoms are more common in teenagers, who go to poorest schools. In conclusion, it can be assumed that both scholar and family context have a significant importance in the teenagers' behaviour and health risks.

Nosratabadi et al. (2017) research the poverty of households in Iran, Specifically, they are focused in those with children, due to the high costs of having children. They use the

[3] It is an instrument that evaluates the QoL. It has 5 dimensions (mobility, self-care, habitual activities, pain/discomfort and anxiety/depression). It is possible to find 243 states of health. The health status varies from 0 (worst health status) to 100 (best health status).

Foster-Greer-Thorbecke (FGT) index. Their results suggest that, in the late 1990s, the health poverty rate reached the largest values for all children age groups. However, there are fluctuations across the time. In the last years analysed, the greatest health poverty rate corresponds to those households with children between 11 and 15 years old. Finally, they conclude that there are not strong government policies to reduce health expenditure to which the Iranian population is subjected.

It can be said that some countries present inequalities in both mortality and morbidity as well as in life expectancy among individuals with higher and lower socio-economic status. These inequalities usually vary between 5 and 10 years in average life expectancy at birth as well as between 10 and 20 years in life expectancy without disability (Leinsalu et al., 2008; Tarkiainen et al., 2011; Mackenbach et al., 2015).

McDonough et al. (1997) study the evolution and the causal relationship between health and poverty, but focusing their study on the comparison between poverty and mortality. They investigate the joint dynamics of mortality and income in American families through the Panel Study of Income Dynamics from 1968 to 1989. Their results confirm that some socio-economic indicators have an inverse relationship with mortality and they are a main consequence of it. Whether education and disability are added to the estimation, the effect of income on mortality risk is reduced, concretely, in those population under 65 years old. In contrast, gender and race do not have effect on income level. They determine that the health of the population who are always poor is worse than the health of the people who is always rich. Specifically, this happens on the population over 65 years old, with low education level, who are not white and who overcome poverty or become poor over the time. They have a very similar health risk to those who have always been poor. In conclusion, increases in household income may lead to improve health results, which could be achieved through some various policy interventions.

In addition, Mackenbach et al. (1997) study inequalities in mortality and morbidity in Western Europe. To that end, they use odds ratios, the relative index of inequality and the index of dissimilarity. As variables, they use some of health nature (mortality and self-rated morbidity) and other socio-economic (income, education and occupational class). The results highlight that countries like Norway and Sweden have greater inequalities in morbidity within countries, for men, than most other countries. The same is true for France, if mortality is the health measure. Still on the theme of mortality, Sweden and Norway have low mortality rates among middle-aged men. The opposite is applied to Finland. In terms of the relative index of inequality, it shows variation between countries for perceived general health by education for both men (inequalities are larger in Great Britain, Spain and Nordic countries) and women (inequalities are larger in Sweden). In conclusion, in all countries, risks of morbidity and mortality are higher in the lower socio-economic groups.

A similar study about socio-economic inequalities in health, in eleven Western European countries, is carried out by Cavelaars et al. (1998). They are mainly focused on differences in self-reported morbidity among individuals with high and low education levels. They use the Relative Index of Inequality (RII) to measure socio-economic health inequalities. They take into consideration that there might be differences in survey questions on perceived health. In general, the size of health inequalities varies across countries. Those inequalities are small in Germany, Spain and Switzerland and large in Denmark, Norway, Sweden and the Netherlands. More specifically, high prevalence rates for self-rated morbidity, chronic conditions as well as long-term disability and illness are observed among people with lower education level. In fact, in the more “open” countries, the education level achieved depends more on personal characteristics. Focusing on inequalities in morbidity, the Scandinavian countries and the Netherlands presents larger results. This is because those countries have higher socio-economic gradients.

Additionally, Gerdtham and Johannesson (2000) analyse how life expectancy changes with income. They use data from Statistic Sweden's Survey of Living Conditions for randomly selected individuals aged 16-84 years. The sample consists of 43.366 individuals. They perform an Ordinary Least Squares (OLS) regression, in which the dependent variable is the Quality-Adjusted Life-Years (QALYs) and the independent variable is the three-point health rating question (poor, fair and good health). Besides, they add the following independent variables: age, age-squared, gender and income. In their analysis, men and women are separated. As a result, they obtain inequalities in health, favouring the groups with higher income. Also, it is shown that income-related inequalities increase with age, being greater in the oldest age-groups. In particular, for men, the relative difference in QALYs grows from 8% in the youngest age-group to 44% in the oldest one, between the highest and the lowest income decile. Meanwhile, this is similar for women, where the difference increases from 7% to 37%.

In addition, Mackenbach et al. (2015) analyse the changes in mortality by socio-economic status in European countries. Education indicates the socio-economic status. There is a growing inequality in health, both within each analysed country and between them. As a result, they obtained an increase in the relative inequality in premature mortality in most European countries since 1990. However, it is also commented a reduction in the population with lower education level. Finally, they emphasize the contrast between the South and the East of Europe. The former group of countries present small inequalities while the second group of countries present greater inequalities.

The SAH variable, in which this paper is focused, has been widely used to study the relationship between health and socio-economic status. The literature shows that SAH also provides an instrument for predicting mortality and morbidity. Kaplan et al. (1996) study the relationship between inequality income distribution and health results (mortality among them) in the United States. They establish the connection between income inequality and all factors age-related mortality as well as unemployment and prison rates, work disability and people who do not have medical insurance, among others. They also highlight that economic policies, which increase income inequality, may have a damaging effect on the population's health. The states, with a higher inequality of the income distribution, spend less money per person on education and, therefore, have a worse academic result. This is associated with a higher cost in medical care for each individual. So, governments must solve this situation.

Van Doorslaer and Jones (2003) carry out their study focusing on the fact that low-income people are more likely to report lower SAH than the higher-income groups. The data used come from the Canadian National Population Health Survey 1994-1995. They analyse the answers obtained to the SAH question, "how do you rate your health status in general?" They use a new approach, specifically, the McMaster HUI[4], to study these answers. The analysis indicates that between the 30 and 40% of SAH inequalities by income are a consequence of the income distribution. Furthermore, it has an independent and significant relationship with health status. Other elements that contribute to this are the unemployed (fundamentally, due to disability and/or to retirement) and the education level. These results are affirmed by the research made by Humphries and Van Doorslaer (2000), who confirm the existence of health inequalities in favour of the rich population of Canada.

Furthermore, Hernández-Quevedo et al. (2004) investigate the relationship between SAH and socio-economic status, using the longitudinal data collected in the British

[4] It is a multi-attribute classification system, which serves to describe the health status. It provides detailed, real and valid measures of health status. It is commonly used in clinical studies (Horsman et al., 2003).

Household Panel Survey (BHPS). They are focused on individual dynamics and heterogeneity in individual's responses to the SAH question. The results indicate that there is a decrease in reporting of better health status from 1991 to 2001. Focusing on determinants such as educational attainment, people with higher education levels report better health. In terms of income, lower income individuals are more likely to report a poor lever of SAH than higher income groups. Finally, in respect of age, as the population gets older, they report a worse health. Furthermore, the short-term and the long-term, CI are positive, indicating that the income-related health inequality favours the rich population in all periods. Meanwhile, the mobility indices are negative, pointing out that the level of long-run of inequality between income and health is greater than it would be in case of using transversal data.

Similarly, Etilé and Milcent (2006) also analyse the heterogeneity of income-related information in SAH question but, in this case, in France. The data to address this question are collected from the Conditions de Vie des Ménages survey. Specifically, they assume that clinical health is the objective result of public health policies. Therefore, they consider the heterogeneity of information as a bias. In other words, SAH is a biased measure of clinical health. Their results show that, the choice of a fair or good health status is the most affected by heterogeneity, which can bias the measure of health inequality. Furthermore, for low-income population with poor SAH, income significantly affects SAH through clinical health. Meanwhile, a decrease in income has a negative report on the rich population, who communicates good or very good health. In general, the effect of an increase in the income on SAH differs according to the individual's initial level of income and SAH.

On the opposite side, Jürges (2006) studies if the socio-economic characteristics of respondents have an effect on mortality, conditional on SAH. He collects data from the German Socio-economic Panel (SOEP) between 1992 and 2003. However, his results point out that richer respondent tend to underestimate their clinical health in their health assessment. Besides, he concludes that SAH has a strong effect on mortality. Conditional on SAH, women live longer than men. Similarly, conditional on the number of nights spent in hospital, women are less likely to die than men. In the same way, female mortality rates tend to be less affected by economic status than male ones. On the other hand, older respondents are less healthy than younger ones. So, mortality increases more heavily in age than it does for SAH. Education has a positive effect on survival at all ages. It also has a strong positive relationship with SAH only for men. Meanwhile, wealth has a weak positive relation to SAH for both, men and women. Finally, being married seems to be beneficial for men' health.

Meanwhile, Mackenbach et al. (2008) continue their project of 1997 and they compare inequalities in SAH and mortality. To the countries analysed in the previous study, others from Eastern Europe are added. In this way, it is possible to determine if countries, that have made a political, economic and health reform, have greater health inequalities than other countries in Europe. To this end, they use the relative index of inequality and the slope index of inequality. Their results show that the lowest socio-economic inequality in health, based on mortality, is found in Southern Europe. Meanwhile, the highest is in Eastern Europe. On the other hand, if SAH is considered as the health measure, these inequalities are larger in the Nordic countries and England. Across Europe, mortality is higher in those countries with less education. Education-related mortality inequalities are higher in most countries in the Eastern and Baltic regions and lower in the Southern Europe countries. Meanwhile, education-related inequalities in SAH are below the European average in Italy, Spain and the Baltic region. Smoking, obesity, excessive alcohol consumption and deficiencies in health care represent some of the immediate determinants in health inequality.

Brzezinski (2015) analyses the trends in self-reported health poverty in Great Britain from 1991 to 2008. The data used come from the BHPS such as incomes, education, household structure and conditions, etc. As a result of his study, whether it is chosen a fair self-rated health status as the poverty threshold, health poverty rate get will increase in Britain. Furthermore, if it is chosen a higher health poverty threshold, poverty will increase too and it will be statistically significant. Focussed in decompositions, the most important poverty effects are health poverty as well as the proportion of persons cohabiting.

Doiron et al. (2015) help to understand better what a SAH measure represents for real health. The report adopts an empirical approach to see if SAH predicts future health results as well as specific diseases. To this end, it has data from the 45 and Up Study, which is a cross-sectional survey of Australian non-institutionalized individuals aged 45 and older. Specifically, it is focused in the state of New South Wales for 2007 and 2008. They focus on two questions about SAH and the QoL of individuals. Their results show that there is a significant positive relationship between worse SAH and the use of health care services. In addition, a lower QoL slightly reduces future health care use, except hospitalizations. In terms of gender, SAH is more predictive of the future use of health services by women than men. They state that SAH represents accurate real health and the variations in SAH reflect variations in the use of past health care services. They also explain that SAH has health content and predict future health. Finally, they find evidence that the effects of poor SAH are big for cancer and diseases of the respiratory and endocrine systems. Meanwhile, it is less predictive with diseases of the skin, eyes and ears. To analyse mental health, QoL is a more appropriate measure than SAH, which does not capture all mental health problems.

In line with SAH and the subjective health indicators, Ivaldi et al. (2017) present an objective and a subjective health indicator for EU countries. They conduct a very similar study to that of Mackenbach et al. (2015). What they intend with this, it is to analyse the relationship between health and income distribution through factor analysis and Pena distance[5], a non-parametric method and another parametric, respectively. They create a ranking for each index according to the score obtained by each factor. With regard to the measurement of objective health, the 10 first countries classified belong to the Northern and Continental Europe as well as the Mediterranean. Meanwhile, in the subjective health ranking, it lists some countries of the Centre and North of Europe as well as one of the Mediterranean (Spain). Their results show that subjective health seems to be related to the territory where population live. It may depend, principally, on the optimism of the individuals as well as economic expectations, the availability and affordability of medical care. The opposite happens with objective health. This means that it does not seem to be related to territory. This type of health tends to be better in those countries with a high GDP per capita and worse when some factors (lifestyle or diet) influence. Finally, they conclude that there is an indirect relationship between health and income distribution.

As a conclusion of the studies that analyse the SAH, it can be affirmed that the magnitude and the sign of the heterogeneity appear to be country-specific.

