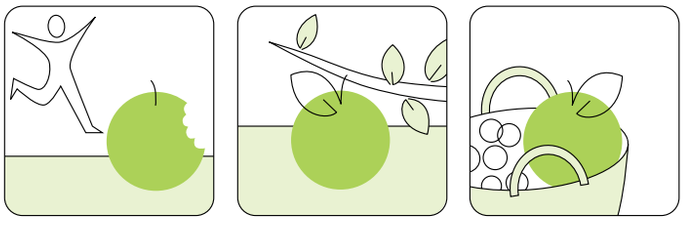
European Commission

Directorate-General for Health & Consumers

Expert Review and Proposals for Measurement of Health Inequalities in the European Union

Full Report



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March 2011

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Acknowledgments

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Executive Summary

Health is wealth. However like wealth, health is not equally distributed among individuals, families, social groups, regions and nations. Several studies have indicated that in all EU Member States, there exist significant differences in health between socio-economic groups, gender and regions. People with lower educational level, income, or employment status tend to report lower subjective health and have higher mortality and morbidity rates. These health inequalities have been the main challenge for public health policies at the Commission level as well as in the Member States. The Commission, in its 2009 communication, underlined the existence of large gaps in health among the EU Member States and invited the Governments of the Member States to develop targeted policies for reducing inequalities in health. In a similar effort, the WHO targeted the reduction of health inequalities both within and between countries by launching the programmes "Health for All by the year 2000" and "Closing the Gap" in 2008[1]. The relevant WHO report reached to the conclusion that health inequalities should be a major concern of governmental policies in all countries and that it is a matter of social justice to combat poverty and health inequalities, particularly among the most disadvantaged. Some EU states, such as the U.K., have developed over the last 40 years a growing concern to investigate and tackle socioeconomic inequalities in health. After the publication of the Black Report in 1977, the Acheson Report in 1998 and the recent Marmot report in 2010, several actions and public health policies have been implemented aiming at the improvement of the living standards of the poor and the reduction of overall health inequalities among regions and socio-economic groups.

Differences in health and especially those associated to socioeconomic or regional differences in the EU trouble the researchers involved in health inequality measurement for many years. As suggested in much literature (e.g. Wagstaff et. al., 1991) the conclusions reached by the various authors in issues about trends in health inequalities vary depending on the type of the measure used. A comment in Masseria, C (2009) is indicative: "*the measurement and monitoring of inequalities in health over time and across countries is not straightforward since the choice of the measure will influence the results*". Therefore, the choice of the appropriate indicators for health inequality measurement is a crucial matter, not only for the accurate estimation of the magnitude of inequality, but also for the proper monitoring of its variation through time.

Performing a trend analysis with "health inequality" data was one of the main objectives of this study. To this end, the first task was to select appropriate indicators for the measurement, through a detailed evaluation of existing proposals. This evaluation focused on the ability of an

[1] "Closing the Gap: Health Equity through action on the social determinants of health", World Health Organization, WHO, 2008.

indicator to capture inequalities and also to monitor existing trends. The existing EU data on mortality, morbidity and also self perceived health played the most important role in this analysis. A prerequisite was for these data to be available for all EU Member States and for a significant number of years (over 5 years, if possible).

This analysis was divided in two parts:

1. *The first one dealt with the mortality differences observed in the EU*. Some suitable measures of health inequality were associated with simple descriptive statistical measures such as the inter-quintiles ratio and the Coefficient of Variance. These measures are simple to calculate, easy to interpret, and very useful for a trend analysis. Their application revealed some interesting inequality patterns for the EU as a whole. The data availability at the country level was high and facilitated much the analysis. The application of *only* such simple indicators however was not considered adequate, as these lack sophistication and have theoretical drawbacks. A more proper inequality indicator such as the Gini coefficient can be used complementarily for an overall better measurement of health inequalities. The Gini-based ranking of the EU Member States based on their inequality levels and their distance from the EU total can assist in the further investigation of the determinants of the inequalities in the countries that diverge much from the EU as a whole. This part of the study analysed these issues in detail and also presented some interesting standardizations of the Gini coefficient. These can improve in some cases its use for ranking purposes.

In general, we concluded that,

- the selection of only one indicator for health inequality measurements may not be the appropriate solution to the problem.

This is in accordance with relevant investigations in the literature. A useful quote is a comment from Schneider, M.C., et.al. (2005): "*The use of different indicators can lead to different conclusions about the existence of inequalities... Regardless of the type of the indicator used, it is very important that there be a descriptive analysis of the differences...*"

For example, the use of the Life Expectancy gap indicator can lead to this descriptive analysis of the differences exhibited in the EU (also across time). Such results can be verified by the proposed monitoring solutions, which include the use of the Gini coefficient.

The evaluation of the various measures was based on specific qualitative and quantitative criteria. This led to the conclusions that,

- The *Gini coefficient* is the most appropriate solution for measuring health inequalities in the EU when the data at hand refer to mortality, life expectancy and health expectancy rates.
- It is however recommended that a life expectancy gap analysis or the inter quintiles ratio is always applied, to verify Gini's estimations.

The Life expectancy gap is a simple solution, very handy and easily understood by those involved in policy decisions in the field of health inequalities. The Inter quintiles ratio is also

very well known and commonly used in the European Union. These and other simple dispersion measures proposed, such as the Coefficient of Variance, offer the benefits of standardization in the measurement of health inequalities, an always desirable aspect.

- Gini is always expected to offer more insights on the existence of inequality than the other simple solutions, especially when the data are very demanding (i.e. are characterised by great variability).

A correlation analysis of the results using these indicators with EU data verified their assumed covariance. For reasons of comparison and verification, these indicators were also compared with other solutions (e.g. Theil's entropy index) that have recently attracted the interest of the researchers involved in the field. An example can be found in Schoen, R., Nau, C., 2008. The authors in this work showed that in the case of mortality data, especially with respect to the monitoring of trends,

- The Gini coefficient and some selected entropy indicators estimate similar trend patterns.

The application of the proposed indicators with EU mortality data (infant mortality rates and standardized mortality rates) for the period 1997 to 2008, served as an additional evaluation of the performance of the proposed indicators. These indicated low levels of inequalities (but statistically significant) and also some significant trends. On the other hand, the analysis of the HLYs indicator at birth and at the age of 65 revealed neither inequalities nor trends (also within each gender). That is, the proposed indicators showed superior differentiating power. At this point, we should mention some findings:

- The most common outcome of the selected indicators is an increasing trend in health inequalities in the period 1997 to 2008.
- But this increasing trend does not imply high inequalities. The trend pattern is far from reaching those high levels of inequality measured in terms of mortality in the EU, an observation that must be taken into account by policy makers in the area.
- There was no evidence for any significant variability or any substantial health inequalities between the NUTS II regions of the EU.
- A significant gap was found between the EU as whole and groups in the EU.
- As expected, there is a significant life expectancy gap between the two genders, and also with respect to educational level.
- A systematic relationship between educational attainment and mortality is observed. Life expectancy is less among persons with a low education level, and increases with educational level.

It is important to highlight the interest shown by the European Commission in the study of inequalities among vulnerable groups of people (e.g. migrants vs. non migrants). As Xavier, A., Price C., Nordheim, F. (2009) comment, migrants face higher risks of non-communicable diseases due to their specific socioeconomic and environmental conditions and usually suffer

by a greater mortality as compared to the rest of the population. This is a dimension of mortality inequalities and also of socioeconomic inequalities in morbidity[2] that has much room for further analysis in the future, provided there is progress in the data collection and availability.

2. *The second part of the analysis dealt mostly with Self-Perceived Health,* as measured by the various survey tools applied in the EU. In this part, the situation with regard to data availability posed some restrictions. Data from the EU SILC were analyzed and the comments of the "Note on harmonization of SILC and EHIS questions on health" of 2008[3] were considered in order to be able to perform the proper comparisons across time. SILC offers a valuable analysis of SPH data through the Mini European Health Module, for various social groups. A further analysis for additional social variables such as the "feel of difficulty or not with household's income" and for additional health variables such as "depression levels or disability prevalence" were tested through the use of the ESS, SHARE and LFS, generally for the period 2002-2008. The Odds ratio, Entropy type indicators (e.g. the Theil index) and the Concentration index were applied within this context.

The main objective in the analysis was the comparison between various social groups. The Odds ratios were extremely useful in most of the cases, since they are directly oriented to between-groups comparisons. The application of the Odds Ratio always implies the comparison of two groups, usually the extreme ones (e.g. poor vs. non poor). On the contrary, the entropy type indices and the concentration index evaluate the whole data distribution and estimate the distribution of health in all social categories together.

