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Explain Patterns of Health Inequalities?**

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Abstract

More needs to be known about the origins of health inequalities and their measurement. This paper contributes by examining how the existence of income-related inequalities in unhealthy behaviours and more specifically, obesity (as a proxy for excessive food intake), alcohol intake and smoking might explain the persistence of health inequalities. We empirically examine data from two countries, England and Spain, which exhibit rising obesity levels, as well as smoking and alcohol use, drawing from unique health survey data. Furthermore, we carry out a sensitivity analysis of the influence of different robustness checks, including primarily, the definition of variables across national surveys, reporting bias associated with self-reported measures of lifestyle and the measurement of income-related inequalities in lifestyle factors across countries. The results document the persistence of income inequalities in obesity and tobacco use, which disproportionately concentrate among the relatively poor. However, we find that inequalities in alcohol consumption over time tend to concentrate among relatively richer individuals in both countries examined.

Keywords: inequalities in life style factors, unhealthy behaviours, obesity, alcohol consumption, smoking, reporting bias, cross-country analysis

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1. Introduction

The explanatory mechanisms underpinning socio-economic inequalities in health during someone's life course are still a black box. Explanations for the persistence of health inequalities point towards changes in income inequalities either directly (Marmot *et al*, 1978), or indirectly through mental health pathways (e.g. depression, anxiety, work stress) (Wilkinson *et al*, 1997)¹. However, if life course events are to influence health inequities, one hypothesis to empirically document is to what extent an income gradient in unhealthy behaviours underpins the persistence of health inequalities over time. To date, this explanation has received less attention despite its obvious policy implications². More specifically, the three main causes of unhealthy behaviour that explain preventable mortality in the developed world (WHO, 2002) include patterns of smoking, alcohol consumption and more recently, obesity (WHO, 2006)³.

Whether a health behaviour income gradient exists or not is an empirical question. Some of the existing literature has addressed this question in several ways. Some studies point towards the existence of income related inequalities in obesity (Costa-Font and Gil, 2008; Offer *et al* (2010); Ljungvall and Gerdtham 2010); however, the existence of an income gradient in alcoholism is less clear-cut. A so-called "alcohol income puzzle" claims that there is a positive income gradient for moderate drinking and this effect does remain even when controlling for endogeneity (Mullahy and Sinclair, 1991; Auld, 2005) but the existence of a penalty for heavy versus moderate drinking is in dispute. Epidemiological studies have documented clear and persistent inequalities in alcohol use and consumption on the basis of socioeconomic status (Makela *et al*, 1999; Harrison and Gardiner, 1999).

To contribute to the debate on the income related effect on health behaviour, we draw upon data (more specifically from samples of adults from the *Spanish National Health Survey* and the *Health Survey for England*) using the last decades of data since unhealthy behaviour have

¹ Alternatively, another hypothesis is that inequalities are the results of different fetal life (Omrod and Sen, 2003).

² If that is the case, once would expect public health, as opposed to health services policies, to take a central role in shaping health inequalities.

³ Among the three, obesity possibly is the unhealthy behaviour most on the rise as it has grown on average by 8% among OECD countries (Flegal *et al*, 2002), and its prevalence has tripled in Europe, where it now reaches epidemic proportions (Branca *et al*, 2007; WHO, 2010).

shown increases i.e., 1987-2006 in Spain, and 1997-2007 for England. In both countries we observe higher rates of change in the above-mentioned unhealthy behaviours. Most existing longitudinal data lacks rich information to undertake cross-country analysis on the question⁴. This leaves us with health surveys as the most adequate measurement instrument. Obesity, in particular, has become a primary concern in countries such as Portugal and Spain, two countries that have been traditionally associated with healthy diets and life styles (the so-called Mediterranean diet). The reason for selecting Spain and England is that they top the rankings of European countries for changes in obesity as well as smoking and alcohol use⁵. We have used different measures of inequality, although consistently with the health economic literature, we rely mostly on the concentration index as a measure of inequality.

In attempting to answer questions on health behaviours data constraints are limiting given that longitudinal data is not available for different countries and controls and measurement is limited when available (e.g., EU Household Panel data ends in 2001 and BMI data is self-reported). Previous attempts to draw upon cross-country analysis of inequalities in health have focused on inequalities in self-reported health, rather than health behaviours. Van Doorslaer et al (1997), for example, estimate income inequalities in self-assessed health (SAH) for 7 EU countries and the US. For this particular study, cross-country data of health survey data is used⁶.

Our results point towards a persistent pattern of income-related inequalities in unhealthy lifestyles. However, the evolution of such inequalities differs according to the specific life style factor under consideration, gender and age. The next section describes the methods employed, Section 3 outlines the data in our study and Section 4 provides the results. Section

⁴ To date, the only survey that includes data on life style factors for a wide set of European countries is the European Household Panel Data (ECHP) which follows up individuals for 8 years until 2001, but its use is limited for current social analysis. The European Union Survey of Income and Living Conditions (EU-SILC) was launched in 2003, and although it was intended to replace the ECHP, it does not include life style indicators.