[5] This technique allows comparison of regions, based on information obtained a group variables or partial indicators. Thus, it is achieved a territorial ranking according to the goal that is to be measured (Holgado Molina et al., 2015).

Table 2.1. Characteristics of the studies about poverty review.

AUTHORS	YEAR	COUNTRY	METHODOLOGY	MAIN RESULTS
Kaplan et al. (1996)	1980, 1990	The United States	Pearson correlation coefficients.	Significant correlation between income inequality and mortality, work disability, homicide, …
Mackenbach et al. (1997)	1985-1992	Western Europe	Odds ratio, the relative index of inequality and the index of dissimilarity.	In all countries, risks of morbidity and mortality are higher in the lower socio-economic groups.
McDonough et al. (1997)	1968-1989	The United States	Pooled and logistic regression.	Low income is a consequence for mortality, especially for persons <65 years.
Van Doorslaer et al. (1997)	All the surveys (1980s) except SWE (1990) and GER (1992)	Europe	Concentration Index.	Statistically significant income-related inequalities in health in all the countries analysed, favouring the groups with higher income.
Cavelaars et al. (1998)	1985-1993	Western Europe	The Relative Index of Inequality.	The size of health inequalities varies across countries. Those inequalities are small in Germany, Spain and Switzerland and large in Denmark, Norway, Sweden and the Netherlands.
Gerdtham and Johannesson (2000)	1980-1986	Sweden	Health Concentration Index.	Income-related health inequalities increase with age.
Humphries and Van Doorslaer (2000)	1994	Canada	Ill-health Concentration Index.	Inequalities in health exist in all socio-economic status, but favour the rich.
Van Doorslaer and Jones (2003)	1994	Canada	OLS, ordered probit and interval regression approaches.	Significant inequalities in SAH by income and favour the better-off.

Table 2.1. Characteristics of the studies about poverty review. (Continuation)

Hernández-Quevedo et al. (2004)	1991-2001	The United Kingdom	Concentration Index of health inequality and of mobility in health.	The report of a worse health status increases with age, lower education level and lower income. So the rich population is favoured in all periods.
Lawson (2004)	1992, 1999	Sub-Saharan Africa	Descriptive data.	Income poverty is associated with higher levels of ill health and long term sickness.
Van Doorslaer and Koolman (2004)	1996	Europe	Health Concentration Index.	Income, education, labour force status and region are the most important factors in health inequality. There are differences between countries.
Etilé and Milcent (2006)	2001	France	Generalised ordered probit model.	The effect of an increase in income on SAH differs according to the individual's initial level of income and SAH.
Jürges (2006)	1992-2003	Germany	Odds ratio.	SAH has a strong effect on mortality. Besides, richer respondents tend to underestimate their clinical health in their health assessment.
Jack Jr (2007)	-	Mississippi	Literature review.	Poor people have inadequate education, limited access to health care, …
Mackenbach et al. (2008)	1990s and earlier 2000s	Western and Eastern Europe	The relative index of inequality and the slope index of inequality.	If SAH is considered as the health measure, socio-economic inequalities are larger in the Nordic countries and England.
Tubeuf (2008)	2004	France	Decomposed Concentration Index.	Inequalities in health to the detriment of the poor people.
Buddelmeyer and Cai (2009)	2001-2005	Australia	Panel data.	Health and poverty are mutually dependent and they are affected by others unobservable variables.
Carroll et al (2011)	Dec 2004-March 2005	New Zealand	Nearest neighbour matching algorithm.	Most respondents say there are more poor people than 10 years ago and it is because of laziness and lack of will power.

Table 2.1. Characteristics of the studies about poverty review. (Continuation)

Ásgeirsdóttir and Ragnarsddóttir (2013)	2007	Europe	Concentration Index and Absolute Concentration Index.	Existence of inequality in health related to income in all the European countries studied, favouring those with higher income.
Gunasekara et al. (2013)	2008-2009 (NZ) and 2008 (Australia)	New Zealand and Australia	Concentration Index and SF-36 scores physical and mental health.	Income-related health inequalities, favouring the rich. The determinants that contribute most to inequality in health are being inactive, living in deprived areas and having low income levels.
Brzezinski (2015)	1991-2008	Great Britain	Ordinal FGT measures.	Health poverty rate increased for all health poverty threshold.
Doiron et al. (2015)	2007-2008	New South Wales (Australia)	Prospective models.	SAH predicts the future use of health care services as well as the symptoms of diseases, focusing more on those more serious.
Mackenbach et al. (2015)	1990s-2000s	European Union	Poisson regression.	Increase in the relative inequality in premature mortality in most European countries. Reduction in the relative inequality in the population with lower education level.
Simões et al. (2016)	2005-2006	Portugal	EQ-5D Index.	Education is the most important determinant of health inequalities. There are differences between regions.
Coley et al. (2017)	1994-1995	North Carolina	OLS, zero-inflated negative binomial models.	Teenagers' behaviour and health risks are principally derived from family and scholar context.
Ivaldi et al. (2017)	-	European Union	Factor analysis and Pena distance.	Indirect relationship between health and income distribution. Subjective health seems to be related to the territory. The same is not true for objective health.
Nosratabadi et al. (2017)	1984-2012	Iran	FGT index.	Fluctuations in health poverty rate across the time for all children age groups.

Source: Author's elaboration.

3 MEASURES OF SELF-RATES HEALTH POVERTY

As seen above, there are health inequalities related to income but also with other socio-economic factors. In this section, some measures of inequality are developed. The estimate and decomposition of these measures, applied to the health sector, are interesting because, in this way, it is shown which factors affect, to a greater or lesser extent, the health inequalities.

In the literature analysing inequalities in health, various inequality measures are used. To obtain these measures correctly, two conditions must be fulfilled: i) to capture the socio-economic dimensions to inequalities in health and the experiences of the whole population and ii) to be sensitive to variations in the distribution of the population among the socio-economic groups (Van Doorslaer et al., 1997).

In this case, it is analysed a variable such as SAH, which has an ordinal scale. These types of scales arise from the order operation. In other words, in variables of this nature is on speaking terms about first, second, third. Their values represent categories, not measurable quantities (Orlandoni, 2010).

There are several indices of poverty, which can be used to implement data corresponding to SAH. It is possible to distinguish between indicators for discrete and continuous living standards variables. Regarding the discrete variables, firstly, it is found the FGT index, which is developed by Foster et al. (1984) and Bennett and Hatzimasoura (2011), among others. This index is used in this article to analyse the trend in health poverty. It considers a sample formed of *N* individuals, whose self-rated health is represented by a vector of *S* categories, all ordered, such as $Y = (y_1, y_2, \dots, y_S)$, with $y_i > y_j$ if and only if the health status *i* is preferred to health status *j*. In practice, y_1 can corresponds to the worst health status proposed in the self-assessment survey, while y_S would corresponds to the best possible health status. If it is determined the assumption of selecting a category *k* as a poverty threshold, Bennett and Hatzimasoura (2011) propose the following measure:

$$\pi_\alpha(Y;k) = \sum_{j=1}^{k} p_j \left(\frac{k-j+1}{k}\right)^\alpha \qquad siendo\ 1 \le j \le k;\ \alpha \ge 0$$

This equation is a weighted sum of the probabilities of having self-report health below the established poverty threshold, where $p_j = \Pr[Y = y_j]$ is the proportion of people *y* in the self-assessment *j*. Moreover, when the parameter α takes de value 0 ($\alpha = 0$), it is obtained the standard poverty head-count ratio, which shows the proportion of poor households below the poverty line. Its simplest version can be describe as q/n (where *q* is the number of poor households and *n* is the total of households). In addition, if $\alpha = 1$, it is weighted equal to the lowest health status. If α is greater than 0, this index is more sensitive to the depth of health poverty, whereas if α is greater than 1, they are more sensitive to depth and distribution. As α grows, the lower valuation categories have more weight. Therefore, the poverty index is sensitive to changes in the probability of the population with poor health status.

Furthermore, the FGT index is additive. This means that the measure of poverty for the whole population is the weighted sum of the poverty measures for the different subgroups of the population. Thus, changes in total poverty over time from t_1 to t_2 can be denoted as follows:

$$\Delta\pi_\alpha = \pi_\alpha(Y_{t2};k) - \pi_\alpha(Y_{t1};k) = \sum_{i=1}^{h} \left[v^i(t_2)\pi_\alpha^i(Y_{t2};k) - v^i(t_1)\pi_\alpha^i(Y_{t1};k)\right]$$

Where v^i is the population share of subgroup $i \in (1, \dots, h)$ and π_α^i is the poverty level of subgroup $i \in (1, \dots, h)$. Looking at the changes in total poverty over time and the Shapley value[6], the subgroup decomposition can be described as:

$$\Delta\pi_\alpha = \sum_{i=1}^{h}(W^i + P^i) = \sum_{i=1}^{h}\left[\frac{v^i(t_1) + v^i(t_2)}{2}\Delta\pi_\alpha^i + \frac{\pi_\alpha^i(Y_{t1}; k) + \pi_\alpha^i(Y_{t2}; k)}{2}\Delta v^i\right]$$

So that changes in poverty within subgroups are represented as $\Delta\pi_\alpha^i = \pi_\alpha^i(Y_{t2}; k) - \pi_\alpha^i(Y_{t1}; k)$ and changes in population shares of subgroups are expressed as $\Delta v^i = v^i(t_2) - v^i(t_1)$, for all $i \in (1, \dots, h)$. So, W^i represents the within-subgroup effects and P^i represents the between-subgroup population shift effects. The first one represents the contribution of poverty variations within subgroups to variations in total poverty weighted by the subgroups' population percentages averaged over time. The second one means the contribution of variations in subgroups' population percentages to variations in total poverty weighted by the subgroup levels of poverty averaged over time.

In addition, in order to support the results obtained with the FGT index, two other indices are calculated: the poverty gap ratio or the Poverty Gap (PG) index and the Theil index.

In respect of the PG index, it represents the proportion of individuals below the poverty line and express it as a percentage. However, it has the disadvantage that only evaluates the poor individuals. In this way, the PG (G_i) is defined as the poverty line (z) less real income for this population (y_i). This is:

$$G_i = (z - y_i) * I(y_i < z)$$

The index (P_1) is obtained as:

$$P_1 = \frac{1}{N}\sum_{i=1}^{N}\frac{G_i}{z}$$

This measure is the mean poverty gap in the population, where *N* represents the individuals in the sample.

Similar to this measure, we have the squared PG index, which consider inequality among the poor. This is a weighted sum of poverty gaps as a percentage of the poverty line. The resulting measure is given by:

$$P_2 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{G_i}{z}\right)^2$$

But this measure is not used very commonly because it does not have intuitive appeal and it is not easy to interpret.

The other index analysed belongs to the Generalized Entropy (GE) measures of inequality. Among these measures, All (2005) specifies the two more used, which are those proposed by Theil (1967). These indices can be obtained as particular cases of

[6] It is a solution concept in game theory. It can be interpreted as a measure of the utility of players in a game. This means that it connects each player with the amount that he should be willing to pay to participate (Aumann and Shapley, 2015).

the GE measures and are as follows: the Theil index and the mean logarithmic deviation. The general formula can be written as:

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right]$$

Where α represents the weight given to distances between incomes at different parts of the income distribution, *N* is the number of individuals in the sample, y_i is the income or expenditure corresponding to individual *i* and $\bar{y}$ is the mean income or expenditure per capita. The values of this measure vary between zero (it represents an equal distribution) and infinite (it represents high values of inequality).

If $\alpha = 0$, we obtain the mean logarithmic deviation measure that may be written as:

$$GE(0) = \frac{1}{N}\sum_{i=1}^{N} ln\left(\frac{y_i}{\bar{y}}\right)$$

And if $\alpha = 1$, we have the Theil index, which is defined as:

$$GE(1) = \frac{1}{N}\sum_{i=1}^{N} \frac{y_i}{\bar{y}} ln\left(\frac{y_i}{\bar{y}}\right)$$

A more popular measure of poverty is the health CI (Wagstaff et al., 1989), which is a measure of health inequality that is related to income. This index has the advantage of estimating the unequal distribution of health by socio-economic condition. It has been used by authors such as Van Doorslaer et al. (1997), Humphries and Van Doorslaer (2000) and Van Doorslaer and Masseria (2004). In a study by Bommier and Stecklov (2002), they argue that the CI is the most appropriate measure of inequality of health related to the socio-economic position of population. It reflects the experience of all individuals. So, if the CI changed, the sizes of the different groups would also do it. Nevertheless, the relative CI does not take into account the level of health within the population, only how much it varies.