Based on the proposed indicators (that is, their evaluation and application with existing data), we concluded that,

- the Odds Ratios present the most adequate solution to the problem of measuring inequalities with respect to social categories. The reasoning for this selection lies mostly with the above mentioned easiness in carrying out all possible paired-comparisons between social groups. An additional reason is their use in statistical modelling techniques (e.g. logistic regression) that can provide more detailed interpretation of inequalities in terms of specific factors and covariates and can take also into account the possible non-linear effects of some social variables.
- The well known in the literature Relative index of inequality (RII) and Slope index of inequality (SII) are similar solutions, that are also related to statistical modelling techniques (e.g. linear regression). However, their application poses certain restrictions, notably the

[2] Council of the European Union, *Conclusions on Health and Migration in the EU*, Brussels, Council of the European Union, 2007.

[3] "Note on harmonization of SILC and EHIS questions on health" (2008), Eurostat, Directorate F: Social statistics and Information Society, Unit F-5: Health and Food Safety Statistics, European Commission

need to use a quantitative variable in order to estimate health inequality. This is not a natural approach in the case of SES characteristics.

As a consequence, it was considered necessary to suggest a similar solution that could verify the performance of the Odds Ratios and also offer additional insights in the study of health inequalities. It should be mentioned that the measurement of inequalities in Self-Perceived health and Morbidity requires a special approach. It is of the same importance to be able to compare two distinct social groups (e.g., *poor vs. non poor*) and to measure variations within the whole range of categories of a social variable.

As it was verified by the analysis of the available EU data,

- The same levels of inequality are estimated by the Concentration index and the Entropy type indices. The Entropy type indices are not widely known to researchers in the field, and appear somewhat complex (due to lack of familiarity with them). On the other hand, the Concentration Index is a very familiar tool in the study of the socio-economic health inequalities. The CI performs adequately, as also verified by the evaluation and analysis presented in this report. The CI has also a graphical interpretation which is appealing and in some cases appears to be the most important aspect in monitoring for policy-making. The adequacy of this indicator is also verified by the recent interest of the researchers such as Quevedo-Hernandez, C. et.al. (2009), in measuring inequalities in “unmet need for health care” based on the EU-SILC. However, the entropy type indices (especially the Theil’s index) although relatively complex, can also perform adequately and in many cases even better, with all kinds of existing EU data on self-perceived health, morbidity and disability.
- For these reasons, and given the increasing familiarity of researchers with Entropy type indicators, it is proposed to always accompany the application of the Odds Ratios with Entropy type indicators, such as various cases of the Theil and the Atkinson index.

Significant inequalities have been estimated in this part of the analysis with respect to income level, activity status, educational level, etc. E.g. “more health” is concentrated in the higher socioeconomic levels, characterised by higher (tertiary) education and higher income. In other words, for numerous EU Member States and the EU as a whole, health inequalities are present and are in favour of individuals with higher socioeconomic status.

Further improvements in the measurement of health and extensions in the existing harmonized survey instruments (e.g. EU SILC) can only improve the measurement of health inequalities based on the tools suggested in this report.

1. Introduction

Monitoring of inequalities in health is an important public health task. Interest in health inequalities among EU countries and their regions as well as among the various social clusters in the EU population is growing.

The search for the best appropriate "summary measure" of health inequality that can be observed individually or in terms of groups of individuals, is a task that occupies a lot the researchers involved in the fields of inequality research.

Lately in the EU, it has been recognized that a more focused effort is required. It is more natural to suggest and construct methodologies or indices that will be suitable for assessing trends in terms of mortality, morbidity and also self-perceived health. The selection of an appropriate indicator or an appropriate measurement methodology for health inequality across the EU-27 countries is a demanding task. Each available indicator has advantages and disadvantages. Simple indicators are usually comprehensive but may not have some specific desirable characteristics. Other indicators are more technical and difficult to understand, apply and/or interpret, but can assist more in explaining significant components of the concept "health inequality". Complex indicators can also be very useful in the decomposition of inequality. Based on the above, it is reasonable to state that one main goal in the study of health inequalities is to,

- propose appropriate measurement methods in the form of indicators that "estimate" and "capture" the exact level of inequality in a population (here the EU population).

The other very important goal of this study is to,

- monitor the variation of health inequalities in all levels of analysis (e.g. social groups, regions, individuals) through time. Thus, perform a trend analysis.

This report describes the outcomes of the project "Expert review and proposals for monitoring trends in health inequalities in the EU", Contract n° SANCO/2008/C4/04 – Lot 1 (SI2.530184). This project was funded and supervised by the European Commission, namely the Directorate of Health & Consumers (DG SANCO). The main objective was to contribute in the area of "**Monitoring Health Inequalities in the EU"**, by combining the best practices in health inequalities measurement with the most reliable data that can be used to calculate these measures.

The specific tasks of the project were:

- the review and analysis of the existing work done in the measurement of health inequalities in the EU.
- the review and analysis of the existing and planned data sets available across the EU, with an assessment of their suitability for the purposes of the analysis.

- to produce proposals and recommendations for summary measures that can monitor trends across the EU.
- to produce worked-out examples of the measures proposed to assess trends in health inequalities in the EU using existing data.

The flow of these specific tasks is presented in Figure 1 that follows. This report describes the main findings of the above and a number of workable options for assessing trends in health inequalities within the EU.

Future data collections of EUROSTAT on the subject of health measurement (e.g. the EU HIS, the new run of LFS ad hoc module on health and disability, etc) will lead to even more opportunities for the monitoring of health inequalities in the EU.

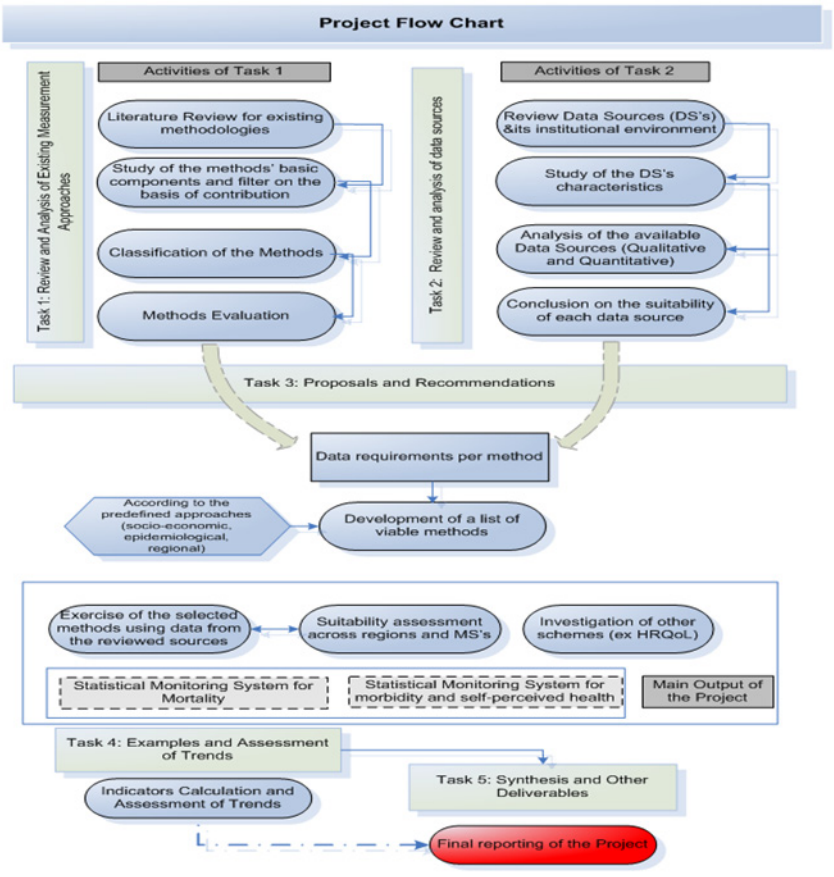


Figure 1: Work flow chart of the project
"Expert review and proposals for monitoring trends in health inequalities in the EU"

2. Measurement of Health & Health inequalities in the EU – Conceptual framework

This Chapter describes the basic concepts of the study at hand. First, the statistics in health that are collected by the various sources and surveys in the EU are described by focusing on EUROSTAT data on mortality and morbidity (e.g. data provided by the European Health Survey System). The basic categories of health indicators that can be used in a study of health inequalities are briefly defined and presented along with their relation to the analysis of health inequalities. The result is a short presentation a) of the most known definitions of the concept of "health inequality" that appear in the reviewed literature and b) of the most applicable measurement methodologies, more or less used in the EU. The extensive review and the critical evaluation of these methodologies is the objective of Chapter 3 of this report.

2.1 Health data - Health Indicators

Statistics in health are collected by various sources and surveys. For instance, Eurostat and DG-Health & Consumers (DG SANCO) have jointly developed a system of health statistics which is based on two pillars – macro-information on health care (both expenditure and non-expenditure) and causes of death (henceforth: CoD) and micro-information based on social surveys such as the European Health Interview Survey (henceforth: EHIS) and the EU Statistics on Income and Living Conditions (henceforth: EU-SILC). An additional macro-data collection is planned on diagnosis-specific morbidity, as are two additional surveys: A European Survey on Health and Social Integration (henceforth: ESHSI), and a European Health Examination Survey (henceforth: EHES). Altogether, these surveys form the European Health Surveys System (henceforth: EHSS).