⁵ While Spain has had one of the highest growth rates of obesity in Southern Europe in recent years, in England the upsurge has been particularly high, with 24% of men and women over 16 years old suffering obesity (HSE, 2007). In addition, it has been predicted that in 2050, the prevalence of obesity in England could affect 60% of adult men, 50% of adult women and 25% of children (Foresight, 2007). Spain is traditionally regarded a country with high levels of tobacco consumption, with the second highest consumption in the EU-15 after Greece. The UK stands among the highest ranked EU countries in terms of alcohol consumption.

⁶ Institutionalised individuals are included in some of the surveys but not in all of them; most countries include individuals of all ages except Sweden, which considers only individuals aged 75 or less in the analysis), as well as different wording of the self-assessed health variable (and categories available for the respondents in each country).

5 discusses some relevant methodological considerations for cross-country comparisons of inequalities in life style factors, and finally section 6 concludes.

2. Methods

The methodology used to measure inequality in this study is based on the Concentration Index (CI), one of the most commonly employed measures of income-related inequality in the health economics literature. Intuitively, the CI is just a measure to demonstrate the association between the health variable of interest and the ranking of individuals by socioeconomic status (SES). The CI ranges between -1 and +1. When the variable under consideration is “ill health” (or unhealthy life style behaviour), negative (positive) values of the CI indicate that the variable under consideration is concentrated among the relatively poor (rich); that is, inequalities are “pro-rich” (“pro-poor”) or favour high SES individuals (low SES individuals). If, instead, the variable of interest is “good health” (or healthy life style behaviour), negative (positive) values of the CI show “pro-poor” (“pro-rich”) inequalities; that is, a distribution of the health variable that favours the poor (rich). If the CI equals 0, there is no evidence of income-related inequalities in the health variable considered.

Although the CI combines a number of desirable properties for the measurement of socio-economic inequality (van Doorslaer et al., 1997), it has several drawbacks that have been highlighted in the literature. Firstly, the CI may depend on the mean of the health variable, making comparison of populations with different mean health levels problematic (Erreygers, 2009). Secondly, when the health variable is binary, the limits of the CI are not necessarily -1 and +1 (Wagstaff, 2005). Thirdly, it has been shown that different rankings are obtained for inequalities in health and inequalities in ill-health (Clarke et al, 2002). Finally, it has been argued that if the health variable has a qualitative nature, then the index becomes arbitrary. Given these issues, Erreygers (2009) suggests a new corrected concentration index to overcome the previous limitations.

Taking into account the standard CI, the corrected Concentration Index proposed by Erreygers (2009) can be calculated as follows:

$$E(h) = \frac{4\mu}{h^{\max} - h^{\min}} * CI(h) \quad (1)$$

where μ is the mean of the health variable, h^{max} and h^{min} are the maximum and minimum values of the health variable, respectively, and $CI(h)$, the conventional concentration index. Next in the paper we explain the data and the variable definition.

3. Data and variable definition

3.1 Datasets

Spanish National Health Survey

Our empirical analysis for Spain is based on the 1987 and 2006 Spanish National Health Surveys (SNHS). These are nationwide cross-sectional surveys that collect information on the level of health and the socioeconomic characteristics of individuals living in Spain. The surveys contain separate samples for adults (>16 years old) and children. For the purpose of this study only data from the adult sample will be used in the analyses.

Health Survey for England

The Health Survey for England (HSE) comprises a series of annual surveys beginning in 1991. The HSE is commissioned and published by the NHS Information Centre and it is designed to provide regular information on various aspects of the nation's health. All surveys cover the adult population aged 16 and over living in private households in England. Children were included in every year since 1995. However, for the purpose of our analysis we focus on the adult population aged 16 and over. In this study we use the 1997 and 2007 cross-sections of the HSE.

Individual weights (provided in both the SNHS and the HSE) were applied in all computations in order to make the results representative of the Spanish and the English populations.

3.2 Variables

In our analysis we consider the following lifestyle related indicators: individual obesity, excessive alcohol use and heavy smoking. As in previous studies, the obesity measure is derived from the widely accepted Body Mass Index Indicator (BMI) (i.e. weight in kg

divided by the square of height in metres). While in the Spanish National Health Survey the BMI is obtained on the basis of respondents' reported weight and height, for the English case, an objective measure of BMI (measured directly by a nurse) is used. Obesity here follows the World Health Organization (WHO) definition, which considers that an individual is obese if $BMI \geq 30 \text{ kg/m}^2$.

For the purpose of this study, an indicator of heavy smoking is considered. Following the WHO approach, a heavy smoker is defined as an individual who smokes at least 20 cigarettes per day. However, due to the large number of individuals in our samples that consume 19 cigarettes per day (20 cigarettes seems to be a focal response), we have relaxed the previous threshold to define heavy smoking to 19 cigarettes per day.

The definition of overconsumption of alcohol in the HSE is based on the number of units of alcohol consumed by the individual. The threshold considered in the HSE to define excess consumption of alcohol follows the Department of Health recommendations, being 3 units per day for men and 2 units per day for women. For the case of Spain, it was not possible to disentangle the number of units drunk by individuals and hence, a variable showing whether the individual has consumed alcohol in the last two weeks is used as a proxy.