The possible results of this index are in a theoretical range such that [-1, 1]. Non-significant or a zero value of CI indicates that there is no socio-economic-related inequality. In other words, a value such 0 represent a perfect equality. Besides, the values of the ends of the interval (-1 and 1) represent total inequality. So, if is obtained positive values of CI, it will be indicated the existence of inequality favouring the rich and vice versa. This index is defined as:

$$C = \frac{2}{N * \mu}\sum_{i=1}^{N} w_i y_i R_i - 1$$

Where

$$\mu = \frac{1}{N}\sum_{i=1}^{N} w_i y_i$$

This measure also can be expressed as:

$$C = \frac{2}{N * \mu}\sum_{i=1}^{N} w_i (y_i - \mu)(R_i - \frac{1}{2})$$

Where μ denotes the weighted sample mean, *N* is the sample size, w_i is the sampling weight of the *i*-th individual and the sum of w_i equal to *N*, cov_w is the weighted covariance and $R_i = \frac{1}{N}\sum_{j=1}^{i-1} w_j + \frac{1}{2}w_i$ is the relative fractional rank of the individual *i*.

This index also can be written by using the "convenient covariance" formula:

$$C = \frac{2}{\mu} cov_w(y_i, R_i)$$

Other poverty index considered is the one proposed by Bourguignon and Chakravarty (2003). They develop a way to define poverty and count the number of poor people explaining the possibility of being poor in any poverty dimension. Thus, the poverty indicator variable is given by:

$$p(x_i; z) = 1 \quad if\ \exists j \in (1,2,\dots,m): x_{ij} < z_j \quad and$$

$$p(x_i; z) = 0 \quad otherwise$$

And the number of poor people is defined as:

$$H = \sum_i p(x_i; z)$$

In addition, Bourguignon and Chakravarty consider decomposable measures in subgroups. A poverty index defined on M^n is defined as:

$$P(X; z) = \frac{1}{n}\sum_{i=1}^{n} p(x_i; z)$$

Where $p(x_i; z)$ can be interpreted as the poverty level associated with a person *I*, who possesses an attribute vector x_i.

It is assumed that $m = 2$ and the poverty index satisfies the assumptions of Monotonicity (MN), Continuity (CN), Subgroup Decomposability (SD) and One Dimensional Transfer Principle (OTP) or Multidimensional Transfer Principle (MTP). So, under SD and $m = 2$, the change in the poverty index is defined as:

$$\Delta P = \frac{1}{n}\left[2 * p\left(\frac{x_{11} + x_{21}}{2}, \frac{x_{12} + x_{22}}{2}; z\right) - p(x_{11}, x_{12}; z) - p(x_{21}, x_{22}; z)\right]$$

Additionally, it is supposed that a subgroup of decomposed poverty index, which satisfies the OTP assumption, has first-order partial derivatives. Then, it is additive between attributes, that is,

$$P(X; z) = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{m} p\left(x_{iJ}; z_J\right)$$

Where $p^j(\cdot)$ is the individual poverty function associated with attribute *j*. With this equation, it can be determined the contributions of the different attributes to total poverty.

For the general case, where we have *m* attributes and *n* individuals, the poverty index can be expressed as:

$$P(X; z) = \frac{1}{n}\sum_{j=1}^{m}\sum_{i \in S_j} f_j\left(\frac{x_{ij}}{z_j}\right)$$

And if:

$$f_j(t) = a_j(1-t)^{\theta_j}, \quad 0 \le t < 1$$

Then, we have the poverty index becomes:

$$P_\theta(X;z) = \frac{1}{n}\sum_{j=1}^{m}\sum_{i\in S_j} a_j\left(1-\frac{x_{ij}}{z_j}\right)^{\theta_j}$$

This method is a simple multidimensional extension of the FGT index. On one hand, if $\theta_j = 1$ for all *j*, P_θ is a weighted sum of poverty gap. On the other hand, if $\theta_j = 2$ for all *j*, the resulting measure is given by:

$$P_2(X;z) = \frac{1}{n}\sum_{j=1}^{m} a_j * F_j * [A_j^2 + (1-A_j^2) * V_j^2]$$

Where F_j is the population size in S_j as a fraction of the *n* individuals, A_j is the average of relative poverty deficit of the *n* individuals in S_j and V_j is the coefficient of variation of the attribute *j* distributed among those of S_j.

As seen above, Tubeuf and Perronnin (2008) utilise the health index, using estimated coefficients for each severity level. They propose to normalise the health measure in two phases. First of all, they normalise each coefficient to $\hat{\alpha}$, which corresponds to the lowest severity level. Therefore, the weight assigned to a disease of severity level *k* is given by:

$$w_k = \frac{\hat{\alpha}_k}{\hat{\alpha}_1}$$

So, this is the number of diseases with the lowest severity level that is needed to have the same effect on self-reported health than a disease with a *k* level of severity. The health index combines the subjective (SAH) and the medical health (the number of diseases taken into account) controlling both through different social dimensions in only one instrument. It can be described as:

$$I_{ij}^{raw} = \sum_{k=1}^{9} \frac{\hat{\alpha}_k}{\hat{\alpha}_1} D_{ij}^{(Sev_k)}$$

Second, the index is described in an interval [0, 1] calculating the gap to the highest possible value and then dividing it by the range of its values.

$$I_{ij} = \frac{I_{max}^{raw} - I_{ij}^{raw}}{I_{max}^{raw}}$$

Another indicator widely used for the measurement of inequality in health is the Atkinson (1970) approach. Social welfare (W) is written as the sum of individual welfare levels (u_i):

$$W = \sum_i u_i$$

It is assumed that the well-being of individual *i* is only determined by income (y_i) and it is given by $u_i = u(y_i)$. It is used an identical individual welfare function for all individuals, which is concave in income. This fact supports that the equivalent income cannot exceed

the average income. Therefore, this index is between 0 and 1, being perfect equality and extreme inequality, respectively. In addition, the social welfare generated by the income distribution can be describe as $W(y) = \sum_i u(y_i)$.

Atkinson's proposal to measure the inequality of this distribution comes from a particular income. Such income would produce the same level of social welfare as the one produced by the unequal income distribution, if this is given to all individuals. The Atkinson index becomes:

$$A = 1 - \frac{y^e}{\mu_y} = \frac{\sum_i (y_i - y^e)}{\sum_i y_i}$$

Now, it is supposed that the welfare of individual *i* is defined by both income (y_i) and health status (h_i), which can take a finite number of *k* different values: $h(1), h(2), \dots, h(k)$. In this case, the welfare of an individual is defined by $u_i = u(y_i, h_i)$ and the social welfare is given by:

$$W(y,h) = \sum_i u(y_i, h_i)$$

A more general measure of poverty for ordinal variables, including the one suggested by Bennett and Hatzimasoura (2011), is the one proposed by Yalonetzky's (2012):

$$\pi_w(Y) = \sum_{j=1}^{k} p_j w_j$$

Where w_j is the weight assigned to the probability of being in a state *j*, p_j.

This equation can be distinguished from the Bennett and Hatzimasoura (2011) because it does not depend on a single parameter (α) that determines the set of weights, but it requires the choice of *k* parameters. The parameter α represents a restrictive property that is not necessary to derive poverty measures for ordinal variables.

In Spain, authors such as Gradín et al. (2012) have used other types of indices to measure poverty. They develop a two-step method. Firstly, they construct an individual intertemporal poverty indicator, which aggregate poverty of each year. After that, the poverty measure is based on the distribution of these indicators. Thus, the individual intertemporal poverty indicator can be described as:

$$p_i(y_i; z) = \frac{1}{T} \sum_{t=1}^{T} g_{it}^{\gamma} \, w_{it}$$

Where γ is the usual FGT parameter that add sensitivity to this index when $\gamma < 1$ and $w_{it} = \left(\frac{s_{it}}{T}\right)^{\beta}$ is the weight of each poverty gap where β indicates that the continuous accumulation of poverty periods make the individual poverty experience worse.

In a second step, they synthesize individual intertemporal poverty indices for all population through an aggregate intertemporal poverty measure *P*:

$$P(Y; z) = \frac{1}{N} \sum_{i=1}^{N} p_i^{\alpha}$$

Where

$$p_i^{\alpha} = \begin{cases} (p_i)^{\alpha} & if\ \ p_i > 0 \\ 0 & if\ p_i = 0 \end{cases}$$

The parameter α consider the sensitivity of the aggregate intertemporal poverty index if $\alpha < 1$.

On the side of the indicators for continuous variables, it is found the Sen (1976) index. It has the following desirable properties: i) sensitive to the head-count ratio, ii) sensitive to how poor are the population of lower socio-economic group and iii) sensitive to total inequality among the poor. This index is generalized by Blackorby and Donaldson (1980) and it is their formulation what is used. It is assumed a health poverty threshold such as *z*, a sample of *N* individuals and a group of poor people (that population whose incomes are equal or less than the determined poverty threshold) such as *Z (z)*, which has *n (z)* members. They define e_z as the representative income of the poor population, which is measured by the Gini social evaluation function that is only defined by the poor:

$$e_z = \varepsilon_{\iota}\left[\int_{y_1}^{z} \psi(\bar{F}(y), y)\bar{f}(y)\, dy\right]$$

Where $\bar{F}$ is the truncated distribution of income and $\psi(\bar{F}(y), y)$ is a value function.

Thus, the Sen Index is obtained as:

$$\mathcal{P}(z) = \frac{n(z)}{N}\left[\frac{z - e_z}{z}\right] = p_z\left[\frac{z - e_z}{z}\right]$$

It can be affirmed that to each one of the social evaluation functions corresponds a different relative poverty index.

Another indicator of this type, as developed by Duclos and Araar (2007), we find the Clark, Hemming and Ulph's (CHU) indices, given by:

$$P(z;\varepsilon) = P(z;\rho = 1;\varepsilon)$$

$$P(z;\varepsilon) = \begin{cases} z - \left(\int_0^1 Q^*(p;z)^{(1-\epsilon)} dp\right)^{\frac{1}{1-\epsilon}}, & when\ \epsilon \neq 1 \\ z - exp^{\left(\int_0^1 \ln\left(Q^*(p;z)\right) dp\right)}, & when\ \epsilon = 1 \end{cases}$$

Whether $\varepsilon = 1$, this poverty index corresponds to the Watts poverty index, which required strictly positive values of the dependent variable and can be written as:

$$PW(z) = \int_0^1 \ln\left(\frac{z}{Q^*(p;z)}\right) dp$$

When $0 \leq \varepsilon < 1$, the CHU poverty index is too the gap corresponding to the index proposed by Chakravarty, as seen above:

$$PC(z;\varepsilon) = 1 - \int_0^1 \left(\frac{Q^*(p;z)}{z}\right)^{1-\epsilon} dp$$

Furthermore, for $\varepsilon = 0$, we obtain the class of S-Gini indices of poverty, which is defined as:

$$P(z;\rho) \equiv P(z;\rho,\varepsilon=0) = z - \int_0^1 Q^*(p;z)w(p;\rho)\,dp$$

4 DATA: EU STATISTICS ON INCOME AND LIVING CONDITIONS (EU-SILC)

In this paper, micro-data have been used from waves 1-9 of the European Union Statistics on Income and Living Conditions (EU-SILC) for the case of Spain. Specifically, this study is interested in analyse the trends in SAH for the case of Spain in the period from 2008 to 2016.

EU-SILC is anchored in the European Statistical System (ESS) and it is also coordinated from the Statistical Office of the European Communities (EUROSTAT). It accumulates data from all private households and individuals residing in countries at the moment in which data is collected. All members are surveyed but only those older than 15 years are interviewed. People living in collective households or institutions are excluded from EU-SILC as well as those living in specific places in the national territory that do not exceed 2% of the national population and territories. It is mainly interested on income components, fundamentally, personal income but also on family income. Also, it collects micro-data about social exclusion, household conditions, poverty, education, work and health, which cover objective and subjective requirements of these issues. Its principal aim is to compare statistics on income distribution and social inclusion to reduce poverty for all European Union countries. For this reason, since the beginning of the Europe 2020 strategy, EU-SILC data is being used to achieve the reduction of the number of people under poverty as well as social exclusion.