Mortality is among the traditional "vital statistics" and is based on the collection of all registrations of deaths. As a consequence, mortality data are generally available only in aggregate form. These data refer to,

- *Standardized Death Rates (*henceforth: *SDRs)* for the EU members and the EU total for the period of 1997-2007. *Infant Mortality Rates (*henceforth: *IMRs)* for the EU members and the EU total for the period of 1997-2007. These are obtained from all the EU27 Member States. Data are also presented for NUTS II regions of the EU and the years 1996-2007.
- *Life Expectancy values at the age of birth (age 0) and at the age of 65* for the EU Member States and their regions by NUTS I, and II and the EU total for the period of 1997-2008. These are obtained from all the EU27 Member States. In most countries, adequate regional analysis is provided.

Morbidity and Self-Perceived Health (SPH), on the other hand, are currently based on survey data and consequently are generally available as raw data at the individual level. Depending on the survey, health is the prime focus of these surveys (for EHIS, EHES and ESHSI) or not (for SILC or LFS ad-hoc modules). Indeed, the examination of health inequalities in relation to social groups, which is of major interest in our study, is in some cases only possible because health related questions have been included in a survey mainly concerned with another topic. Thus, income-related health inequality can, in most countries, only be examined through surveys that measure income and health (e.g. EU SILC).

Mortality data are objective and strictly defined. Self perceived health data are subjective and affected by various factors. Combining the information in both can result to another set of data that can predict in a better way differences in health in the EU population. This combination, mainly through the "Life Expectancy" indicator and information on "limitations in daily activities" results to the increasingly used indicator of Healthy Life Years (henceforth: HLYs). This is similar to a Life expectancy measure, conditional to the judgment of its individuals health and morbidity prevalence. For reasons of better presentation and because of its direct relation with Life Expectancy, HLYs are included in the mortality part of the statistical analysis presented in the following Chapters.

As an instrument for the collection of data needed for EU Health Indicators, the use of the EHSS is of major importance. The EHSS is a combination of international and national survey instruments with appropriately designed European common modules of questions. It is composed of:

- a Health Interview Survey, managed by the Community Statistical Programme (EHIS) which is composed of 7 health questions in the EU-SILC, EHIS, EHSI, and the LFS 2011 ad-hoc module,
- a set of Special Health Interview Survey modules and additional interview surveys, managed by the Public Health Program (ESHIS).

The following figure shows the basic components of the EHSS.

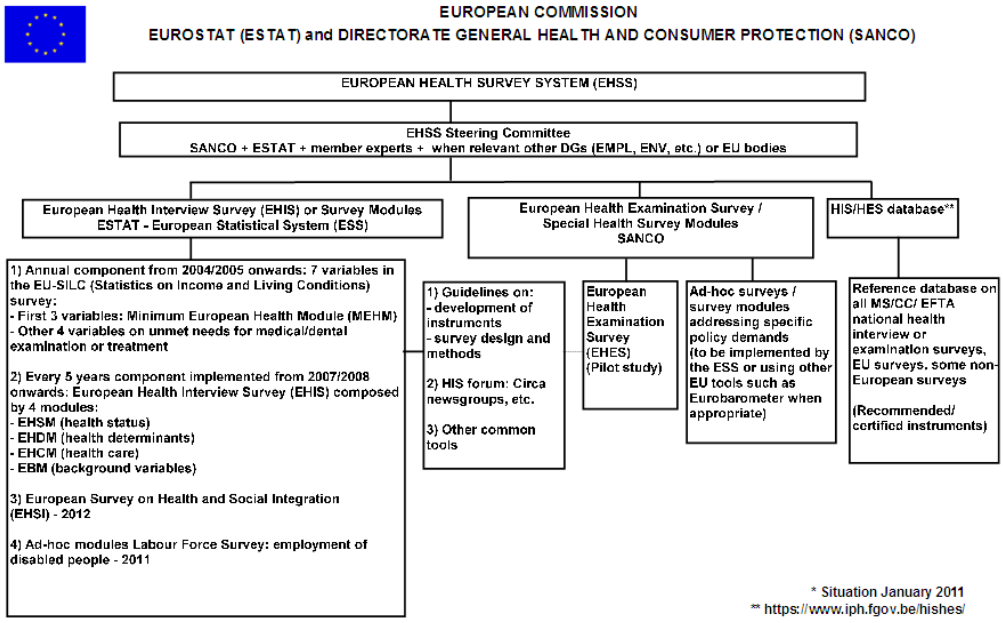


Figure 2: Schematic representation of the European Health Survey System (EHSS)

A first effort to comment on the suitability of data sources that can produce summary measures for health inequalities was performed in the previous reports of this project[4]. Initially their suitability was defined in terms of appropriateness to provide long term reliable data for all EU Member States based on regular statistics, produced under commonly accepted methodological frameworks.

As regards the statistical data sources reviewed, these are provided by various organisations, to serve their particular data needs. The methodologies, as well as the type of data collected, are not common for all these organisations often, they are not based on a country's official statistics system, but on other secondary data sources such as national level studies[5]. Such types of data sources can of course provide alternatives in health measurement. However, they are vulnerable in terms of methodological strength, especially if reliable cross country comparisons are needed. In contrast, some other data sources or data providers such as the *Eurostat Statistics Database* provide statistics based on countries' official statistics produced according to harmonised methodologies. Such data sources contributed the most to this study.

The suitability of the reviewed data sources was initially evaluated in terms of a qualitative and a quantitative analysis. In the quantitative analysis we made an effort to categorise the indicators collected from the various data sources in several dimensions. In the qualitative analysis we assessed the data sources from various organisations (Eurostat, OECD, WHO etc) from a methodological point of view, in an attempt to present all the information collected

[4] "Review and Analysis of EU data sources, SANCO2008C404Lot 1_SI2.530184" and "Supplementary Material for Task 1 and Task 2, SANCO2008C404Lot 1_SI2.530184"

[5] For instance some statistics in OECD Health Data 2009 are based on a National academic study ex: Acquired Immunodeficiency Syndrome (AIDS)

under a comprehensive structure. This analysis resulted to an exhaustive evaluation which showed which are currently the most suitable data sources in the EU, for the purposes of this project and similar uses.

The various European data sources are mainly characterized by dimensions such as Indicator categories, Type of data provided (e.g. raw, aggregated data, indicators, etc), classifications used (e.g. International Classifications of Diseases, ICD for morbidity indicators), Time & Country coverage. An exhaustive analysis can be found in a previous report of the project[6] .

Such data sources deal mostly with quantitative information (57,1% in total e.g., indicators for various dimensions of health, such as mortality indicators). There are also data repositories that comprise quantitative and qualitative information (28,6% in total). The existence of mostly quantitative information reveals the size of the effort undertaken by the various EU agencies to collect and harmonize data that can be used for the monitoring of health and also health inequalities in the EU area.

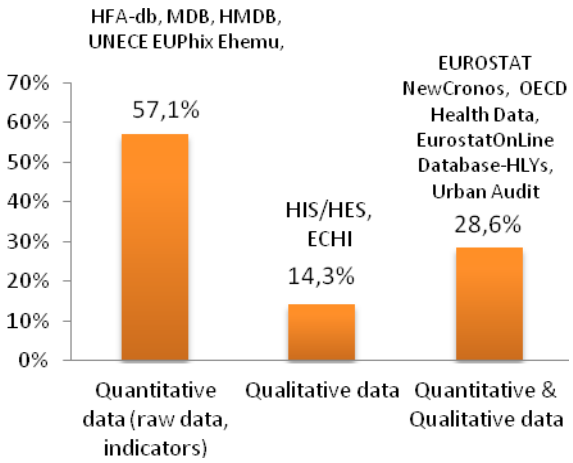


Figure 3: % European Data sources by Type of provided health information[7]

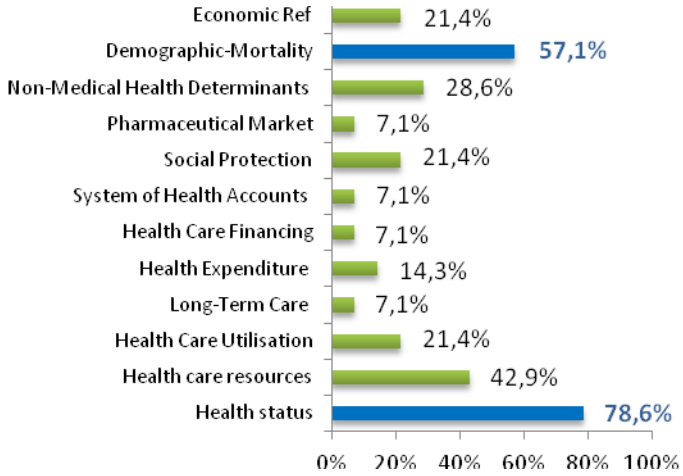


Figure 4: % of data sources covering health indicators by subject

Source: ***"Review and Analysis of EU Data Sources, SANCO2008C404Lot 1_SI2.530184"***

Some of the existing data sources cover the statistics needed for research in Health Inequalities to a great extent (e.g. the EUROSTAT Statistics Database, OECD health data) providing extensive analysis in all health topics. Others provide more specialised information (for instance, with a focus on the issue of mortality (WHO Mortality database) or Life expectancy (EHEMU database). Mortality data are commonly met (57,1% of the EU data sources, see Figure 4). Data on mortality usually appear in at least 3 data sources. Even more

[6] "Review and Analysis of EU data sources, SANCO2008C404Lot 1_SI2.530184"

[7] The HIS/HES and ECHI databases are mostly reference points to health indicators and provide less on quantitative data. For that reason these are presented here as qualitative.

commonly found are data on Health status, such as Self Perceived Health, Chronic illness and Disability, in almost 80% of the EU data sources (see Figure 3).