The ranking variable is the equivalised total income earned by the household for both countries, defined as monthly income for Spain and annual income for England. In the Spanish National Health Survey (SNHS), income is measured as a multi-category variable including 12 categories in 1987 and 8 categories in 2006. Given the high proportion of item non-responses and the fact that income is not measured as a continuous variable in the SNHS, we have imputed household income by regressing the lower and upper bounds of each income interval on a set of variables such as education, activity status and socioeconomic position of the main earner as well as region of residence. The income estimates are similar to other health surveys.

Descriptive analysis

Descriptive statistics on unhealthy behaviours and the ranking variable are shown in Tables 1 and 2 for both Spain and England.

The descriptive statistics for **Spain** in Table 1 show that men are more likely to engage in alcohol consumption and heavy smoking than women. For obesity, however, the data shows a similar prevalence rate for both men and women of around 15% for a measure of obesity based on self-reported height and weight. In the period of study, the prevalence of heavy smoking among Spanish males shows a reduction by a third of its initial prevalence. By contrast, obesity rates are steeply increasing for both men and women. In fact, the obesity rate as measured by the WHO definition has almost tripled between 1987 and 2006.

Table 1: Descriptive statistics, 1987 and 2006, Spanish National Health Survey, by gender

	1987		2006	
	Mean male N=12095	Mean female N=12729	Mean male N=10561	Mean female N=14647
Alcohol (2 previous weeks)	0.731	0.403	0.702	0.418
Obesity self-reported	0.062	0.059	0.152	0.148
Heavy smoker	0.412	0.075	0.153	0.068
Equivalent Income ^a	48402.3	52287.0	832.7	803.0

^a *Monthly equivalent income is expressed in pesetas in 1987 and in euros in 2006 (1 euro = 166,386 pesetas)*

Similarly, descriptive statistics for **England** in Table 2 show that the proportion of obese individuals has doubled between 1997 and 2007 for the adult population. While women exhibit higher obesity prevalence than men in both years, men double the female rates of alcohol use and smoking consumption both in 1997 and 2007.

Table 2: Descriptive statistics, 1997 and 2007 England health survey, by gender

	1997		2007	
	Mean			
	Male	Mean female	Mean male	Mean female
	N=3394	N=4042	N=2158	N=2510
Obesity	0.169	0.182	0.254	0.261
Alcohol – over limit	0.297	0.160	0.435	0.340
Heavy smoker	0.177	0.071	0.156	0.073
Equivalent Income ^b	20452.22	18293.54	32952.44	29217.63

^b *Equivalent income corresponds to annual equivalent household income, expressed in British pounds*

A comparison of life style characteristics between England and Spain reveals that in the two countries males in both countries are more prone to drink and smoke, with the prevalence of heavy smoking being very similar in both. *Over time, however, there is a substantial decrease in heavy smoking rates among Spanish males and a paradoxical increase in the rate of over consumption of alcohol in England for both males and females.* Despite a remarkable upward trend in obesity prevalence in both countries, obesity rates are far higher in England.

4. Results

4.1 Inequality patterns

In this section we present the results corresponding to the corrected Concentration Index, as proposed by Erreygers (2009) (defined here as ECI).

Table 3 reports estimates of the ECIs, which measure the level of socioeconomic inequalities in all unhealthy health-related behaviours examined for Spain. According to these results, we can conclude that there is evidence of significant income-related inequalities in alcohol use, heavy smoking and obesity in **Spain** in 1987 and 2006, though patterns differ by the specific life style factor used, as well as gender and age. Alcohol consumption inequalities are found

to be concentrated among the richest individuals and they slightly increase over the period. However, a different picture emerges when we examine heavy smoking. Indeed, while inequalities among women favour the less affluent individuals, even though declining over time, they appear to favour the most affluent individuals among men. Importantly, inequalities in obesity, for both males and females, tend to be concentrated among the poor, especially among women, for whom inequalities have tripled during the period of study.

Table 3: Income-related inequalities in lifestyle factors (Erreygers Concentration Index, ECI), 1987 and 2006, Spanish National Health Survey, by gender

	Alcohol (2 previous weeks)		Heavy smoking		Obesity	
	1987	2006	1987	2006	1987	2006
	ECI	0.17***	0.19***	0.09***	0.02***	-0.05***
female						
t-stat	14.9	16.9	14.3	2.9	-9	-15
ECI male	0.06***	0.11***	-0.04***	-0.04***	-0.04***	-0.05***
t-stat	5.8	8.1	-3.3	-3.9	-7	-5.3

*Note: *Statistically significant at 10% significance level; ** statistically significant at 5% significance level; ***statistically significant at 1% significance level*

A sensitivity analysis of the results by age (<45 years and >45 years) confirms that the patterns described above remain for all subgroups for all lifestyle factors, except for heavy smoking, for which the inequalities for females aged 45 or less turned significantly pro-poor in 2006⁷.