This representative database of households and individuals was developed for the first time in 2003, as an agreement between Eurostat, Norway and six Member States[7]. A year later, it covers Estonia, Iceland and Norway in addition to the EU-15[8], except Germany, the Netherlands and the United Kingdom. In 2005, it includes Norway, Iceland and all EU-25[9] Member States. In 2006, Bulgaria and Turkey join them. In 2007, Romania and Switzerland also do it and, finally, in 2010, Croatia unites too.

Every year, this survey supplies cross-sectional and longitudinal annual data for every year at national and European level. Such cross-sectional information is of high quality in terms of its timeliness and comparability. In the case of longitudinal information, the same individuals are studied repeatedly over a period of years at different moments in time (in Spain it is studied over four years).

Table 4.1 includes detailed information of the sample of households and individuals from all the countries that take part of the EU-SILC. It should be noted that the sample has a minimum size depending on the type of data:

- Cross-sectional data: it contains variables like income, poverty, social exclusion and other living conditions for a particular time or period of time. Approximately 130,000 households and 270,000 persons older than 15 years are interviewed.
- Longitudinal data: it contains the individual-level changes collected over a four-year period. Approximately 100,000 and 200,000, households and persons older than 15 years, respectively, are interviewed.

[7] Austria, Belgium, Denmark, Greece, Ireland and Luxembourg.

[8] Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, Portugal, Spain and Sweden.

[9] Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

Table 4.1. Minimum sample size for EU-SILC countries.

EU-Member States	Households		Persons interviewed (older than 15 years)	
	Cross-sectional	Longitudinal	Cross-sectional	Longitudinal
Austria	4,500	3,250	8,750	6,250
Belgium	4,750	3,500	8,750	6,500
Bulgaria	4,500	3,500	10,000	7,500
Cyprus	3,250	2,500	7,500	5,500
Czech Republic	4,750	3,500	10,000	7,500
Denmark	4,250	3,250	7,250	5,500
Estonia	3,500	2,750	7,750	5,750
Finland	4,000	3,000	6,750	5,000
France	7,250	5,500	13,500	10,250
Germany	8,250	6,000	14,500	10,500
Greece	4,750	3,500	10,000	7,250
Hungary	4,750	3,500	10,250	7,750
Ireland	3,750	2,750	8,000	6,000
Italy	7,250	5,500	15,500	11,750
Latvia	3,750	2,750	7,650	5,600
Lithuania	4,000	3,000	9,000	6,750
Luxembourg	3,250	2,500	6,500	5,000
Malta	3,000	2,250	7,000	5,250
Netherlands	5,000	3,750	8,750	6,500
Poland	6,000	4,500	15,000	11,250
Portugal	4,500	3,250	10,500	7,500
Romania	5,250	4,000	12,750	9,500
Slovakia	4,250	3,250	11,000	8,250
Slovenia	3,750	2,750	9,000	6,750
Spain	6,500	5,000	16,000	12,250
Sweden	4,500	3,500	7,500	5,750
United Kingdom	7,500	5,750	13,750	10,500
TOTAL	130,750	98,250	272,900	203,850
Iceland	2,250	1,700	3,750	2,800
Norway	3,750	2,750	6,250	4,650
TOTAL including Iceland and Norway	136,750	102,700	282,900	211,300

Source: Author's elaboration adapted from Eurostat.

EU-SILC is founded on the idea of an usual "framework", which specifies the following points: i) common guidelines and methods; ii) usual ideas such as household and income and their classifications to maximize comparisons and iii) variables that they have to notify to Eurostat, which can be:

- Primary: which are accumulated every year and include:
    - Basic housing, material deprivation and income data for households.

    - Basic demographic, education, health, work and income data at the individual level.
- Secondary: which are collected every four years or less frequently and they present information like well-being, housing conditions, material deprivation or access to services, social participation, among others, for both households and individuals.

In the same way as Table 4.1, Table 4.2 includes information of the sample of households and individuals for Spain and it adds all the waves analysed in the study. The first wave (2008) consists of 13,014 households (30,082 individuals), while in the ninth wave (2016) 14,240 households (30,688 individuals) are included. The sample has been growing until 2010. However, at that point, it declined to its lowest level in 2014 (11,965 and 26,531, households and individuals, respectively). After that, it increased again and, in the last wave, it reaches the highest value collected. In the case of the observations related to SAH, it ranges from 29,926 in 2008 to 30,431 in 2016. This is because some of the respondents did not respond to that question.

Table 4.2. Composition of households and individuals sample in the EU-SILC for Spain (2008-2016).

Concept	**Wave 1 (2008)**	**Wave 2 (2009)**	**Wave 3 (2010)**	**Wave 4 (2011)**	**Wave 5 (2012)**	**Wave 6 (2013)**	**Wave 7 (2014)**	**Wave 8 (2015)**	**Wave 9 (2016)**
Households	13,014	13,360	13,597	13,109	12,714	12,139	11,965	12,367	14,240
Individuals	30,082	30,836	30,953	29,211	28,210	26,883	26,531	27,215	30,688

Source: Author's elaboration adapted from Eurostat.

The EU-SILC provides information about the average income of households for the previous year. In other words, the survey of 2016 reports data from 2015, while the survey of 2015 publishes data from 2014 and so on. The average annual net income per household in 2016 increased by 2.4% compared to the previous year, reaching to 26,730 euros. Meanwhile, the average income per person achieved 10,708 euros, being 2.8% higher than the value recorded the previous year.

On the other hand, to select the poverty risk threshold, it is going to follow the Eurostat criterion. It is set at 60 per cent of the average income[10] per Consumption Unit (CU)[11] of individuals. This type of income it is used for accounting for economies of scale in households and also to calculate poverty risk measures. Specifically, a coefficient is assigned to each household member using the Organisation for Economic Co-operation and Development (OECD) scale and then we have the following weights:

- 1 CU for the first adult in the household;
- 0.5 CU for the other adults;
- 0.3 CU for the children under 14 years.

In that case, 1 CU is a household formed by a single person and a household composed by two adults will be 1.5 CU. In this way, the number of members became the number of CU. Besides, once the income per unit of household's consumption has been calculated, it is assigned to each household member. So, living standards can be compared between households of different size. Therefore, the threshold decreases or increases according

[10] The average income is that value, which, by ordering from lowest to highest all the individuals income, leaves one half above of that value and the other half below. It is a relative measure, so its value depends on both the income level and how that income is distributed among individuals.
[11] The income per CU is obtained dividing total household income by the number of CUs.

to the average income. Therefore, if income per person increases, the poverty risk threshold will also increase.

Now, we can observe (Table 4.3 and Figure 4.1) the evolution that has followed the poverty risk threshold from the survey of 2009 (with data from 2008) to the survey of 2016 (with data from 2015). The first year of this study corresponds in time with the beginning of the current economic crisis in Spain. So, we have that the highest average income value in a single-person household corresponds to 2008. Thereafter, income decreases almost by € 1,000, in particular to € 7,961, in 2013. After that, it has increased to € 8,209 in the last year of this study. The same applies to the household with two adults and two children under 14 years old. The highest value is reached in 2008 (€ 18,641) until 2013 (€ 16,719). Then, it grows until the last year, where it reaches € 17,238.

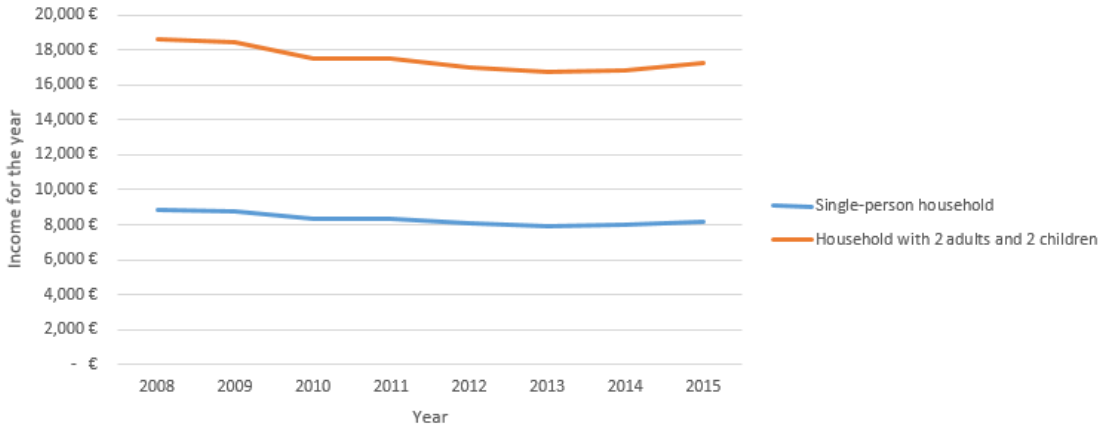
In 2016, the poverty risk threshold for those single-person households situated itself at 8,209 euros, 2.5% more than the estimated value in the year before. Similarly, for those households composed by two adults and two children under 14 years old, the threshold was € 17,238. Thus, the poverty line is calculated for each type of household.

Table 4.3. Poverty risk threshold from 2008 to 2016.

Year of the survey	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Income for the year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Single-person household	8,877€	8,763€	8,358€	8,321€	8,114€	7,961€	8,011€	8,209€
Household with 2 adults and 2 children	18,641€	8,402€	17,551€	17,473€	17,040€	16,719€	16,823€	17,238€

Source: Author's elaboration adapted from INE, 2017.

Figure 4.1. Trends in poverty risk threshold from 2008 to 2015.



Source: Author's elaboration.

In respect of data, it is divided into four sections. First, there are basic household data. It is made up of those households who have answered both, the household questionnaire and, at least, one individual questionnaire. It provides the information required to identify the household, to locate it geographically, the degree of development in the area where it is located and the year of the survey as well as the weighting factors. Secondly, there are the individuals' basic data. It is formed by both adults and children who live in those

collaborating households. It supplies the information needed to identify the person and their household, demographic information, type of interview, the number of hours that children attend school, if they are cared for by other people (for those aged 12 or under) as well as the weighting factors, among others. In the survey of 2016, variables related to access services are included. Then, there are the household file. It includes data for each collaborating household. It contains detailed household information distributed in the following sections: i) basic household information; ii) housing data; iii) social exclusion data; iv) income data; v) other complementary variables; vi) material deprivation data and vii) access services variables. Finally, it is found the person file. It is formed by adults over 15 years of age. It contains data for each adult with the variables collected in the individual questionnaire. If this questionnaire has not been completed, an imputed record is formed. It covers detailed information of the individual such as: i) individual basic data; ii) education data; iii) health data; iv) employment data; v) income data; vi) material deprivation data and vii) access services variables.

The EU-SILC has a set of questions related to individuals' health status, but this paper is focused on the first one, which is the relative to SAH. Therefore, the file on the individuals' basic data has been used. The self-reported health status is measured in the EU-SILC for the case of Spain using the following questions:

- General health status. Respondents can say if their health is very good, good, fair, poor or very poor. In other words, this question is measured by an ordinal scale with possible answers ranging from 1 to 5, respectively.
- Do you have any disease or chronic health problem? The answer is affirmative or negative, corresponding number 1 to the first choice and number 2 to the second.
- At least, for the last 6 months, how much have you been limited to carry out activities, which people usually do, due to a health problem? The possible answers, which are valued from 1 to 3, are severely limited, limited but not severely and no limited, respectively.
- During the past 12 months, did you ever really need to consult a doctor (except for a dentist) but did you not do it? There are two responses: i) yes, at least once (corresponding number 1) and ii) no, on any occasion (corresponding number 2).
- Main reason for not consulting a doctor (except for a dentist). For each one of this answers are assigned a number from 1 to 8, respectively. The responds are as follows: i) you cannot afford it; ii) you were on a waiting list or you did not have a referral note; iii) you did not have time because of work, children care or any other people; iv) the doctor is too far to travel or you do not have any means of transport; v) you are afraid of doctors/hospitals; vi) you wanted to wait and see if the problem improved by itself; vii) you did not know any doctor or specialist; viii) any other reasons.
- During the past 12 months, did you ever really need to consult a dentist but did you not do it? The answer is affirmative or negative, corresponding number 1 to the first choice and number 2 to the second.
- Main reason for not consulting a dentist. Respondents can say whether: i) you cannot afford it; ii) you were on a waiting list or you did not have a referral note; iii) you did not have time because of work, children care or another people; iv) the doctor is too far to travel or you do not have any means of transport; v) you are afraid of doctors/hospitals; vi) you wanted to wait and see if the problem improved by itself; vii) you did not know any doctor or specialist; viii) another reasons. The possible answers are valued from 1 to 8, respectively.