To summarize, we can say that, variations in health can be measured with respect to various health-related topics. The "Health Status" and "Mortality" indicators appear to be the most useful, since they are based on more data available. This data availability is observed both with respect to groups of interest for the analysis in this report, and also with respect to time (allowing therefore trend analysis).

2.2 What is Health Inequality?

Usually health inequality is related to observed divergences in health status between groups of individuals of a population (here, the EU population). Differences that are related "indirectly" with the health status of a population are also observed in various deterministic measures e.g., mortality rates or survival rates. Such measures reflect to a large degree the effect of differences in the daily life of individuals (life habits, e.g. smoking, nutrition, etc) to morbidity. Significant differences may be observed between various populations groups, such as the regions of the EU Member States (e.g. NUTS II level), cities, ethnic minorities etc.

Figure 5: Determinants of Health-Dahlgren & Whitehead's model
(Source: Dahlgren G and Whitehead M, (1998), Health Inequalities, London HMSO)

All these must be measured and interpreted. Interpretation is mostly related to the effort of linking the observed differences to the various groups of Socioeconomic status (henceforth: SES groups) that are formed in the EU or to some other dimension of differentiation (e.g. regional differences).

- "*Which are the most important descriptors of Health inequality in the EU population?*"

This is a question that must be answered within the following analysis.

Kunst and Mackenbach (1995) adopted an epidemiological or public health view to provide a workable definition of health inequalities:

"*Differences in the prevalence or incidence of health problems between individual people of higher and lower socio-economic status*"

Gakidou et. al. (2000) on the other hand defined health inequality as "*the variations in health status across individuals in a population"*. A key argument in their work is that, in an analysis of measurement methodologies, such as the one at hand, it is critical first to define in detail the quantity to measure and then proceed to its measurement (the selection of the appropriate methodology).

For the comparison of health status or share between the higher and the lower socioeconomic categories, a much descriptive approach is based on the very well-known Lorenz curve of inequality (see Figure 6). As it is described in the bibliography and also mentioned in this report, this is a curve related to the Concentration index and the Gini index of inequality. This is useful for much of the discussion that follows. It should be emphasized however, that the existence of a method allowing the graphical representation of health inequality does not mean that all proposed health inequality indicators must necessarily be characterised by such illustrative power. The attempt is to select the most adequate measures in terms of differentiating power, regardless of visualisation aspects.

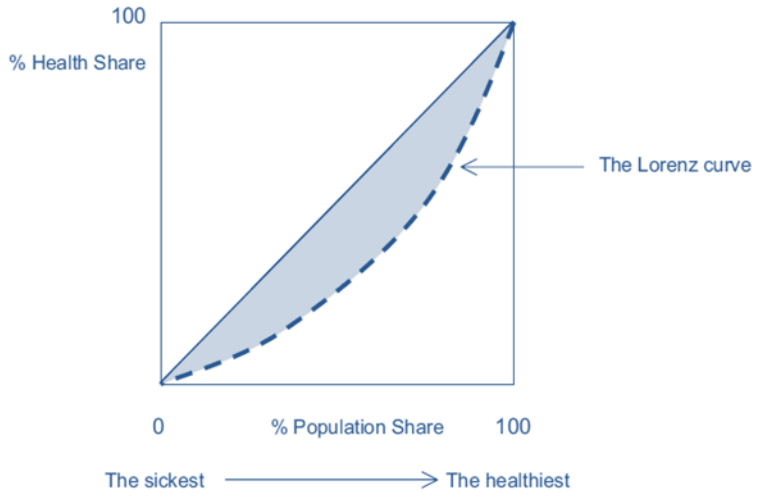


Figure 6: Definition of health inequality based on the Lorenz curve (Source: Yukiko Asada (2005)

The Lorenz curve describes the distribution of health (moving from the "sickest" individual to the "healthiest") across the population being studied. The differences exhibited in the data can be studied by comparing all values of the distribution or by just comparing the extreme cases of the population (e.g. deprivation deciles 1 to 10, or 1st to 5th income quintiles).

The methodologies involved in the measurement of such differences follow one or both of the above approaches. There exist indices of inequality, constructed in a way that compares only the extreme values. There are also indices that can tell us a lot about the whole health distribution.

As already commented, divergences in health can be located in various forms of health data. This report focuses on the one hand on the study of **Mortality and Life expectancy** variations within the EU countries and regions. Analysis of inequalities for smaller groups of populations, such as among cities of the EU and in immigrants or ethnic minorities is also of interest. For the latter issue, the possibilities for exploration are very much limited, due to low data availability.

The data availability issues also affect the analysis of mortality differences with respect to wealth, education and other socioeconomic characteristics of the EU population. Recently, attention has been brought upon the analysis of Mortality level with respect to Education. Although the analysis does not cover yet the EU as a whole, it is worth noticing some results and commenting on them, and also, importantly, to suggest ways to improve such measurements in the future.

Of equal interest is the study of variations on **Self Perceived Health and Disability** within the various SES groups that exist in the EU area. Comparison in these cases mostly concludes to a contrast of the extreme SES groups (e.g. Lowest vs Highest Income, Lowest vs Highest education).

It is of much interest to include in this analysis the inequalities in terms of Health Expenditure and Health care data (e.g. unmet need for health care). Several researchers have started using such data recently (see, Koolman, X. 2006, van Doorslaer E and van Ourti, T., 2009, or Van Doorslaer, E and O'Donnell, O., 2009). The presentation is however constrained by the limited availability of such data, which does not allow an adequate analysis of inequalities. E.g., Self reported unmet need for health care has been an issue of study by the EU-SILC and SHARE lately but differences in the sample of these surveys and the questions used in the corresponding questionnaires poses limits in terms of comparability between the EU member states.

Reference is made in cases where available information on future data collections exists, related to the use of the proposed indicators for measuring health inequalities and expected developments in the near future. Figure 7 presents some of the most indicative types of data for studying health inequalities in the EU. Health data categories are presented in a ranked form based on their availability and adequacy at the time of this study.

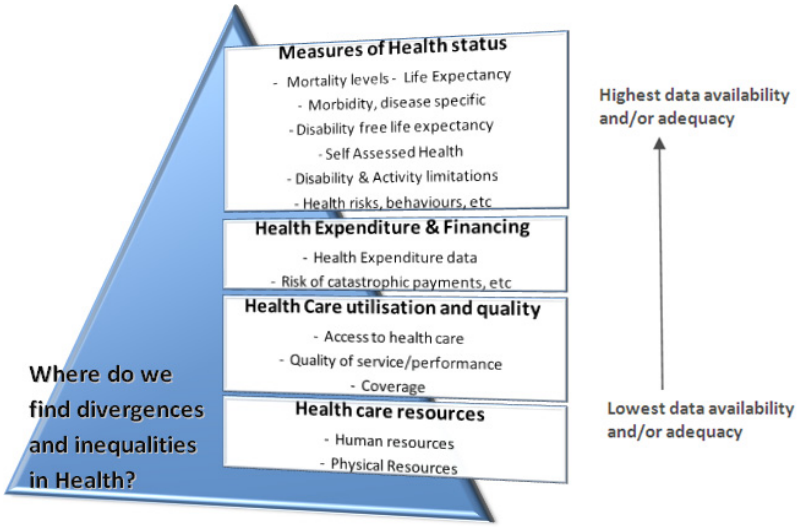


Figure 7: Data & Indicators that reveal inequalities in health (Based on the ECHI Taxonomy of indicators[8])

2.3 Measurement of health inequality in the EU – A historical review

The concept of inequality has long been an issue of intensive research among economists, epidemiologists, demographers, sociologists, statisticians, political theorists, politicians, and administrators. A detailed discussion of economic, societal or even philosophical notions of inequality is beyond the objectives of this study. However, within the economic doctrine, the views of an eminent professor, Amartya Sen,(1973) who worked extensively on this topic, are worth mentioning. He describes the "idea" of inequality as "*a very simple and a very complex*" notion. In a similar vein, Frank Cowell (1977) states that: "*Inequality is in itself an awkward word, as well as one used in connection with a number of awkward social and economic problems*". "*Inequality obviously suggests a departure from some idea of equality*" (Cowell, 1977, p.1). Equality, as a concept, is deeply rooted in the history of mankind, either as a revolutionary idea in the grenadiers of French Revolution or as a moral concept in the minds of Aristotle, Plato, Jean-Jacques Rousseau and other philosophers.