In contrast, evidence for **England** in Table 4 shows that the corrected Concentration Indices differ in sign depending on the lifestyle factor considered and the gender of the individual. Inequalities in excessive alcohol use, for both female and male individuals exhibit a positive and statistically significant concentration index, showing evidence of income-related inequalities in excessive consumption of alcohol that are concentrated among the most affluent. Importantly, we find that these pro-poor inequalities double between 1997 and 2007,

⁷ Results from this sensitivity analysis are available on request from the authors

and appear to be slightly higher among males in 1997. In contrast, both male and female exhibit similar levels of inequality in 2007.

As in the case of Spain, the HSE data for 1997 shows inequalities in the prevalence of heavy smoking that differ significantly on the basis of gender. Whilst inequality among women is disproportionately concentrated among the rich, for men it is disproportionately concentrated among the poor. However, in 2007 there is evidence of income-related inequalities in heavy smoking, concentrated in poorer individuals regardless of their gender.

In terms of obesity, there is evidence of statistically significant income-related inequalities for both women and men in 1997 and only for women in 2007. The distribution of these inequalities is pro-rich, with less affluent individuals concentrating the highest obesity rates.

Table 4: Income-related inequalities in lifestyle factors (Erreygers Concentration Index, ECI), 1997 and 2007 Health Survey for England, by gender

	Alcohol consumption over limit		Heavy smoking		Obesity	
	1997	2007	1997	2007	1997	2007
ECI female	0.13***	0.27***	0.02**	-0.04*	-0.077***	-0.070***
t-stat	9.5	10.6	2.4	-1.9	-5.6	-3.6
ECI male	0.16***	0.27***	-0.03*	-0.03*	-0.026*	0.016
t-stat	8.9	12.5	-1.8	-1.9	-1.8	0.7

*Note: *Statistically significant at 10% significance level; ** statistically significant at 5% significance level; ***statistically significant at 1% significance level*

Table 5: Direction of inequalities across time in Spain and England for lifestyle factors

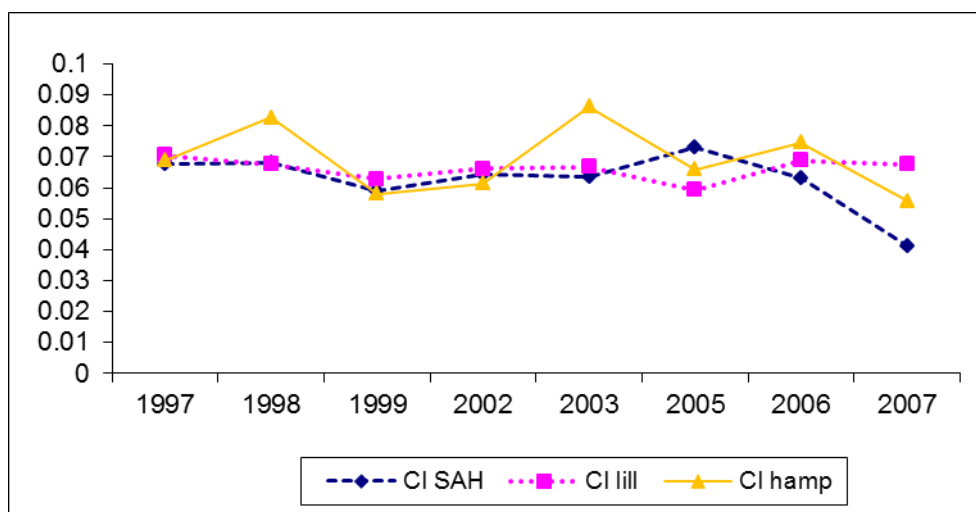
	Spain (1987 – 2006)		England (1997-2007)	
	Men	Women	Men	Women
Obesity	▲ (pro-rich)	▲ (pro-rich)	▼ (pro-rich → pro-poor, no significant)	= (pro-rich)
Alcohol consumption	▲ (pro-poor)	▲ (pro-poor)	▲ (pro-poor)	▲ (pro-poor)
Heavy smoking	= (pro-rich)	▼ (pro-poor)	▲ (pro-rich)	▲ (pro-poor → pro-rich)

According to the results summarised in Table 5, income-related inequalities in lifestyle factors have increased with time in both Spain and England (except for obesity in England), having a similar distribution: pro-rich inequalities in Spain and England for obesity, while pro-poor inequality for alcohol consumption, for both men and women. However, there is a different trend for heavy smoking in both countries. In Spain, the trend appears to be stable over time among males. In contrast, among women, pro-poor inequalities appear to decrease over time. In England, inequalities in heavy smoking increase for both men and women, but are concentrated in poor individuals for men, while for women there is a change of tendency from pro-poor in 1997 to pro-rich in 2007.

4.2. Relationship between inequalities in lifestyle variables with inequalities in health

In **England**, results of income-related inequalities in health variables are illustrated in Figure 1. Income-related inequalities in longstanding illness and in suffering a chronic illness decrease slightly from 1997 to 2007, while inequalities in self-reported health status have shown the greatest reduction over the period. Regarding the sign of these inequalities, higher categories of SAH are concentrated among the better-off, while chronic illness and health limitations are concentrated among the worse-off.