The dependent variable used in the estimated of this study is the degree of subjective evaluation of the individual's overall health available in the different waves of the EU-SILC. Specifically, the data used come from the answers to the first question of the survey related to health, which deals with the general health status of the individuals.

This variable is commonly included in surveys with longitudinal data, such as the ECHP in the case of European countries as well as in the EU-SILC used in this study. More focused on surveys of particular countries, it can be found in the BHPS in the case of the United Kingdom, the National Health Interview Survey (NHIS) in the case of the United States or the *Encuesta Nacional de Salud* (ENS), for the case of Spain. It should be mentioned that, in the case of BHPS, this survey asks respondents to rate their health in relation to other people of the same age.

So the distribution of this variable in its five different ordered categories, throughout the study period, is shown in Table 4.4. It can be said that, in Spain, more than half of the respondents have declared that their health status is good. Additionally, the population who claims to have a very good health status increases 1% from 2008 to 2016. The same is true for those individuals who declare a fair health status. By contrast, there is a decrease in the population that express a good, poor and very poor health status between 2008 and 2016. There are only a small number of respondents who rate their health as very poor (less than 2.3%). In the same way, the number of respondents who rate a poor health status does not exceed 7%.

Table 4.4. Relative frequencies of individuals' self-assessment health status in each wave for Spain.

Self-assessment health status	**Wave 1 (2008)**	**Wave 2 (2009)**	**Wave 3 (2010)**	**Wave 4 (2011)**	**Wave 5 (2012)**	**Wave 6 (2013)**	**Wave 7 (2014)**	**Wave 8 (2015)**	**Wave 9 (2016)**
Very good	13.94	14.92	16.2	19.77	20.64	18.55	16.17	15.08	14.91
Good	56.7	54.37	53.73	53.31	51.7	51.74	54.79	55.73	55.86
Fair	20.73	21.44	21.28	18.69	18.75	20.66	20.06	21.01	21.63
Poor	6.82	6.99	6.7	6.09	6.71	6.95	6.84	6.38	5.98
Very poor	1.81	2.27	2.09	2.14	2.2	2.1	2.14	1.8	1.62

Source: Author's elaboration.

5 EMPIRICAL RESULTS

The results have been obtained using the statistical program STATA 12.

Now, it is presented the descriptive statistics of the main health variables for 2016 (Table 5.1). The sample has 30,688 observations. However, all observations are not always available due to the absence of response from some people who have been surveyed. Considering that, value 1 corresponds to the best health status (very good) and value 5 concerns to the worst (very poor), the average of the health status in this sample is 2.2354. Therefore, it can be said that this result supposes a "good" average of the health status. In addition, the majority of people surveyed declare that they have no health problems or a chronic disease. In respect of the fact of being limited to do the daily life activities during the last 6 months, the average of responses is 2.7125. In other words, the most of the survey respondent expound that is not limited. In the case of attending to the doctor and the dentist, it has values of 1.9852 and 1.8883, respectively. So, in both cases the majority did not attend. In the event of not consulting, there are only 365 observations for the doctor's question and 1.730 for the dentist's one. In the first case, the average of their answers (3.7671) is focused between not having time and living too far. As long as the most common responses to not going to the dentist (1.9075) is due to being on the waiting list or not having a referral note.

It has been calculated descriptive statistics for the remaining years. These can be seen in Appendix A.

Table 5.1. Descriptive statistics of the person file: health. 2016.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	30431	2.2354	0.8338	1	5
Do you have a chronic illness or health problem?	30431	1.6689	0.4706	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	30432	2.7125	0.5505	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	24610	1.9852	0.1209	1	2
Main reason for not consulting a doctor (except dentist)	365	3.7671	2.3459	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	15482	1.8883	0.3151	1	2
Main reason for not consulting a dentist	1730	1.9075	1.9903	1	8

Source: Author's elaboration.

Table 5.2 shows the estimates of health poverty using ordinal FGT indices by Foster et al. (1984) and Bennett and Hatzimasoura (2011) mentioned above. It presents the mean, the standard error and 95% confidence intervals for three different values of α. Also,

three different poverty thresholds (*k*) are established. In the first place, the alpha (α) values have been selected with the guideline of being equal to zero, π_0, $(\alpha = 0)$, greater than zero, π_1, $(\alpha = 1)$ and greater than one, π_2, $(\alpha = 2)$. On the other hand, the three lowest poverty threshold have been chosen for the analysis. Nevertheless, some authors as Brzezinski (2015) say that a poverty threshold such that $k = 1$ is unsuitable to analyse. This is because people, who declared a higher self-reported health condition, consider it poor. Its trend can be seen in Figure 5.1. Therefore, the following poverty threshold are to be determined:

- $k = 2$: poor self-reported health status;
- $k = 3$: fair self-reported health status.

First, the results focused on 2008 will be discussed and, in particular, those obtained for a poor SAH status ($k = 2$). Whether a self-rated health poverty as measured by poverty headcount rate, π_0, is determined, it is gotten a value such 0.1142. This value reaches 0.0802 if health poverty as measured by π_1. Whereas, in the case of π_2, it is accomplished a value such 0.0749. Meanwhile, if it is established a fair SAH status ($k = 3$) like the poverty threshold, it has a value of 0.4114 for π_0, it falls to 0.2745 for π_1, but it increases at 0.3209 for π_2.

In this way, for 2016, when there is a poverty threshold established such a $k = 2$, the next results can be observed. With a self-rated health poverty as measured by π_0, a value such 0.1082 is obtained. This value decreases if health poverty as measured by π_1, reaching 0.0786. The same happens in the case of π_2, where a value of 0.0760 is achieved. In the meantime, if it is supposed $k = 3$ like the poverty threshold, it has the next results. At a self-reported health poverty as measured by π_0, it has a value like 0.4064, which is reduced to 0.2682. Finally, for π_2, it takes the value 0.3153.

When comparisons are made across years (or countries in other cases), it is important to use the same health measure, SAH in this case. The reason is because estimates are sensitive to the health measures used. So, comparing the first and the last year of this study, it is observed that health poverty as measured by π_0 decreased by 5.25% and by 1.21% for a poor SAH ($k = 2$) status and for a fair SAH status ($k = 3$), respectively. This decrease (1.99%) is lower when $k = 2$ and the health poverty as measured by π_1. Nevertheless, if self-rated health poverty as measured by π_2, there is an increase of 1.46%. In the event of $k = 3$, the decreases are higher in the remaining two cases. The reduction is 2.29% and 1.74% if self-rated health poverty as measured by π_1 and by π_2, respectively.

It also provides results of significance tests on health poverty comparisons between 2008 and 2016. A conventional 5% significance level is specified. Firstly, the findings of the lower poverty threshold fixed in this paper, that is, a poor self-assessed health ($k = 2$) are discussed. The result, if it is employed a self-rated health poverty headcount (π_0) to measure, is not significant. Moreover, the health poverty decreases relevant to measure sensitive to depth (π_1) is also not significant. As with poverty reduction, relevant to measure sensitive to depth and distribution (π_2) of poverty. This means whether health poverty is measured by π_0 as well as by π_1 or by π_2, the results of the estimations made are significant. Secondly, it is assumed a fair self-assessed health ($k = 3$). In this case, the opposite happens. A change in all self-reported health poverty decreases are statistically significant.

It has been calculated other indicators detailed in section 3 (Measures of self-rates health poverty). These can be seen in Appendix B.

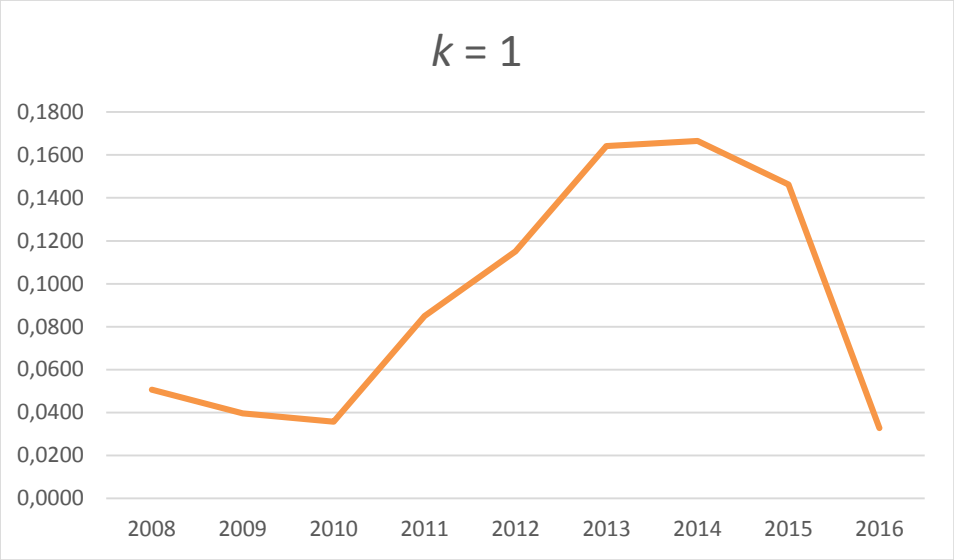
Table 5.2. FGT index for self-rated health status.

		π_0	π_1	π_2
k = 2				
2008	**Mean**	0.1142	0.0802	0.0749
	Std. Err.	0.0022	0.0019	0.0022
	[95% Conf. Interval]	[0.1098; 0.1185]	[.0766;0.0839]	[0.0706:0.0792]
2016	**Mean**	0.1082	0.0786	0.0760
	Std. Err.	0.0022	0.0019	0.0022
	[95% Conf. Interval]	[0.1040; 0.1125]	[0.0749;0.0822]	[0.0717;0.0803]
2016 vs 2008	**Mean**	-0.2308	-0.3461	-0.5192
	Std. Err.	0.2809	0.4213	0.6320
	[95% Conf. Interval]	[-0.8428;0.3812]	[-1.264;0.5718]	[-1.8962;0.8578]
k = 3				
2008	**Mean**	0.4114	0.2745	0.3209
	Std. Err.	0.0040	0.0041	0.0068
	[95% Conf. Interval]	[0.3900;0.4058]	[0.2664;0.2825]	[0.3076; 0.3342]
2016	**Mean**	0.4064	0.2682	0.3153
	Std. Err.	0.0041	0.0041	0.0068
	[95% Conf. Interval]	[0.3985;0.4144]	[0.2602;0.2761]	[0.3019;0.3286]
2016 vs 2008	**Mean**	0.1424	0.3323	0.7753
	Std. Err.	0.0720	0.1681	0.3922
	[95% Conf. Interval]	[0.0007;0.2841]	[0.0016;0.6630]	[0.0036;1.5470]

Source: Author's elaboration.

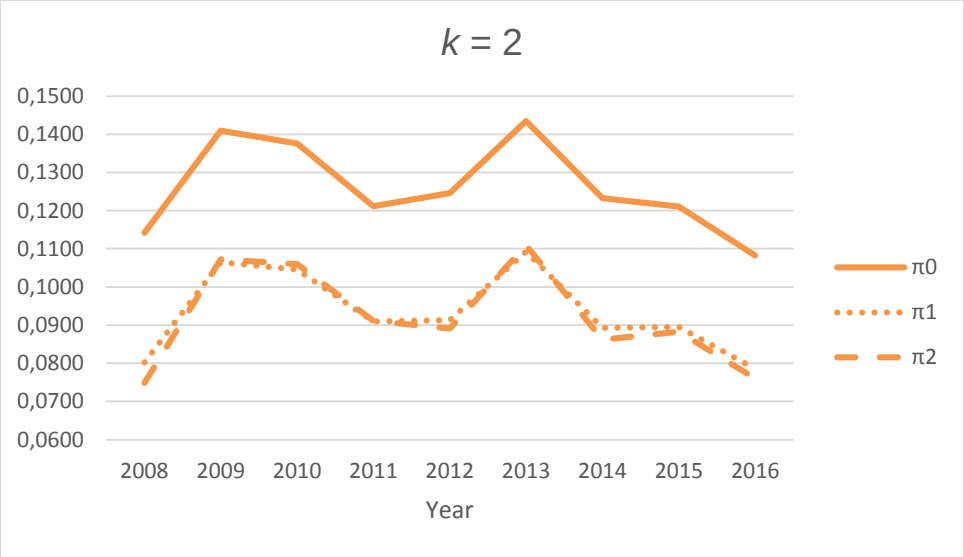
In addition, Figure 5.2 and Figure 5.3 show the trends, which result from applying the FGT index for a poor self-reported health status (k = 2) and a fair self-reported health status (k = 3), respectively.