Equity is a policy objective in all societies, because there is always some concern for a more just or fair distribution of resources among social classes, regions or nations. McLachlan and Maynard (1982) argued that: "*The vast majority of people....would elect for equity to be a prime consideration of a health service*".

At the international level, WHO has stated (on the basis of research findings) that "*The existing gross inequality in the health status of people…must be drastically reduced*". In the targets for Health For All by the Year 2000, it is stated that "*The target on health inequalities presents a challenge: to change the trend by improving the health opportunities of disadvantaged nations and groups*". The meaning of equity in health proposed by the WHO in the programme HFA

[8] http://www.healthindicators.org/ICHI/general/ECHI_Hierarchy.htm

2000 includes both a “moral” and an “ethical” component: It refers to differences which are unnecessary and avoidable, but in addition, are also considered unfair and unjust.
Equity in health in WHO terms is defined as:

- Equal access to available care for equal need
- Equal utilization for equal need
- Equal quality of care for all

In the epidemiological and health policy literature several authors have attempted to measure these aspects of health inequities.

2.4 Inequality Indicators - Definitions & Classifications

The family of measurement methods applied in the field of health inequalities is very wide. Measurement methods that appear in the literature usually arise from the disciplines of Statistics and Economics. These can be very “straightforward” and “simple” such as the very well known to researchers in many fields measure of “range”. Some are related to statistical modelling techniques such as logistic regression in the case of the Odds Ratios (henceforth: OR) or simple regression analysis in the case of the Slope Index of Inequality (henceforth: SII), and the Relative Index of Inequality (henceforth: RII). Statistical models offer more possibilities in terms of interpretation of health inequality. They are used to straightforward build and test a relation of the measured health inequality with several factors (usually social factors, SES variables). On the other hand, they appear rather complex to those researchers who are not familiar with statistics. Finally, there are some indices that are more known to the researchers involved in measuring inequalities in general, such as the Gini coefficient, and the Concentration index. These offer some advantages in the visualisation of inequality level, through the Lorenz and the Concentration curve.
Different measures can give information about different aspects of health inequalities. Some measures concentrate on the extremes, others study inequalities across the whole span of a distribution. A main distinction is between Absolute and Relative measures, see for example Houweling et.al. 2007. The authors in this work examine many aspects of these two approaches and give recommendations for monitoring health inequalities on the basis of empirical data. The interpretation of health inequality can also be quite different, depending on the measure used. The same applies for the analysis of trends in health inequalities (see Wagstaff et.al.1991). Usually, in order to have a fuller understanding of the health inequalities, it is better to use more than one measure and combine their outcomes.
A debate exists between the researchers that prefer to measure inequality with respect to the whole health distribution (e.g. using the Gini coefficient, or entropy type indices) and those that measure inequality across the categories of another variable (e.g. a SES variable), using the

Odds Ratios, or the Relative index of inequality (see Walker, A.E., Becker, N.G. 2005). It is also interesting the distinction between measures that manage to capture variations within the upstream (e.g. income level), midstream (e.g. health behaviour), or downstream (e.g. biological factors) health gradients.

In general, the distribution of health can be described with various types of statistical measures, such as dispersion measures, inequality measures, relative measures such as the coefficients that arise from statistical models (see e.g. Regidor E., 2004).

The approach followed in this report, concluded to the following taxonomy of indicators (based on pre-selected criteria):

i) **Simple measures** that are easily interpreted
ii) **Regression based measures**
iii) **More advanced measures** that take into account the whole distribution of health and usually satisfy many more of certain desirable properties.

This taxonomy was the result of the preliminary evaluation of the various measurement techniques but it was not the only one taken into account in the analysis of the proposed indicators. Apart from some basic filtering criteria, some additional criteria where used for a more advanced evaluation, e.g. indicator's closeness to widely accepted practices, applicability for a gradient approach (i.e. instead of focusing only on extreme segments of a population), measurement of non-linearity effects, use of theoretically sound measures (e.g. Concentration Index, Relative Index of Inequality) etc.

Both relative and absolute measures are useful for the evaluation of health inequalities. Sometimes the relative position of two indicators may remain unchanged, yet the absolute gap indicates narrowing trends between the worse and the better off. Many of the simple indicators are not unique to the study of health inequalities but are well known epidemiological indicators. Kunst and Mackenbach (1995) presented a battery of several health inequality measures of this type (such as the Rate ratio, the Rate difference and the Odds Ratios), along with simple numerical examples for illustration. The aim was to combine the desirable features of indicators from various approaches into a feasible (with the given data landscape) calculation base.

This report also focuses on such classifications by describing the various approaches and proposing the best solutions based on the indicators characteristics and the availability of data in the EU at the specific time frame. It takes into account evaluation criteria that are considered critical by the literature on inequalities (e.g., Harper S, Lynch J. 2006).

The proposed indicators were also evaluated based on their applicability with the available EU mortality and morbidity data. The evaluation concluded to the best choice of indicators for monitoring inequalities in health in the EU, based on the available data and also future data

collections. The results of this extensive evaluation and the rationale for the proposed solutions is presented in the following Chapter.

3. Most suitable summary measures for monitoring health inequalities in the EU

In the health literature *the first comprehensive approach* to measure health inequalities was published by Wagstaff A., Paci, P. & van Doorslaer, E. in 1991. These researchers critically assessed the various measures used to evaluate trends and cross country differences in socio-economic inequalities in health. Their focus was on six inequality measures ranging from simple absolute measures, such as the statistical measure of the "range", to more complex relative measures such as the Gini coefficient, the Index of dissimilarity, the Slope index of inequality and the Concentration index. Subsequently, Mackenbach and Kunst (1997) presented a more detailed analysis of health inequality measures by building on the previous work of Wagstaff et al. (1991), and by presenting some indicative examples using European data. In 2000, Gakidou E., Murray C.J.L. and Frenk J. from the WHO suggested that emphasis should be given to individual data and not to aggregate analysis. We should comment here that the selection of the proper approach really depends on the objective(s) of the analysis.

The following Sections describe the evaluation and selection of the most suitable solutions of summary measures for monitoring health inequalities in the EU. Experimentation was done with several indicators in order to examine and demonstrate the potential applicability of various indices in measuring in the best possible way the magnitude of health differences in the EU.

The indicators that were reviewed in previous reports of this project[9] were additionally evaluated using some more advanced criteria. These selection criteria involved,

- properties that must be satisfied by an "inequality indicator" in general, and
- properties that must be satisfied, more specifically, by a "health inequality indicator".

Properties such as "scale or time invariance", and "decomposability" are needed and are important for any selection of indicator. Inequality indicators such as the very well known in the literature Gini coefficient or the Concentration index gather some or all of these desirable characteristics. The Concentration index is very commonly used in the quantification of inter-individual differences, especially in the context of social inequalities (for example it is very frequently used in comparisons across income and education levels) but it can sometimes be misinterpreted, because its upper value of 1 is not valid in health inequalities issues. Remedies for this, in terms of corrections and standardizations, were also considered in the analysis.

[9] "Review and Analysis of Existing Measurement Approaches, SANCO2008C404Lot 1_SI2.530184"

Section 3.1 describes in brief, what we need to measure in the EU in order to capture the level of health inequalities, and which inequality indicators to use. Section 3.2 presents the most suitable solutions of inequality indicators for capturing variations that exist in terms of mortality in the EU. It also presents the key outcomes of an analysis of mortality in the EU and its regions, and an analysis of trends. Similarly, Section 3.3 presents the analysis of inequalities that are present in self-perceived health and other self-assessed morbidity data with respect to various social characteristics of the individuals. The relevant results focus mostly on Self-Assessed health data as measured by the Minimum European Health Module (see Figure 2). Such data arise from well known survey instruments in the EU, such as the EU-SILC, the SHARE and the ESS. These surveys are different in several ways and any comparisons must be performed with caution. Apart from trend analysis carried out with data from the EU SILC and the ESS, some "localised" comparisons were also conducted.

Finally, Section 3.4 discusses the results of the analysis of differences in "disability" within various "social groups" based on the 2002 EU-LFS ad-hoc module data. Some of the proposed solutions are considered quite adequate for the study of health inequalities with similar data that will be collected by EUROSTAT in the near future (such as the EU-LFS disability data from the 2nd run of the ad-hoc module on "Employment of Disabled People" that will take place in 2011[10]).

3.1 Which indicators do we need? - What do we need to measure?

The monitoring of Health inequalities through the use of carefully selected indicators can be examined in two stages:

- *First*, we need to ***measure-capture the exact level of inequality***. In order to perform this, it is necessary to define the characteristics of the health data to be used and the form and extent of the analysis to be conducted.