Figure 1: Concentration Indices for health-related variables, England 1997-2007.



Source: Costa-Font et al (2010)

Note: SAH refers to “good” or “very good” self-assessed health; *lill* refers to suffering a long-standing illness; *hamp* is an indicator of being hampered in daily activity by a long-standing illness

Hence, while in England, income-related inequalities in SAH decrease with time for all individuals, inequalities in lifestyle factors such as obesity, alcohol consumption and heavy smoking all increased over time (see Table 5 above).

In **Spain**, income-related inequalities in most unhealthy behaviours show an increasing trend, while inequalities in self-assessed health remain relatively stable over the period (see Table 6). The magnitude of inequalities for a binary indicator of ‘very good’ or ‘good’ self-reported health is substantial relative to the same outcome for England and the other life style factors.

Table 6: Concentration Indices for self-reported health, Spain 1987-2006

	Self-assesed health	
	1987	2006
ECI female	0.22	0.22
t-stat	21.1	19
ECI male	0.19	0.20
t-stat	18.1	16

*Note: *Statistically significant at 10% significance level; ** statistically significant at 5% significance level; ***statistically significant at 1% significance level*

Both in England and Spain, very good and good SAH is concentrated among the better-off while unhealthy behaviours are concentrated among the worst-off and hence, with poor individuals being at a disadvantage. The main exception is alcohol consumption, for which inequalities are concentrated among rich individuals in both countries, especially in England.

5. Methodological considerations in cross-country analysis

5.1 Alternative measures of inequality based on the Concentration Index

In order to make comparisons between population groups with different levels of average health, we have used the corrected version of the Concentration Index suggested by Erreygers (2009). The Erreygers CI has been previously employed to make cross-country comparisons of income related inequalities in health. For instance, in the study by Van De Poel et al (2009), normalization of the CI is used to compare rural-urban inequalities in several measures of children's health outcomes in 47 developing countries. Hernández-Quevedo et al (2010) use the corrected version of the CI to compare socio economic inequalities in health across European countries. The Erreygers CI is also useful to compare inequality measures not only across different groups of countries but also across population sub-groups. For instance, Hernández-Quevedo and Jiménez-Rubio (2009) apply the corrected version of the CI to immigrants and the native population in Spain.

Tables 7 and 8 show the corrected and uncorrected versions of the CI for England and Spain, respectively.

Table 7: Erreygers CI vs non-corrected CI for Spanish National Health Survey, 1987 and 2006

(a) Uncorrected CI

	Alcohol (2 past weeks)		Heavy smoking		Obesity	
	1987	2006	1987	2006	1987	2006
	CI female	0.10	0.12	0.31	0.06	-0.21
t-stat	14.9	16.9	14.3	2.9	-9	-15
CI male	0.02	0.04	-0.02	-0.07	-0.16	-0.09
t-stat	5.8	8.1	-3.3	-3.9	-7	-5.3

(b) Erreygers CI

	Alcohol (2 past weeks)		Heavy smoking		Obesity	
	1987	2006	1987	2006	1987	2006
	ECI female	0.17	0.19	0.09	0.02	-0.05
t-stat	14.9	16.9	14.3	2.9	-9	-15
ECI male	0.06	0.11	-0.04	-0.04	-0.04	-0.05
t-stat	5.8	8.1	-3.3	-3.9	-7	-5.3

Table 8: Erreygers CI vs non-corrected CI for Health Survey in England, 1997 and 2007

(a) Uncorrected CI

	Alcohol consumption over limit		Heavy smoking		Obesity	
	1997	2007	1997	2007	1997	2007
	CI female	0.14	0.16	0.08	-0.070	-0.106
t-stat	8.9	10.6	2.5	-1.92	-5.63	-3.61
CI male	0.20	0.17	-0.038	-0.051	-0.039	0.016
t-stat	9.5	12.5	-1.81	-1.91	-1.81	0.76

(b) Erreygers CI

	Alcohol consumption over limit		Heavy smoking		Obesity	
	1997	2007	1997	2007	1997	2007
ECI			0.02	-0.043		
female	0.13	0.27			-0.077	-0.070
t-stat	9.5	10.6	2.5	-1.92	-5.63	-3.61
ECI male	0.162	0.273	-0.027	-0.031	-0.026	0.016
t-stat	8.9	12.5	-1.81	-1.91	-1.81	0.76

In **Spain**, using the conventional rather than the normalized CI would result in an overestimation of the magnitude of the inequalities for some lifestyle factors such as obesity and an underestimation of the inequality levels for some other measures such as alcohol consumption. In the specific case of **England**, conclusions may also vary depending on which of the CIs is used. For example, for the case of alcohol consumption over the limit, the important increase on pro-poor inequalities for female individuals over time is clearly underestimated by the uncorrected CI. The normalization of the CI is therefore important in order to provide accurate information on the evolution and the magnitude of inequalities in life style factors to policy makers.