Figure 5.1. Trends in FGT index for a very poor self-reported health status (k = 1).



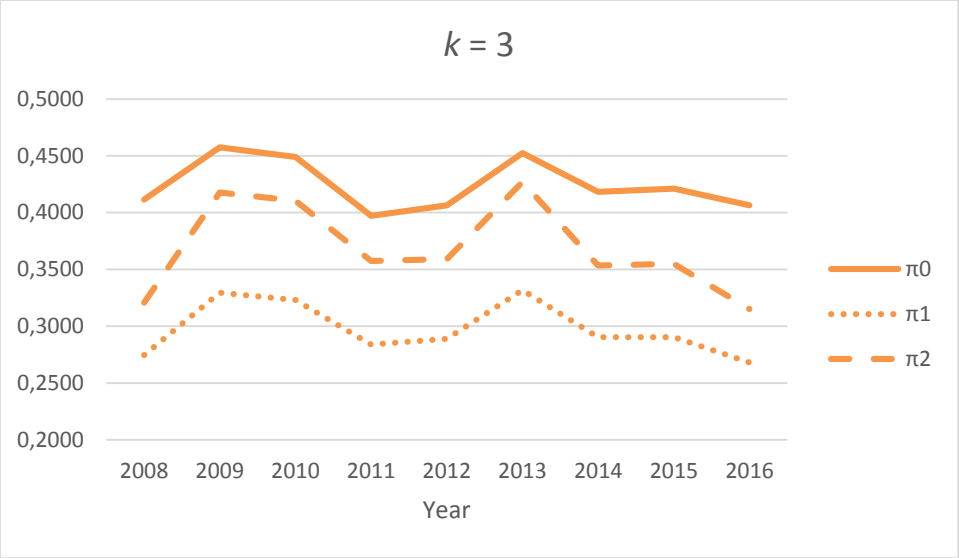
Source: Author's elaboration.

Figure 5.2. Trends in FGT index for a poor self-reported health status (k = 2).



Source: Author's elaboration.

Figure 5.3. Trends in FGT index for a fair self-reported health status (k = 3).



Source: Author's elaboration.

Once the FGT index is calculated, the contribution of diverse population subgroups to changes in overall poverty between 2008 and 2016 is to be analysed. It is going to be decomposed health poverty into their determinants. In terms of this, it is used information for three subgroups defined by: i) gender, in which it is divided between men and women; ii) age, it is divided into eight age groups at intervals of 10 years (except the first and the last one) and iii) education level, which is divided into 5 levels (primary school, 1st stage of secondary school, 2nd stage of secondary school, no higher post-secondary education and higher education). These three variables have been chosen, partly because authors such as Jürges (2006) argue that SAH is likely to be comparable only within defined socio-economic groups. This suggests using subjective health measures within a subsample. Therefore, it would have to be divided, which raises problems when answering interesting research questions. There is no clarity of which characteristics should be used to divide it, but gender and age are the most likely candidates. Apart from these two characteristics, there do not seem to be any generally accepted set of variables.

So, Table 5.3 shows the results of these decompositions of changes in SAH poverty between 2008 and 2016 for Spain. It is also established the assumption that health poverty is measured by π_2, with a fair self-rated health status (k = 3). Therefore, it has been determined the time period as well as the hypotheses of π and k. In this way, it can be defined that the total change in health poverty, in relative terms, is 0.0001 or 0.303%. This total change is expressed as δ.

The population of men surveyed suffers an increase of approximately 2% between 2008 and 2016, thereby offsetting the female population decreases by the same percentage. In the age subgroup, there is a little variation in population rates from 2008 to 2016. The biggest increase in the subgroup of individuals older than 80 years has risen from 14.04% in 2008 to 18.22% in 2016. The opposite happens with the population between 71 and 80 years old, which is reduced by more than 3%. Lastly, the decomposition based on education level indicate that individuals, who only finished primary school, decreased between 2008 and 2016 from 56.62% to 36.06%. Increases in the populations of secondary school (2nd stage) and higher education contributed to more than 5% each one.

Table 5.3. Subgroup decompositions for self-rated health status.

Subgroup		2008		2016	
		v	π_2	v	π_2
Gender					
	Man	40.96	0.1820	42.93	0.1908
	Woman	59.04	0.0655	57.07	0.0634
Total population		100	0.0227	100	0.0209
Age					
	16-20	0.57	0.1498	0.65	0.1748
	21-30	3.20	2.0233	2.36	1.5832
	31-40	6.35	7.9541	5.49	6.8148
	41-50	12.77	26.4564	11.99	24.6167
	51-60	17.08	52.7406	19.84	61.5735
	61-70	22.06	95.8907	20.86	90.7243
	71-80	23.93	102.9082	20.59	119.8475
	80+	14.04	140.2467	18.22	134.0354
Total population		100	0.0227	100	0.0209
Education level					
	Primary school	56.62	0.2517	36.06	0.1603
	Secondary school (1st stage)	20.18	0.0295	30.12	0.1369
	Secondary school (2nd stage)	11.67	0.0224	17.29	0.0335
	No higher post-secondary education	0.41	0.0005	0.18	0.0002
	Higher education	11.13	0.0494	16.35	0.0727
Total population		100	0.0227	100	0.0209

Source: Author's elaboration.

Additionally, it is made the estimation of an ordered probit model and a probit model because, as it has been mentioned, SAH is conditioned by several factors. These, are ordered and discreet response models, in which the error term follows a normal distribution (Cantarero and Pascual, 2005). This is carried out with the objective of reflect the ordinal nature of the dependent variable of this study (SAH). In this way, some personal characteristics of individuals are considered as independent variables. These variables include gender, age, education level, employment situation, income and marital status. As a general rule, coefficients obtained from a probit regression cannot be interpreted in a standard way. Therefore, it is necessary to interpret the marginal and the average effect of the regressor. In other words, it is modelled the (conditional) probability of a "successful" outcome, while everything else remains constant (ceteris paribus).

In the study of the ordered probit model shown below, the dependent variable used in the estimates is the SAH that each individual makes of its health status. In this sense, the higher the value of the dependent variable gets, the greater the probability that the individual will declare a higher category in the SAH scale. As independent variables, the same as those found in the subgroup decompositions are analysed, adding another three to them. In total, there are six independent variables. First of all, three binary variables are considered: gender (variable that takes a value 1 if the individual is a woman and it takes a value of 0 if it is a man), employment status (variable that takes a value 1 if the individual is employed and it takes a value of 0 otherwise) and marital status (variable that takes a value 1 if the individual is single and it takes a value of 0 otherwise). The gender variable can determine part of the differences in individuals' self-rated health. All other variables are age, education level (primary school, 1st stage of secondary school, 2nd stage of secondary school, no higher post-secondary education and higher education) and income.

Therefore, the probit model is specified as follows:

$$P[Y_i = 1|X_{1i}, X_{2i}, \dots, X_{Ki}; \beta_1, \beta_2, \dots, \beta_K] = \Phi\left(\beta_0 + \sum_{k=1}^{K} \beta_k X_{ki}\right)$$
$$= \Phi(\beta_0 + \beta_1 * gender_i + \beta_2 * age_i + \beta_3 * educ_i)$$

Where $\Phi(\cdot)$ is the cumulative distribution of the standard normal distribution.

The marginal and average effects of a regressor of the probit model on the probability of belonging to each category can be obtained as:

$$\frac{\partial P[Y_i = 1|X_{1i}, X_{2i}, \dots, X_{Ki}; \beta_1, \beta_2, \dots, \beta_K]}{\partial X_{ki}} = \beta_k \Phi\left(\beta_0 + \sum_{k=1}^{K} \beta_k X_{ki}\right)$$

Where $\Phi(\cdot)$ is the standard normal probability density function. So, the marginal effect of a regressor (X_k) depends on the value of the coefficient (β_k) and the values of the above mentioned density function for that individual.

The results are shown in Table 5.4. The coefficients of the explanatory variables in the ordered probit model have an interpretation in qualitative terms. Therefore, it only can be interpreted the coefficients' signs, that define the direction of the variation of probability of belonging to the highest response due to an increase in the corresponding explanatory variable. Thus, the coefficient of the independent gender variable has a positive sign. This means that, if there is a female individual, there is a higher probability to report a poor health status against a male. Likewise, the independent age variable presents positive sign. In other words, the older the individual gets, the higher probability to report poor health. Meanwhile, the employment status is positively related to SAH. Therefore, the probability of reporting poor health increases when the individual is employed. Marital status is also positively related to SAH. This means that, if there is a single individual,

there is a higher probability of reporting poor health. By contrast, the explanatory education level variable has a negative effect on reporting poor health. In other words, the probability of reporting poor health decreases as the education level increases. Finally, the income variable has a negative sign. So, the higher income, lower is the probability to report poor health.

Table 5.4. Estimation of the ordered probit regression for SAH. 2016.

SAH	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Gender	0.0992	0.0200	4.96	0.0000	0.0600	0.1384
Age	0.0305	0.0010	31.95	0.0000	0.0287	0.0324
Educ	-0.0716	0.0074	-9.61	0.0000	-0.0862	-0.0570
Employ	-0.0088	0.0050	-1.78	0.0760	-0.0186	0.0009
Income	-0.0007	0.0005	-0.83	0.0000	0.0009	0.0005
Marital st.	0.0384	0.0117	3.29	0.0010	0.0156	0.0612
Number of obs = 14311						
LR chi2(3) = 1669.16						
Prob > chi2 = 0.0000						
Log likelihood = - 12556.409				Pseudo R2 = 0.0623		

Source: Author's elaboration.

The problem of the ordinal scale can be solved by dichotomizing the dependent variable (between poor and good health status) or imposing some kind of order. This kind of models present several well-known advantages and disadvantages for processing of dichotomous variables, those that can only take two values, versus other methods. Because of the disadvantages presented by the dichotomization, a potential alternative is to assume that the underling category of the empirical distribution of responses to SAH is a latent health variable, continuous but unobservable with a standard lognormal distribution.

In this case, one big disadvantage is that it does not use all the health variation collected by the SAH index. In addition, comparisons concerning inequality about time or between population groups are not totally reliable. This is due to the results depend on the choice of the poverty threshold to consider poor health status versus good health status (Greene, 2003; Van Doorslaer and Koolman, 2004).

In this way, the results can be quantified. Thus, the endogenous variable takes a value 1 if the self-reported health status is fair, poor or very poor. Otherwise, it takes a value of 0, that is, if the self-reported health status is good or very good. In this way, there is a binary probit model. The coefficients' signs of the explanatory variables from the model are equal to those obtained with the previous estimate. This can be seen in Table 5.5.

Table 5.5. Estimation of the probit model for SAH. 2016.

SAH	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Gender	0.0827	0.0276	3	0.0030	0.0286	0.1369
Age	0.0285	0.0013	22.15	0.0000	0.0260	0.0310
Educ	-0.0868	0.0102	-8.53	0.0000	-0.1068	-0.0669
Employ	0.0202	0.0066	3.05	0.0020	-0.0072	0.0332
Income	-0.0001	0.0001	-0.64	0.0000	-0.0004	0.0000
Marital st.	0.0244	0.0347	0.70	0.4830	-0.0436	0.0924
Constant	-2.0908	0.0687	-26.42	0.0000	-2.2255	-1.9561
Number of obs = 14311						
LR chi2(3) = 987.67						
Prob > chi2 = 0.0000						
Log likelihood = - 5514.3764				Pseudo R2 = 0.0822		

Source: Author's elaboration.