It is one matter to estimate inequalities-variations in terms of the mortality levels in the EU (e.g. based on mortality rates) and within the various breakdowns of the EU population (e.g. its regions, cities etc.) and quite another matter to carry out this analysis based on self-assessment health data across the various social groups in the EU population. Mortality data are "deterministic" and contain no subjective features. They represent one state of health which is death. Self-Perceived health data on the other hand are mainly "subjective" and are affected by various latent characteristics of the individuals. The selection choices depend on these and other important considerations.

The main objective in this report is to measure health inequalities and their statistical significance. It is also important to try to establish a "mathematical relationship" between the

[10] Commission Regulation (EU) No. 317/2010, "adopting the specifications of the 2011 ad hoc module on employment of disabled people for the labour force sample survey provided for by Council Regulation (EC) No. 577/98.

estimated inequality level and its descriptors (e.g. income, education). This kind of knowledge may assist in the future the effort to tackle such inequalities by revising public health policies.

- *The next* step in the investigation is to study the variation of health inequalities through time. Therefore, the selected indicators must also provide the means for the ***monitoring of trends***.

A trend analysis seeks for a pattern of inequality with respect to time. The discovery of such a pattern can be very valuable. Various statistical techniques offer the means for modelling such inequalities with respect to time. An immediate extension of such a study may be the "prediction" of health inequality levels with respect to certain predictors (e.g, income distribution) with the use of statistical trend modelling techniques.

Returning to the previously mentioned differences with respect to mortality (and population groups) and self-assessed health (and social groups), if the interest posed by the study is on mortality differences across the EU countries and their regions, then the choice of a simple absolute measure such as the Inter-quintiles ratio maybe an interesting solution, especially for a trend analysis. However, this simple measure can easily fail to retrieve certain characteristics of health inequalities. A more sophisticated solution may be more adequate.

In this context, one of the main objectives was the evaluation of inequalities at the national as well as at the regional level. Although not all the EU Member States provide regional data on mortality, several of them present an adequate analysis at the level of NUTS II regions. Others provide data only at the NUTS I level. Such complications were more evident in the evaluation of mortality differences across regions through time (trend analysis). The selection of appropriate indicators needed therefore careful considerations to compensate for these data problems. A recently grown interest is also in the study of differences in mortality by wealth, income, education and other social variables. Data availability for this analysis is quite limited and as a consequence, the results are rather inconclusive.

On the other hand, if the interest is on measuring health inequalities and their trend across the entire range of various social groups, then the choice must be made between absolute measures such as e.g. the Concentration index and the Odds ratios, and Relative measures such as the Relative index of inequality or the Relative Concentration Index. Relative measures are usually decomposable which means that they can facilitate a trend analysis within a social variable. Decomposability is also a main characteristic of entropy type measures (e.g. Entropy, Theil's index and Atkinson index) and, for this reason, entropy type measures may serve just as well, or in some cases even better, as a measure of social health inequality.

As it is described in the previous reports of the project[11], some of these indicators may lead to similar results when applied to various data sets. This is mainly due to their mathematical relation and similarities. In such cases, not all indicators are needed.

The following Sections (Sections 3.2 and 3.3) deal with the evaluation and the proposals for the most suitable solutions for monitoring health inequalities in terms of mortality across the EU and also morbidity (self perceived health, disability etc) across social groups within the EU. This evaluation is presented along with the study of inequalities within the EU for the period 1996 to 2008, given the data availability in each case.

Results on how "Health inequalities are evolving in the EU area" are presented and comments are offered which should be useful for policy making purposes, in particular with respect to the determination of the factors that cause these inequalities.

3.2 Inequalities in mortality across the EU area, regions and time

This section deals with the evaluation and the final proposals for the most suitable solutions for monitoring health inequalities in terms of mortality data (e.g. death rates or life expectancies) within the EU area, countries, regions etc. The following results present and explain the level of health inequalities on mortality in the EU area and its regional populations, as it was captured by the health inequality indicators tested.

3.2.1 Proposed Indicators

The applications ranged from the use of simple "statistical dispersion" measures (e.g. inter-quintiles ratio, see ANNEX II, Table A1) to more sophisticated ones (e.g. Coefficient of Variance, Standard deviation of log values, see ANNEX II, Table A1) and finally to general "inequality" oriented indicators such as the Gini coefficient and the Theil and Atkinson indices of the Entropy family of indicators (see also ANNEX II, Table A1).

More specifically, the outcomes of this research conclude to the use of the following inequality indicators:

The absolute/relative Life Expectancy gap

Life Expectancy is a widely used and accepted measure for monitoring the evolution of mortality within a population such as the EU. It can facilitate comparisons between demographic groups that exist within a population, such as between genders or groups of countries of the EU.

[11] E.g., "Task 5: Draft Final Report, SANCO2008C404Lot 1_SI2.530184".

Based on the above, it is very common in the health inequality literature to calculate the difference in life expectancy between two categories (usually the extremes) of a demographic or social group of a population.

This index is known as the Life Expectancy Gap (henceforth: LE gap) and is very simple in its application and interpretation (details are given in previous reports of the project[12] and also in Annex V in this report). As Harper S, Lynch J. (2006) propose, it is very convenient to apply an indicator that also has an easy understood graphical representation. This facilitates communicating health disparity indices to the researchers and policy makers.

The index has two forms:

Absolute Life expectancy gap:

$LE_i - LE_j$,

where *i,j* represent two groups being compared, e.g. males and females.

Relative Life expectancy gap:

$\frac{LE_i}{LE_j}$,

where *i,j* represent two groups being compared.

This index can be used for social group comparisons, for example to compare "rich" vs. "poor". As a simple solution it is very handy and easily understood especially to policy people involved in the field of health inequalities, but it is restricted in terms of its applicability since it requires Life Expectancy data.

It is however very useful for the description of the evolution of the health gap in the EU. As Schneider, M.C., et.al. (2005) mention, it is very important to have a descriptive analysis of the differences presented in mortality and health in general. The LE gap can facilitate this descriptive analysis and can also be used to verify the existence of inequalities captured by another indicator.

The Inter-quintiles ratio

Any general statistical measure used to express the variability of a set of values is also potentially a measure of what, in this project, we have been terming inequality. For example, the healthy life years at age of 65, the infant mortality rates or the standardized death rates in the EU constitute a set of 27 data points with a variability that can be summarized by any of more familiar statistical measures such as the standard deviation or the range. Since these measures are not related in any way with the particularities of the study of inequality, but can be applied with any set of data, they can be characterised as simple measures. The *Inter-quintiles ratio* is a case of such measure that is usually expressed as:

$$\frac{P_i}{P_j}, i \neq j$$,

where P_i and P_j are two selected quintiles of the same distribution.

[12] "Review and Analysis of Existing Measurement Approaches, SANCO2008C404Lot 1_SI2.530184"

For example, $\frac{P_{75}}{P_{25}}$ compares the 4th and the 1st quintile of the health distribution.

The advantages and the disadvantages of such an indicator are presented in the following SWOT analysis Table (Table 1). We emphasize on the "simplicity" and "easiness in understanding and interpretation". On the other hand, important restrictions on the usefulness of this indicator arise in cases of demanding data (very much variability), where what is first and foremost needed is to evaluate the whole distribution of the data and estimate the inequality level observed.

Table 1: SWOT analysis for the inter-quintiles ratio

Because of the simplicity of calculation and the applicability with any health variable, the inter-quintiles ratio is also a very promising *trend monitoring tool*. This was also verified by the data analysis presented in Chapter 3 of this report. Furthermore, the inter-quintiles ratios have been used extensively in the academic literature on income and health inequality and also in the European Commission literature[13], to highlight health inequalities across Member States.

The Coefficient of Variation (CV)

The *Coefficient of Variation* (henceforth: CV) as well as the *squared Coefficient of Variation* (henceforth: CV^2) have been used extensively in the literature of economic and health inequality (see, Atkinson A. 1970, Cowell FA, Mehta F., 1982, Chakravarty S.R. 2001). It is a normalized measure of dispersion and it is defined as the ratio of the square root of variance (standard deviation) to the average value of the distribution,

[13] Social Situation Report of 2009, European Commission

$$CV = \frac{\sigma}{\mu} = \frac{\sqrt{\frac{\sum_{i=1}^{n}(X_i - \mu)^2}{n}}}{\mu},$$

where σ is the standard deviation of the health distribution and μ the average health level.

The Standard Deviation of the logs (S_{log})

The *Standard Deviation of the logs* (henceforth: S_{log}) is another normalized measure that arises from the family of statistical dispersion measures. It is usually expressed as:

$$S_{log} = \sqrt{\frac{\sum_{i=1}^{n}(\ln X_i - \ln \mu)^2}{n}},$$

where X_i is a measure of health of the *i-th* individual (individual level data) or the *i-th* country or region (aggregate data). In our analysis X_i always refers to mortality rates in the EU Member States and/or regions. This indicator measures the standard deviation of the log values of the health distribution**.** The log transformation of the health variable offers more **standardization** and the opportunity to reveal some additional variations regarding the existing health inequality level. The advantages and the disadvantages of both the CV and the Slog are gathered in the following SWOT analysis Table (Table 2).