5.2 Definition of variables across countries

Cross-country comparisons of life style measures based on individual, country-specific health surveys pose the problem that key life style variables are defined differently in different health surveys, making cross-country comparisons difficult. For instance, in our study, the definition of over consumption of alcohol in the HSE is based on the number of units of alcohol consumed by the individual. The threshold considered in the HSE to define excess consumption of alcohol follows the Department of Health recommendations, being 3 units per day for men and 2 units per day for women. For the case of Spain, however, it was not possible to disentangle the number of units drunk by individuals as the National Health Survey only provides information about the number of glasses and not the units of alcohol drunk by the individual. Hence, a variable showing whether the individual has consumed

alcohol in the last two weeks is used as a proxy. However, we are aware that interpretation of these results should be made with caution, in particular for the case of alcohol consumption, as it is not strictly comparable across the two countries.

5.3 Cross-sectional vs longitudinal data

Relative to cross-sectional data, longitudinal data has several advantages including controls for non observable variables. Furthermore it is possible to gather information on population-representative disease trajectories, to explore how differences in outcomes are related to differences in earlier experiences and behaviours and to what extent individual and family choices about medical care, purchasing insurance, or asset accumulation interact with biological indicators. Ljungvall and Gerdtham (2010) use Swedish cohort data and find evidence of some difference between short-term and long-term measures of income that could be computed using longitudinal data. Hence, we can conclude that some differences can arise, and that the strength of control will be more limited under cross sectional data.

5.4 Reporting bias

A key challenge for health policy makers relates to the potential reporting bias caused by self-reported measures of health and other anthropometric information that are frequently included in health surveys.

Reporting bias regarding SAH has been identified as an important concern in the literature and can be defined as the situation in which different population groups systematically under- or over-report their health status relative to other groups. Due to its subjective nature, SAH can be influenced by a variety of factors that impact on perceptions of health. That is, the mapping of “true health” into SAH categories may vary according to respondent characteristics. Indeed, subgroups of the population use systematically different cut-off levels when reporting SAH, despite having an equal level of “true” health (Hernández-Quevedo et al, 2008). Moreover, the rating of health status is influenced by culture and language (Angel and Thoits, 1987; Zimmer et al, 2000), social context (Sen, 2002), gender and age (Groot, 2000; Lindeboom and van Doorslaer, 2004), fears and beliefs about disease (Barsky et al, 1992), as well as the way a question is asked, such as the ordering of the question with other

health-related questions and whether the question is posed via a written form or face-to-face (Crossley and Kennedy, 2002).

Various approaches have been developed to correct for reporting bias in the literature. The first is to condition the estimation on a set of objective indicators of health and argue that any remaining variation in SAH reflects reporting bias. For example, Lindeboom and van Doorslaer (2004) use Canadian data and the McMaster Health Utility Index as their quasi-objective measure of health, finding some evidence of reporting bias by age and gender, but not for income. However, this approach relies on having a sufficiently comprehensive set of objective indicators, such as mortality, to capture all the variation in true health, which are not usually included in the corresponding dataset.

The second approach to overcoming reporting bias consists of using health vignettes such as those currently included in the World Health Survey (Kapteyn et al, 2004; Murray et al, 2001; Bago d'Uva et al, 2008). The vignettes have been designed to represent fixed levels of latent health and so all variation in their rating can be attributed to the influence of reporting biases. Assuming that individuals rate the vignettes in the same way as they rate their own health, it is possible to identify a measure of health that is corrected for reporting heterogeneity (Bago d'Uva et al, 2008). However, vignettes are only included in specific surveys such as SHARE data or WHO Multi-Country Survey.

Objective measures such as physicians' assessments or hospital stays are best for comparative purposes, because individuals tend to evaluate their own health relative to that of their peers. If one group is characterised by a lower level of objective health, subjective assessments made in reference to different peer groups will mask this differential. However, the availability of objective measures of health, such as biomarkers, is limited. Studies such as Banks et al (2006) combine self-reported data with biological data, which could result in less ambiguous results. Also Johnston et al report that the income gradient appears significant when using an objective measure of hypertension measured by a nurse rather than the self-reported measure of hypertension included in the Household Survey of England (Johnston et al, 2009).

With respect to obesity, the use of self-reported measures of weight and height is also of great concern given the potential underestimation of the true obesity prevalence rates caused by

reporting bias (IOFT, 2005). For the case of Catalonia, in particular, Gil and Mora (2011) compare declared versus measured indicators of height and weight and find that the use of self-reported anthropometric data leads to an important underestimation of BMI and obesity especially among women. The authors found that for weight, the size of the bias represent the degree of dissatisfaction of individuals with their own body image; that is, the more satisfied an individual is about her weight or the closer the weight is to that of the individual's reference group, the less likely it is that she will misreport her weight.

In the specific case of this study, while the Health Survey of England includes a valid indicator of BMI, with weight and height measured by a nurse, in the Spanish National Health Survey, the BMI is based on self-reported data and therefore is likely to be underestimated. Hence, for the Spanish sample, we use the correction factors provided in Gil and Mora (2011) separately for men and women's BMI, which are, respectively, 1.012 and 1.039. As shown in Table 9, when the correction weights for self-reported BMI are applied to our data, the prevalence rates differ by almost 3 percentage points.