To interpret the quantitative implications of results achieved, the marginal effects of a regressor on the probability of belonging to each category are calculated for the continuous explanatory variables (age, education level and income). Besides, the average effects are calculated for binary explanatory variables (gender, employment status and marital status). This can be seen in Table 5.6. The results show a positive average effect of 0.0175 for the gender variable. This can be interpreted that, by being a woman, the probability of reporting a poor health status increases by 0.0175. Meanwhile, it is obtained a positive marginal effect of 0.0060 and another negative marginal effect of 0.0183, for the variable age and the variable education level, respectively. It could be interpreted as follows. A change of one unit in the age variable, increases the probability of reporting a poor health status at 0.0060. By contrast, the change of one unit in the education level variable, decreases the probability of reporting a poor health status at 0.0183. On the other hand, employment status variable has an average effect of 0.0043. So, the probability of reporting poor health status increases by 0.0043 when an individual is employed. The opposite happens with the income variable. The probability of reporting poor health status decreases by 0.0002 as income increases. In the case of marital status variable, it is obtained that, by being a single man, the probability of reporting a poor health status increases by 0.0052.

Besides, the results suggest that all explanatory variables are significant, except the marital status variable.

Table 5.6. Marginal effects and average effects of the probit model for SAH. 2016.

SAH	dF/dx	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Gender(*)	0.0175	0.0058	3	0.0030	0.0060	0.0289
Age	0.0060	0.0003	22.15	0.0000	0.0055	0.0065
Educ	-0.0183	0.0021	-8.53	0.0000	-0.0225	-0.0141
Employ	0.0043	0.0014	3.05	0.0020	0.0015	0.0070
Income	-0.0002	0.0001	-1.38	0.0000	-0.0008	-0.0004
Marital st.	0.0052	0.0074	0.70	0.4830	-0.0093	0.0210
Number of obs = 14311						
LR chi2(3) = 987.67						
Prob > chi2 = 0.0000						
Log likelihood = -5514.3764				Pseudo R2 = 0.0822		

Note: (*) dF/dx is for discrete change of dummy variable from 0 to 1. Z and P>|z| correspond to the best of the underlying coefficient being 0. Source: Author's elaboration.

6 DISCUSSION

Trends in income-related health inequalities are a topic of interest because of concerns about health gaps between countries as well as within countries. These gaps increase as economic inequalities do.

As it has mentioned above, this paper examines the trends in health poverty among respondents aged 16 and over through SAH using nine waves (2008-2016) from the EU-SILC. There are other covariates analysed here such as gender, age, education level, employment status, income or marital status. The majority of these variables have strong effects on SAH. The use of SAH as an indicator of real health may lead to an incorrect conclusion about social inequalities in health. This is, partly, due to the independent effects of these explanatory variables.

In case the SAH is a valid and unbiased measure for real health, the results would be correct. It is normally used as an indicator of poor health and it has proved to be a valid indicator for health analysis. Therefore, SAH should take up some of the existing health risks, which are associated with the covariates mentioned. Among them, are the self-reported measures, which can produce biased results because different people may qualify their health status differently (Lindeboom and van Doorslaer, 2004; Delpierre et al., 2009).

Some authors (Van Doorslaer and Koolman, 2004) have conducted research on factors that mainly affect health inequalities in certain European countries. They find that the most important factors are changes in the distribution of learning achievements and health inequalities among different education groups. Meanwhile, Cantarero and Pascual (2005) find that education has a positive impact on health. The results obtained in their paper on the marital status also agree with those found in this paper.

Furthermore, in this analysis, it is found that being older have positive effects on the probability of reporting poor health in 2016. Authors, such as Contoyannis et al. (2004), conclude that young people evaluate their health more favourably than older people. Similarly, Bago d'Uva et al. (2008), say that there are inequalities in health, and older people have lower expectations of health than the younger ones.

The pattern of the existence of negative correlations between SAH and gender, to the detriment of women, also can be observed in studies carried out by authors such as McCallum et al. (1994) or Cantarero and Pascual (2005). Meanwhile, Arber and Cooper (1999) conclude that women are more optimistic than men and less likely to report poor health. Obare (2007) also shows that female teenagers are less prone to declare fair health compared to male teenagers.

Lindeboom and van Doorslaer (2004) find significant reporting heterogeneity associated with age and sex. Meanwhile, gender, age and education level show persistent and substantial effects of health status. This effect is still present even when other variables are added to the analysis. One possible conclusion may be that these variables are the only legitimate ones in the analysis of SAH status (Ahn, 2002).

Regarding income, Bago d'Uva et al. (2008) conclude that the individuals with the lowest health expectations are those with the lowest income. Meanwhile, for the case of Spain, García-Gómez and López (2004) say that there are inequalities in health between rich and poor regions, operating through inequality of employment status.

7 CONCLUSIONS

In this paper, it is developed a health poverty index to identify trends in health poverty in subjective terms, specifically, through the SAH status. To this end, it is used micro-data from the EU-SILC for the case of Spain in the period 2008-2016. The study is mainly focused on the FGT poverty index. With this, results of statistical inference are provided. Other indices have been calculated to confirm and consolidate the results obtained. Besides, the subgroup decomposition has been made to analyse health poverty changes. Finally, to make a more thorough analysis, the estimation of an ordered probit model has also been made.

The analysis provides the following conclusions.

The results of the FGT index for 2008 suggest the following. Whether it is established a poor self-rated health status as a health poverty threshold, the values from the FGT index reach their lowest value in the case of self-rated health poverty as measured by π_2. Meanwhile, if it is chosen a fair self-rated health, the lowest value is reached for π_1. The same happens in both situations (a poor and a fair self-reported health status) for 2016.

In the same way, the FGT index indicates a negative growth of health poverty in Spain between 2008 and 2016, when it is established a poor self-rated health status as a health poverty threshold. This happens for a self-rated health poverty as measured by poverty headcount rate (π_0) and π_1. As with the negative growth of health poverty, in the case of a self-rated health poverty as measured by π_2. Moreover, in all three cases the results are not significant. However, when it is chosen a fair self-rated health status, the FGT index shows that this growth is positive for a self-rated health poverty as measured by poverty headcount rate (π_0), π_1 or π_2, in a statistically significant way.

Furthermore, on the basis of the results obtained for the subgroup decomposition, the following can be stated. In terms of gender, it is shown an increase (2%) of the men surveyed between the first year of the study and the last one. Therefore, the female population decreases in the same proportion. In respect of age, the population age 80 and older is the one that has experienced greater increase (more than 4%) from 2008 to 2016. The opposite happens with the population between 71 and 80 years old, which is reduced by approximately 3%. Lastly, the results of the decomposition analysis show that the majority of the respondents are individuals with low education, specifically, those who only finished primary school.

Finally, the estimation of the ordered probit model, using SAH as the dependent variable, indicates the following results in the case of Spain from the EU-SILC data for 2016. Both, education level and income have negative effects on reporting poor health. In other words, in terms of education level, the probability of reporting poor health status decreases if a change of one unit were to occur in the education level variable. In the same way, regarding income, such probability decreases as income increases. By contrast, gender, age, employment status and marital status have positive impacts on the individuals' poor self-rated health. So, being a woman, increases the probability to report poor health status against being a man. It is also predicted that the probability to report poor health status increases as the individual gets older. Meanwhile, the probability to report poor health status increases if the individual is single as well as is employed.

The results shown here provide further empirical evidence on the relationship between health and some personal characteristics, as well as socio-economic determinants (when it is measured by education) by using individual data for the case of Spain. The association between socio-economic status and health has implications for the allocation of health care resources. However, in many European countries, including Spain, health

systems are public. So, the wealth of an individual should not have great importance in life expectancy.

In addition, these results may have significant implications for the design of policies in terms of health. This is due to a fundamental goal of investment in health as the decrease of health inequalities reduce exclusion and poverty. In other words, in order to improve health and eliminate or, at least, reduce inequalities, different policies should be applied. The most relevant could be those that ensure a greater equality and a better health system.

Although health is a multidimensional and complex issue, making it difficult to measure, the dataset used in the analyses are large and contain a great amount of information about individuals' health in Spain. Therefore, it provides a good base for cross-country comparison. In this way, as a possible line of research in the future for this project, the results obtained for Spain could be compared with other European countries. Following the line of this study, it could be extended to the different Spanish Autonomous Communities. In addition, the inequality between SAH and some socio-economic determinants such as income or employment status could also be analysed. On the other hand, it would be possible to carry out a similar study with other health measures such as mortality or life expectancy. Another future analysis could be to calculate the continuous indices, described in previous sections, using the variables provided by EU-SILC. Furthermore, another future line of research may be the evaluation of public policies. Nowadays, I continue with this through the collaboration with UNICEF in a study based on child poverty in Cantabria.

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APPENDIX A

The following is a detailed description of the main statistics of health for each year since 2008. The next considerations are taken into account. First of all, not all observations are available in the survey of each year. This is cause for the absence of response from someone who has been surveyed. Secondly, as has been mentioned, it is considered that the SAH status variable takes the value 1 if an individual assesses his health as very good and it takes the value 5 if the individual assesses his health as very poor.

In the first year of study, the sample has 29,926 observations. The average of the health status in this sample is 2.2585, so it could be said that most respondents report having a "good" health status as well as no health problems or chronic illnesses (1.6779). In terms of being limited to do the daily life activities during the last 6 months, the average of responses is 2.7006. That means the majority of people surveyed declare not to be limited. If the question is to have attended to the doctor and the dentist during the last 12 months, it has a values of 1.9440 and 1.9230, respectively. In both cases, the majority did not attend. In this case, the average of the answers to the doctor's question is 4.9081. So, the majority are too far to travel or they do not have any means of transport. Meanwhile, the average of the answers to the dentist's one is 3.3438. This can be explained by the majority did not have time because of work, children care or another people.

Table A.1. Descriptive statistics of the person file: health. 2008.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	29926	2.2585	0.8457	1	5
Do you have a chronic illness or health problem?	29925	1.6779	0.4673	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	29926	2.7006	0.5672	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	29926	1.9440	0.2299	1	2
Main reason for not consulting a doctor (except dentist)	1676	4.9081	1.9086	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	29925	1.9230	0.2666	1	2
Main reason for not consulting a dentist	2304	3.3438	2.4650	1	8

Source: Author's elaboration.

For the year 2009, the sample has 30,418 observations. The average of the health status in this sample is 2.2734, slightly higher than that for 2008. Therefore, it can be said that this result supposes a "good" average of the health status. Besides, the majority of people surveyed declare that they have no health problems or chronic illnesses (1.6727). In respect of the fact of have been limited to do the daily life activities during the last 6

months, the average of responses is 2.6816, which means that the majority of respondents are not limited. In the case of have attended to the doctor and the dentist, it has a values of 1.9190 and 1.9135, respectively. So, in both cases the majority did not attend. In addition, it reaches the lowest value in the doctor's question, compared to the remaining years. In this way, the average of the answers to the doctor's question is 5.4553. According to the majority of replies, the individuals are afraid of doctors/hospitals as well as they wanted to wait and see if the problem improved by itself. Meanwhile, the average of the answers to the dentist's one is 3.6927. This can be explained by the majority did not have time because of work, children care or another people.

Table A.2. Descriptive statistics of the person file: health. 2009.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	30418	2.2734	0.8794	1	5
Do you have a chronic illness or health problem?	30419	1.6727	0.4692	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	30418	2.6816	0.5792	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	30414	1.9190	0.2728	1	2
Main reason for not consulting a doctor (except dentist)	2462	5.4553	1.9858	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	30413	1.9135	0.2811	1	2
Main reason for not consulting a dentist	2629	3.6927	2.8417	1	8

Source: Author's elaboration.

For the year 2010, the sample has 30,482 observations. This is the year in which a higher number of observations is obtained. The average of the health status in this sample is 2.2476, lower than it was in 2008 and 2009. Therefore, it can be said that this result supposes a "good" average of the health status. According to the majority of replies, the respondents do not have health problems or chronic illnesses (1.6817). In terms of being limited to do the daily life activities during the last 6 months, the average of responses is 2.6975. That means the majority of people surveyed declare not to be limited. If the question is to have attended to the doctor and the dentist during the last 12 months, it has a values of 1.9357 and 1.9190, respectively. So, in both cases the majority did not attend. In the first case, the average of their answers is 5.0892. According to the majority of replies, the individuals are afraid of doctors/hospitals. As long as the most common responses to not consulting to the dentist (3.0648) is due the majority did not have time because of work, children care or another people.