STRENGTHS	WEAKNESSES
■ Basic tool in distribution theory ■ Extensive use in the economic literature ■ A tool that offers "*normalization*" in the assessment of inequalities ■ Scale invariant ■ Easy to interpret ■ Easy to compute with every software tool ■ Offers easiness in group comparisons (e.g. countries) ■ Increases accuracy in cases of sparse data	■ Limited use with non ratio data ■ Sensitive to outliers in case of weighted data ■ It works satisfactory when individual data are available ■ The acceptable level of inequality is selected only empirically
OPPORTUNITIES	**THREATS**
■ Possibility to extend more its use in the health inequality measurement ■ Opportunity to perform Country, Region and Time comparisons in a fast and efficient way	■ Other indicators are more theoretically justified and more capable in capturing all the aspects of inequalities in health

Table 2: SWOT Analysis for the Coefficient of variation (CV) and the Standard Deviation of log values

Because of the weaknesses presented by the inter-quintiles ratio (see Table 1), the Coefficient of Variation and the Standard deviation of the log values of a health variable under consideration are proposed to always accompany its application. The property of “standardization” and “use of the whole health distribution” that are introduced by these two solutions can only improve to a significant extent the measurement of inequality when mortality data present extreme fluctuations.

The Gini Coefficient of inequality (*G*)

The Gini coefficient is very extensively used for the measurement of inequality, especially in the field of economics and income inequality measurement (see, Kawachi and Kennedy, 1997). This is one good reason for investigating its applicability for the present purposes. But mostly, the Gini coefficient is an informative measure, examining all parts of the distribution at once. It also facilitates direct comparisons with any quantitative variable which describes two or more populations, regardless of their sizes. It can therefore be used easily for the comparison of inequality between groups, countries or regions. It has a geometric interpretation: it can be defined as the ratio of two areas defined by a 45 degree line and a Lorenz curve in a unit box. It can also be expressed as a function of Gini's mean difference, or as the covariance between specific variables and their ranks, or in a special matrix form. All these interpretations and expressions favour its widespread use, because every formulation has its own appeal in some specific context (see, Xu, Kuan 2004).

The Generalized formulae of the Gini coefficient are,

Individual-Mean differences

(see, Lai, D, et.al., 2008):

$$G_1 = \frac{\sum_{i=1}^{n} |y_i - \mu|^{\alpha}}{n\mu^{\beta}}$$

Inter-individual absolute differences

(see, Gakidou, E.E., et.al., 2000):

$$G_2 = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j|^{\alpha}}{2n^2\mu^{\beta}},$$

where y_i is the health of individual *i*, μ is the average health level of the population.

The above expressions refer to the Generalized form of the Gini index, hence the parameters α, β (which range between 0 and 1), appearing in the expressions.

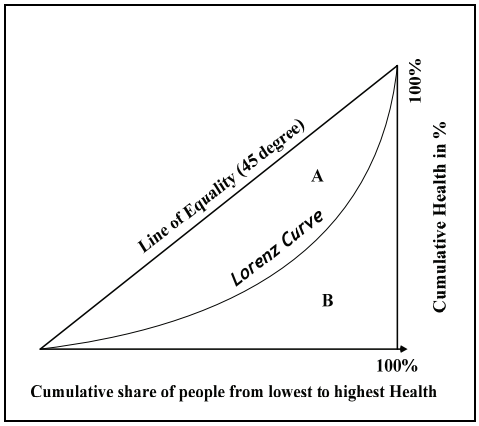


Figure 8: Example of a Lorenz Curve (Source: Task 1 Report Review and Analysis of Existing Measurement Approaches)

Selected values of these parameters lead to some of the previous proposed indicators. This indicates the *significant correlation between Gini and the latter in the field of mortality inequality measurement*. E.g., for $\alpha=2$, $\beta=1$, G_1 is the Coefficient of Variation (CV).

The advantages and the disadvantages of this solution are gathered in the following SWOT analysis Table (Table 3).

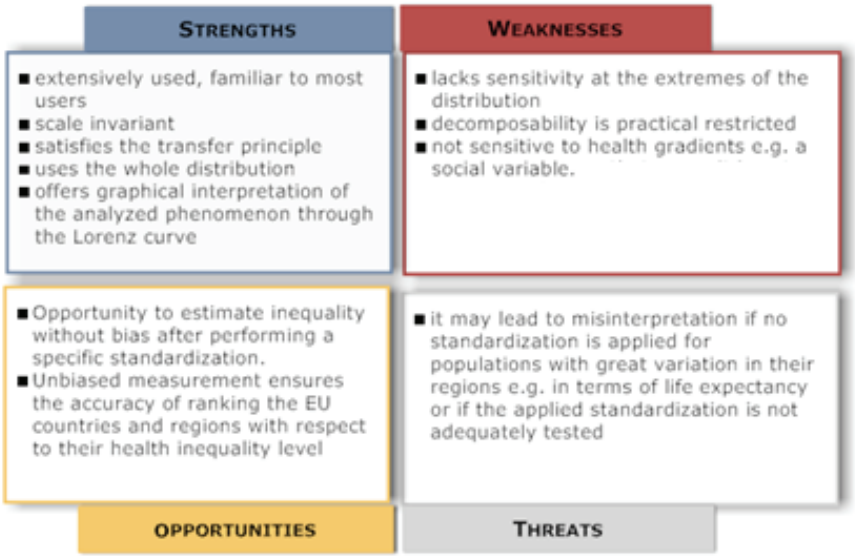


Table 3: SWOT analysis for the Gini coefficient

Although the Gini index cannot cope perfectly of variations that are related to a social gradient, it is adequate to apply when the need is to study Mortality variations between income level. So, it would be an interesting tool suggestion for any future studies of mortality inequalities in terms of social factors. For example, lately researchers parallelize mortality differences, either within or between societies, with income and longevity. A common finding is the "Preston curve," which shows that longevity increases with income (see Preston, S. 2007). Anyway, it appears very interesting to study such a relation with future EU data and the Gini coefficient appears a very good candidate for such a task (see Peltzman, S., 2009)[14].

We can present graphically much of the discussion of the indicators characteristics in this section, with regard to the three families examined, their accuracy in measuring health inequalities, their level of sophistication and some point of interest (see Figure 9).

[14] Peltzman, S (2009) describes the use of the Gini coefficient for studying mortality inequalities with respect to economic level and wealth of a society.

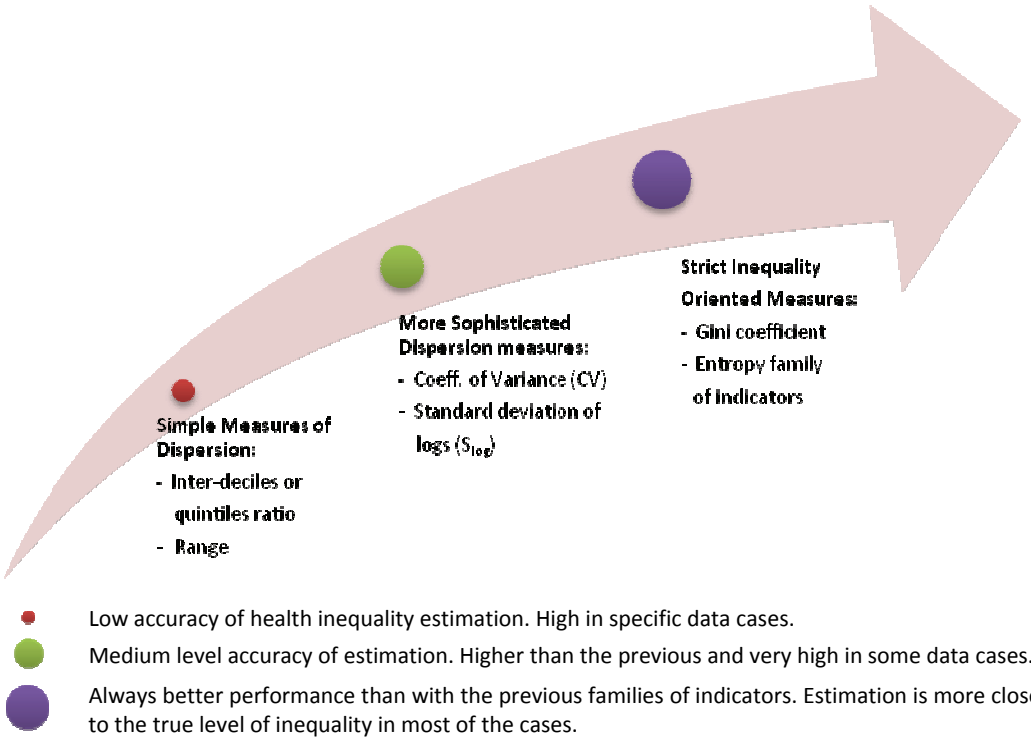


Figure 9: Accuracy Levels of achieved estimation in the selected families of indicators.