In any case, despite a remarkable increasing trend in obesity prevalence in both countries, obesity rates are far higher in England even after correction weights are applied to Spanish self-reported based BMI data.

Table 9: Descriptive statistics for obesity, 1987 and 2006 Spanish health surveys by gender

	1987		2006	
	Mean male N=12095	Mean female N=12729	Mean male N=10561	Mean female N=14647
Self-reported obesity	0.062	0.059	0.152	0.148
Obesity corrected for self-reporting	0.071	0.088	0.170	0.196

However, when income-related inequalities are measured for both self-reported obesity and its corrected version, inequality indices for the corrected measures of obesity in Spain are slightly more pro-poor, especially for women for whom the self-reporting bias is higher (Table 10).

Table 10: Income-related inequalities in obesity (Erreygers Concentration Index, ECI), 1987 and 2006, Spanish National Health Survey, by gender

	Obesity		Obesity corrected for self-reporting	
	1987	2006	1987	2006
ECI female	-0.051***	-0.135***	-0.064	-0.154***
t-stat	-9	-15	-9.5	-15.6
ECI male	-0.041***	-0.055***	-0.043	-0.051***
t-stat	-7	-5.3	-7.0	-4.7

Notes: BMI correction weights are obtained from Gil and Mora (2011)

Statistically significant at 10% significance level; ** statistically significant at 5% significance level; *statistically significant at 1% significance level*

While results on income-related inequalities in obesity are similar whether or not a correction for reporting bias is used, the absolute levels for this variable differ considerably after the adjustment (see Table 9). This shows the importance of adjusting for reporting bias when we are only interested in performing a comparative analysis based on prevalence rates.

5.5. Limitations of the CI

Although the Concentration Index is a widely used measure of health inequalities, it has several drawbacks that have been highlighted in the literature and are identified in section 2. One of the most important limitations of the CI for the purposes of this study is that the CI may depend on the mean of the health variable under consideration, making comparison of populations with different mean health levels problematic. To overcome this problem we have used the normalization of the CI proposed by Erreygers that allows cross-country

comparisons of the CIs since it is not mean-dependent and ensures that the range of the index lies between +1 and -1 when the variables of interest are binary (such as those related to life style).

The CI also provides a single numerical figure to analyse the distribution of a variable over time, and therefore focusing on this measure alone can be a very simplistic approach to analyse the distribution of a variable over time. For instance, in Brewer et al. (2008), the Gini coefficient – a similar indicator to the CI that measures income inequality - remains largely unchanged or becomes slightly more unequal during the Labour Government in the United Kingdom from 1996. However, while inequalities in income have narrowed considerably in the bulk of the distribution, the tails show opposite trends. These trends have cancelled out the reduction of the inequality in the middle-income percentiles, which comprise the bulk of the population.

In addition, it is important to highlight that the CI is purely descriptive, being a measure of the association between the ranking of individuals by their income level and some indicator of health status or health behaviour as in our case. However, assessment of the gradient of health or health behaviour is confounded to some extent by reverse causality. For obesity, a common finding is that obesity affects wages negatively, especially among women (Cawley, 2004; Norton and Han, 2008). A similar problem with unobserved heterogeneity might affect assessment of alcohol abuse.

5.6 Alternative measures of inequalities in lifestyle factor

In the health inequalities literature, there are a few measures that have been used extensively. These are: the range, the Lorenz curve and Gini coefficient, the slope and relative indices of inequality and the concentration index, among a few others that will not be discussed in this article (Wagstaff, Paci and van Doorslaer, 1991). The purpose of this section is to identify different measurement methods that could be useful in implementing cross-sectional comparisons of inequalities in life style behaviours.

The **range** compares the experiences of the top and bottom socioeconomic groups. However, this measure has several drawbacks, including the fact that intermediate categories are not

considered, and it does not take into account the size of the groups, which does not facilitate cross-country analysis.

The **Lorenz curve and Gini coefficients** allow us to measure absolute inequalities in health variables, without taking into account the socioeconomic dimension of these inequalities. It plots the cumulative proportions of the population, with individuals ranked by their level of health, from the sickest to the healthiest individual, against the cumulative proportions of health. The Gini captures the area between the 45-degree line, which represents perfect equality, and the Lorenz Curve.

A clear step forward from the Lorenz curve and Gini coefficient is the **Concentration Curve and associated Concentration index**, which captures the socioeconomic dimension of health inequalities, and has been described in detail earlier.

However, other measures of inequalities in health reflect this socioeconomic dimension. These are: the **slope index of inequality** and the **relative index of inequality**. The slope index of inequality (SII) is defined as the slope of the regression line showing the relationship between the level of health in each socioeconomic group and the hierarchical ranking of each socioeconomic group on the social scale. Given that SII is sensitive to the mean health status of the population, the Relative Index of Inequality (RII) would be a better choice if the focus is on making cross country comparisons. The RII can be obtained by simply dividing the SII by the mean level of population health (Regidor, 2004).