Table A.3. Descriptive statistics of the person file: health. 2010.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	30482	2.2476	0.8773	1	5
Do you have a chronic illness or health problem?	30483	1.6817	0.4658	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	30483	2.6975	0.5722	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	30483	1.9357	0.2453	1	2
Main reason for not consulting a doctor (except dentist)	1961	5.0892	1.8227	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	30483	1.9190	0.2729	1	2
Main reason for not consulting a dentist	2470	3.0648	2.5536	1	8

Source: Author's elaboration.

For the year 2011, the sample has 28,942 observations. The average of the health status in this sample is 2.1752, the lowest value recorded during the years covered by this study. From this year to 2016, there is an increase in the general health status of the majority of the respondents. Therefore, it can be said that this result supposes a "good" average of the health status. This give the highest value to the question of whether the individual has health problems or chronic illnesses (1.7454). In terms of being limited to do the daily life activities during the last 6 months, the average of responses is 2.7142. This year it reaches the highest value, which means that the majority of respondents are not limited. In terms of have attended to the doctor and the dentist, it has a values of 1.9476 and 1.9323, respectively. So, in both cases the majority did not attend. In addition, it reaches the highest value in the dentist's question, compared to the remaining years. In this way, the average of the answers to the doctor's question is 5.2687. According to the majority of replies, the individuals are afraid of doctors/hospitals. Meanwhile, the average of the answers to the dentist's one is 3.2034. This can be explained by the majority did not have time because of work, children care or another people.

Table A.4. Descriptive statistics of the person file: health. 2011.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	28942	2.1752	0.8889	1	5
Do you have a chronic illness or health problem?	28945	1.7454	0.4357	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	28947	2.7142	0.5568	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	28948	1.9476	0.2228	1	2
Main reason for not consulting a doctor (except dentist)	1470	5.2687	2.1989	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	28945	1.9323	0.2512	1	2
Main reason for not consulting a dentist	1903	3.2034	2.6825	1	8

Source: Author's elaboration.

For the year 2012, the sample has 28,008 observations. The average of the health status in this sample is 2.1812, so it could be said that most respondents report having a "good" health status as well as no health problems or chronic illnesses (1.7176). In terms of being limited to do the daily life activities during the last 6 months, the average of responses is 2.7104. That means the majority of people surveyed declare not to be limited. If the question is to have attended to the doctor and the dentist during the last 12 months, it has a values of 1.9464 and 1.9183, respectively. So, in both cases the majority did not attend. In the event of not consulting a doctor, the average of the answers (4.8413) is focused between the doctor is too far to travel or they do not have any means of transport and they are afraid of doctors/hospitals. As long as the most common responses to not consulting to the dentist (2.3182) is due to they are on the waiting list or not having a referral note.

Table A.5. Descriptive statistics of the person file: health. 2012.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	28008	2.1812	0.9096	1	5
Do you have a chronic illness or health problem?	28008	1.7176	0.4502	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	28008	2.7104	0.5619	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	28008	1.9464	0.2251	1	2
Main reason for not consulting a doctor (except dentist)	1500	4.8413	2.0295	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	28008	1.9183	0.2739	1	2
Main reason for not consulting a dentist	2288	2.3182	2.2037	1	8

Source: Author's elaboration.

For the year 2013, the sample has 26,429 observations. The average of the health status in this sample is 2.2231, so it could be said that most respondents report having a "good" health status as well as no health problems or chronic illnesses (1.6700). In respect of the fact of have been limited to do the daily life activities during the last 6 months, the average of responses is 2.6867, which means that the majority of respondents are not limited. In respect of have attended to the doctor and the dentist, it has a values of 1.9331 and 1.8936, respectively. So, in both cases the majority did not attend. In this case, the average of the answers to the doctor's question is 4.9361. So, the majority are too far to travel or they do not have any means of transport. Meanwhile, the average of the answers to the dentist's one is 2.4701. This can be explained by the majority are on the waiting list or not having a referral note or they did not have time because of work, children care or another people.

Table A.6. Descriptive statistics of the person file: health. 2013.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	26429	2.2231	0.8997	1	5
Do you have a chronic illness or health problem?	26430	1.6700	0.4702	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	26428	2.6867	0.5752	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	26430	1.9331	0.2498	1	2
Main reason for not consulting a doctor (except dentist)	1767	4.9361	2.0414	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	26430	1.8936	0.3083	1	2
Main reason for not consulting a dentist	2812	2.4701	2.3689	1	8

Source: Author's elaboration.

For the year 2014, the sample has 26,361 observations. This is the year in which a lower number of observations is obtained. The average of the health status in this sample is 2.2399, so it could be said that most respondents report having a "good" health status as well as no health problems or chronic illnesses (1.6796). In respect of the fact of have been limited to do the daily life activities during the last 6 months, the average of responses is 2.6960. That means the majority of people surveyed declare not to be limited. In terms of have attended to the doctor and the dentist, it has a values of 1.9455 and 1.8953, respectively. So, in both cases the majority did not attend. In the event of not consulting a doctor, the average of the answers (4.9861). So, the majority are too far to travel or they do not have any means of transport. Meanwhile, the average of the answers to the dentist's one is 2.3483. This can be explained by the majority are on the waiting list or not having a referral note.

Table A.7. Descriptive statistics of the person file: health. 2014.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	26361	2.2399	0.8780	1	5
Do you have a chronic illness or health problem?	26360	1.6796	0.4666	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	26361	2.6960	0.5708	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	26359	1.9455	0.2270	1	2
Main reason for not consulting a doctor (except dentist)	1437	4.9861	2.0038	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	26358	1.8953	0.3061	1	2
Main reason for not consulting a dentist	2759	2.3483	2.3400	1	8

Source: Author's elaboration.

For the year 2015, the sample has 26,910 observations. The average of the health status in this sample is 2.2410, so it could be said that most respondents report having a "good" health status. This give the lowest value to the question of whether the individual has health problems or a chronic illness (1.6492). In respect of the fact of have been limited to do the daily life activities during the last 6 months, the average of responses is 2.6873, which means that the majority of respondents are not limited. In the case of have attended to the doctor and the dentist, it has a values of 1.9837 and 1.8808, respectively. So, in both cases the majority did not attend. In addition, it reaches the highest value in the doctor's question and the lowest value in the dentist's one, compared to the remaining years. In this case, the average of the answers to the doctor's question is 3.9699. So, the majority are too far to travel or they do not have any means of transport. Meanwhile, the average of the answers to the dentist's one is 1.9047. This can be explained by the majority are on the waiting list or not having a referral note.

Table A.8. Descriptive statistics of the person file: health. 2015.

Variable	Obs	Mean	Std. Dev.	Min	Max
General health status	26910	2.2410	0.8486	1	5
Do you have a chronic illness or health problem?	26911	1.6492	0.4772	1	2
For at least the last 6 months, to what extent have you been limited due to a health problem to perform the activities that people usually do?	26911	2.6873	0.5692	1	3
During the past 12 months, was there ever a time when you really needed to see a doctor (except for a dentist) but you did not?	20425	1.9837	0.1265	1	2
Main reason for not consulting a doctor (except dentist)	332	3.9699	2.5697	1	8
During the past 12 months, was there ever a time when you really needed to see a dentist but did not?	13026	1.8808	0.3241	1	2
Main reason for not consulting a dentist	1553	1.9047	1.9871	1	8

Source: Author's elaboration.

APPENDIX B

In addition, other alternatives to FGT index have been calculated to measure health poverty.

In the first place, it has been calculated the estimates of the PG index (Table A.9). This index only considers the poor population, those who are situated below of the poverty line. In this case, it is expressed as a percentage of the poverty line in health. This index also has a certain advantage over the headcount ratio, because this one ignores the depth of poverty. In other words, if poor individuals became poorer, the headcount ratio does not change. While, PG index calculates the depth of poverty, considering how far are the poor population from the poverty line, on average. For that, it is possible to compare poverty results. Nevertheless, PG index does not capture differences of inequality between the poor population.

As it has been done for the FGT index, for the PG index, it has been established two poverty thresholds. On one side there is a poor SAH status (k = 2) formed by those individuals who report poor and very poor health. Alternatively, there is fair SAH status (k = 3). This poverty line incorporates individuals just mentioned and, in addition, those who express to have a fair health status.

The results obtained for 2008 are 0.90% for k = 2 and 3.48% for k = 3. So, the results for 2016 are lower in both cases for a poor and a fair SAH status, 0.81% and 3.07%, respectively. These values indicate the ratio between poverty and the poverty line. If it is made a general evaluation of the progress of health poverty in Spain between 2008 and 2016, it can be said that in the year of the beginning of the economic crisis, there was a higher proportion of poor population than there is now. This value increases by, almost, 0.10% for k = 2 and more than 0.40% for k = 3.

Table A.9. Poverty gap index for self-rated health status.

	k = 2	***k = 3***
2008	0.90%	3.48%
2016	0.81%	3.07%

Source: Author's elaboration.

In addition, it has also been calculated some GE measures. The most common values of α used are 0, 1 and 2. So, these are the ones that have been employed to find the GE indices. In such a way that if it is chosen $\alpha = 0$, it is obtain the mean logarithmic deviation measure, also known as Theil's L, GE (0). Instead, whether it is chosen $\alpha = 1$, it is obtaining the Theil's T index, GE (1).

In this paper, the Theil index measures inequality across health status in 2008 and 2016 can be shown in Table A.10. The index is always positive overall but the contributions of each group need not be. This means that the positive contributions are always higher than the negatives. Moreover, those groups that have higher SAH, contribute positively to the Theil index. In other words, it is clear that the negative contribution corresponds to

the individuals who report a bad health. So, it is true that the lower SAH is, the smaller the value get. This can be seen below.

In 2008, the weighted average of SAH in the sample is 2.2585. To find GE (1), for a "very poor" and a "poor" health status ($SAH = 1$ and $SAH = 2$), the ratio between SAH and population shares for the individuals with worst health is lower than one (0.4428 and 0.8855). Meanwhile, its logarithm is negative (-0.8147 and -0.1216). However, the same ratio for the people with better levels of health (fair: $SAH = 3$; good: $SAH = 4$; very good: $SAH = 5$) has values higher than one. Consequently, the logarithm of each of them is positive. Thus, it is specified the contribution of each health status to the index. So, it is obtained the Theil's T index (0.0677) through the aggregate of these values. For the case of GE (0), it is reached the mean logarithmic deviation measure as 0.0703. Therefore, it can be assumed that the alpha value is higher for GE (0) than for GE (1). But whether it is increased to 2, the GE measure is bigger than the unit (1.1402).

The same happens in the case of 2016. Weighted average of SAH in the sample is 2.2354. It is obtained a GE (1) measure, which its value is 0.0676. The value that corresponds to GE (0) is 0.0706. Finally, for GE (2) it is reached the highest value for this year, 1.1391.

It is also possible to compare inequality between health status for 2008 and 2016. The last year comes across more unequal than 2008 by having a lower Theil index. Although both years have very similar values, which only vary by 0.0001. The Theil measures for 2008 and 2016 are: 0.0677 and 0.0676.

Table A.10. Generalized Entropy inequality indices for self-rated health status.

SAH (= y_i)		1	2	3	4	5
2008						
Mean SAH (ÿ)	2.2585					
ln (ÿ / y_i)		0.8147	0.1216	-0.2839	-0.5716	-0.7947
GE(0): Theil's L	**0.0703**					
y_i / ÿ		0.4428	0.8855	1.3283	1.7711	2.2138
ln (y_i / ÿ)		-0.8147	-0.1216	0.2839	0.5716	0.7947
Contribution to the Theil Index		-0.3607	-0.1077	0.3771	1.0123	1.7594
GE(1): Theil's T	**0.0677**					
(y_i / ÿ)^2		0.1960	0.7842	1.7644	3.1366	4.9010
GE(2)	**1.1402**					
2016						
Mean SAH (ÿ)	2.2354					
ln (ÿ / y_i)		0.8044	0.1113	-0.2942	-0.5819	-0.8050
GE(0): Theil's L	**0.0706**					
y_i / ÿ		0.4473	0.8947	1.3420	1.7894	2.2367
ln (y_i / ÿ)		-0.8044	-0.1113	0.2942	0.5819	0.8050
Contribution to the Theil Index		-0.3599	-0.0996	0.3948	1.0412	1.8006
GE(1): Theil's T	**0.0676**					
(y_i / ÿ)^2		0.2001	0.8005	1.8010	3.2019	5.0029
GE(2)	**1.1391**					

Source: Author's elaboration.