Of all these inequality measures, the range is the most extensively employed in cross-country comparative analysis given that it is relatively simple to calculate and interpret. However, it could lead to results that are in apparent contradiction to those obtained by other more complex measures of inequality. For instance, data for 2004/2006 show that the relative gap in life expectancy between the rest of England and designated to especially prioritises areas is widening relative to the baseline (1996/97) (Department of Health, 2007). However, the study by Sassi (2009) using the slope index of inequality found that inequalities in life expectancy between the least and most deprived health authorities increased during the early nineties but have declined slightly since 2002, representing, at least on this measure, a reversal of the trend.

6. Discussion

This paper has sought to examine the extent to which the persistence of income-related inequalities in unhealthy lifestyles is associated with the persistence of inequalities in health. We contribute to the research literature drawing on health survey data from Spain and England, two of the EU countries exhibiting the highest rates of change in unhealthy behaviours in recent decades. The objective is to examine cross-country changes in income inequalities in health prevention areas - and more specifically, obesity, smoking and alcohol beverage intake - to evaluate their contribution to changes in health inequalities over time.

Overall, we find that inequalities in unhealthy behaviours appear to vary significantly depending on gender and the age of the individual. In particular, the income-related inequality indices obtained in this study reveal that *inequalities in alcohol consumption concentrate among relatively richer individuals both in England and in Spain, whilst inequalities in obesity are disproportionately concentrated in the relatively poor*. Whilst in England the rates are similar between males and females, in Spain we find that females are more likely to be obese, a finding that is consistent with previous studies (Costa-Font et al, 2010)⁸. Inequalities in alcohol consumption are particularly significant in the English sample for both genders, while inequalities in obesity are disproportionately concentrated among females in both countries. As expected, *inequalities in tobacco consumption concentrate in low-income males in the two samples analysed*. Among females, inequalities in the prevalence of heavy smoking favour the relatively rich, although the trend reverses for England in the last year of study.

We can conclude that there is evidence of income-related inequalities in unhealthy behaviours in both England and Spain that vary according to the specific health behaviour considered, gender and age. The latter results from studies that use data from rich cross-sectional surveys, given that health surveys are the only surveys that include cross-country data on unhealthy behaviours without an obsolete time frame to draw relevant policy conclusions. Cross-country comparison of unhealthy lifestyles suggests that besides data

⁸ Despite a considerable increasing trend in obesity prevalence in both countries, obesity rates are still far higher in England even after correction weights are applied to Spanish self-reported derived BMI data.

comparability issues, income-related inequalities in obesity are unaffected by reporting bias corrections but absolute prevalence rates considerably differ after the adjustment⁹.

One of the main challenges for the cross-country analysis of life style behaviours is the lack of reliable nationally representative data for the key variables of interest¹⁰. In this study, we exemplify the limitations associated with cross-country comparisons of inequalities in unhealthy behaviours. Regarding obesity, in particular, despite the widespread recognition that self-reported weight and height measures may underestimate true levels of obesity and overweight, there are still only a few countries like England that collect weight and height measured directly by a nurse. The magnitude of the self-reporting bias concentrates around measuring the prevalence rates of obesity rather than for calculating socioeconomic inequality indices.

Other important sources of variation lie in some differences in variable definition across different health surveys. For instance, in the Health Survey for England, alcohol consumption is based on the Department of Health definition of a unit of alcohol, whereas in the Spanish case, the National Health Survey only provides information about the number of glasses and not the units of alcohol drunk by an individual. Finally, if the objective is to compare the level of socio-economic inequality in unhealthy life styles, many of the existing inequality indices pose an important problem, as they are mean-dependent. That is, they are sensitive to the mean of the life style indicator under consideration. In this article, we have chosen to use a corrected version of the Concentration Index to measure inequalities, which is not sensitive to the mean of the key life style indicator. It would be interesting to compare the results of this study with an alternative index of socioeconomic inequality, which does not depend on the mean of the key health variable, such as the widely used Relative Inequality Index.

⁹ However, it should be noted that the Concentration Index is a purely descriptive measure of inequality, and therefore assessment of the gradient of health or health behaviour is confounded to some extent by reverse causality between income and obesity or alcohol consumption.

¹⁰ Previous work on cross-country analysis of inequalities in self-assessed health (van Doorslaer et al, 1997) already shows the limitations associated with the results obtained when data is not homogeneous.

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Appendix

Table A1. Definition of variables for both national surveys

	Spain	England
Obesity	Self-reported height and weight; self-reported BMI ≥ 30 kg/m ²	Height and weight measured by a nurse; valid BMI ≥ 30 kg/m ²
Overconsumption of alcohol	Indicator of whether individual has consumed alcohol in the last two weeks	Self-reported units of alcohol consumed per day; 3 units per day for men and 2 units per day for women
Heavy smoking	Self-reported number of cigarettes smoked per day ≥ 19	Self-reported number of cigarettes smoked per day ≥ 19
Income	Equivalised total monthly income earned by household	Equivalised total annual income earned by household

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