Value range and Cut-Off points of the proposed indicators

It is important to make the interpretation of the above indicators as clear as possible, by describing their cut-off points. This will make the communication of health inequality indices to the various users much more comprehensive.

The following Figure (Figure 10) is an illustrative presentation of the ranges of values of the applied inequality indicators with EU Mortality data.

In general, *large values of an indicator* suggest a case of *inequality*. But each indicator has a different structure. The inter-quintiles ratios usually range from 0 to 4, but larger values may occur, suggesting unusual inequalities. On the other hand the CV and the Gini coefficient have an upper value of 1. Values of these indices that approach unity, indicate very high inequalities of health.

For means of comparison and verification, these indicators are also presented together with other solutions that have recently attracted the interest of the researchers involved in this field (see Schoen, R., Nau, C., 2008), and arise from the Entropy family of indicators (e.g. Theil's entropy).

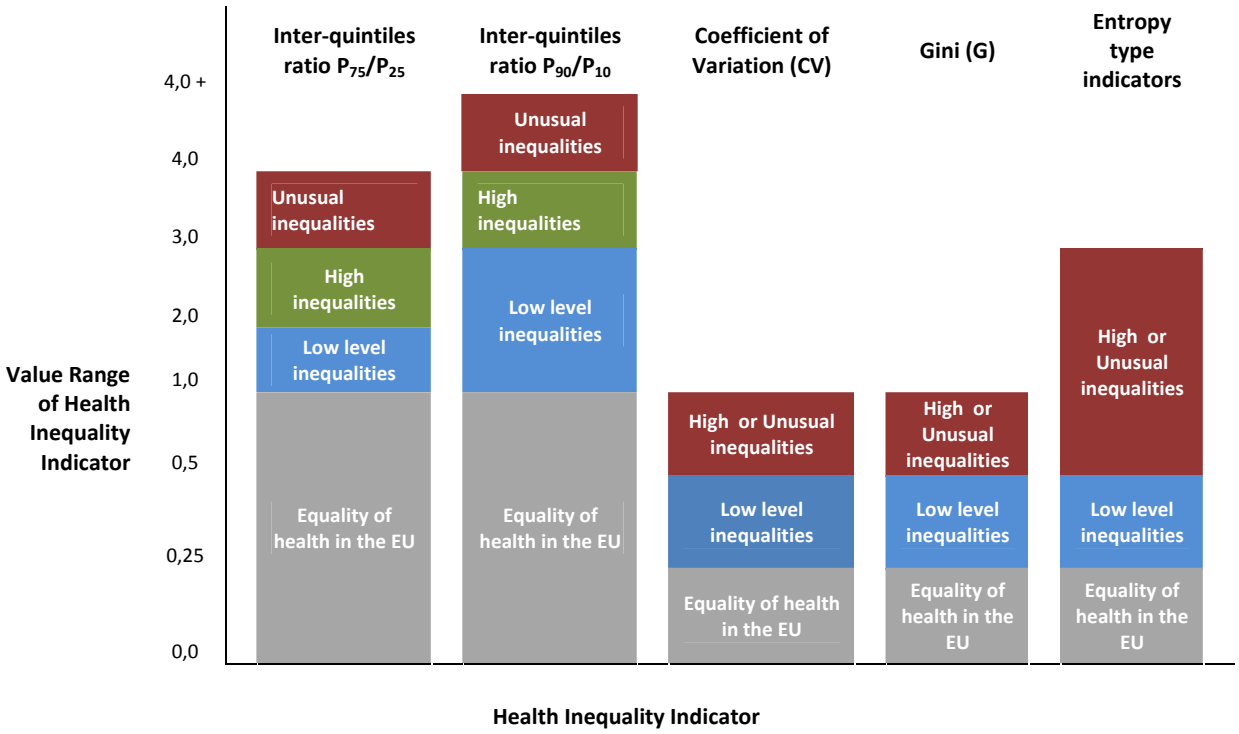


Figure 10: Indicative values and range of values for selected health inequality indicators in the field of Mortality.

A Correlation Analysis

In the following, we describe a correlation analysis of the results with the proposed indicators, with EU mortality data. The aim is to demonstrate the covariance observed between most of the proposed indicators.

For means of comparison and verification, these indicators are also compared with other solutions that arise from the Entropy family of indicators (e.g. Theil's entropy)

Table 4 presents the correlation of the applied indicators when using the HLYs data for the EU males aged over 65 years. Most of the proposed indices present almost "perfect" positive correlation (values of Pearson correlation are close to 0,9), meaning that in the case of the HLYs data, these indicators perform almost identically in the measurement of inequality. The only variation exists between the inter-quintiles ratio p90/p10 and the inter-quintiles ratio p75/p25. This correlation has a lower value close to 0,6, which is expected, given that the latter does not take into account values at the extreme areas of the distribution.

Indicator	p90p10	p75p25	Relative Mean Dev.	CV	Slogs	Gini	Theil0	Theil1	Atk0.5	Atk1	Atk2
p90p10	1										
p75p25	,616*	1									
Relative Mean Dev.	,829**	,681*	1								
CV	,839**	,628*	,977**	1							
Slogs	,771**	,543	,936**	,985**	1						
Gini	,854**	,634*	,987**	,995**	,968**	1					
Theil0	,843**	,635*	,959**	,995**	,984**	,984**	1				
Theil1	,802**	,589	,947**	,992**	,994**	,979**	,995**	1			
Atk0.5	,852**	,607*	,950**	,992**	,987**	,979**	,996**	,992**	1		
Atk1	,806**	,582	,940**	,990**	,994**	,976**	,995**	,998**	,993**	1	
Atk2	,768**	,539	,921**	,980**	,997**	,959**	,985**	,994**	,987**	,996**	1

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Table 4: Pearson Correlations between health inequality indicators for Healthy Life Years (age of 65, males) in the EU

The correlation analysis was also conducted with the same selected indicators and data on Infant Mortality Rates (IMRs) and Standardized Mortality Rates (SDRs). Table 5 presents the results on the IMRs. The conclusions are similar. Additional results are given in Tables A21 and A22 in Annex II.

Indicator	p90p10	p75p25	Relative Mean Dev.	CV	Slogs	Gini	Theil0	Theil1	Atk0.5	Atk1	Atk2
p90p10	1										
p75p25	,560	1									
Relative Mean Dev.	,684*	,907**	1								
CV	,688*	,884**	,987**	1							
Slogs	,617*	,875**	,946**	,952**	1						
Gini	,663*	,886**	,973**	,982**	,992**	1					
Theil0	,685*	,892**	,987**	,997**	,965**	,990**	1				
Theil1	,645*	,897**	,975**	,986**	,987**	,998**	,992**	1			
Atk0.5	,684*	,889**	,978**	,988**	,976**	,993**	,993**	,994**	1		
Atk1	,653*	,897**	,976**	,983**	,992**	,999**	,990**	,998**	,992**	1	
Atk2	,609*	,878**	,946**	,952**	1,000**	,992**	,966**	,987**	,976**	,992**	1

Table 5: Pearson Correlations between health inequality indicators for Standardized Mortality Rates in the EU.

It is important to measure the level of uncertainty of each indicator by proposing some error terms (e.g. a confidence interval). All the proposed indicators in this part try to measure the variability that exists in the used mortality data. This variability is what termed as inequality and for that reason there is no need to add an additional measure of that concept (already captured

by the proposed indicators). Confidence intervals could be useful in the case that a social variable may be involved, when applying for example the Gini coefficient in relation to income and not a single mortality variable. Based on the existing bibliography, the small sample variance properties of the Gini coefficient are not known, and large sample approximations to its variance are poor (see Mills and Zandvakili, 1997), therefore confidence intervals are usually calculated via bootstrap methods (see Efron and Tibshirani, 1997). The use of bootstrap techniques can be very useful in future applications of the proposed indices when regarding social characteristics (mortality vs education or income). As already commented the existing data availability does not allow the application of the proposed indices in a social variable setting and for that reason such calculations are avoided in the report.

Summarizing, we can confidently say that the selection of only one indicator for health inequality measurement may not be the appropriate solution to the problem. Different choices may lead, in some cases, to different conclusions. So, it is always more preferable to accompany the estimations produced by the best indicator with another indicator that usually works as well as the best one.

For example, the use of the Life Expectancy gap indicator can lead to a descriptive analysis of the inequality exhibited in the EU (also across time). Such results can verify the results of monitoring solutions, such as the Gini coefficient.

Based on the evaluation that was carried out, we concluded that:

- The Gini coefficient is the most appropriate solution for measuring health inequalities in the EU when the data at hand refer to mortality, life expectancy and health expectancy rates. Gini is expected to say more on the existence of inequality than the other solutions, especially when the data are very demanding (very much variability).
- It is however recommended to apply one of the other proposed simple solutions (such as the life expectancy gap or the inter quintiles ratio) in order to verify Gini's estimations.

3.2.2 Inequalities in the EU - Analysis of trends

The proposed indicators were applied with the available EU data on Mortality rates and Life expectancies. The results demonstrated their capabilities and performance and also led to some comments on the evolution of health inequalities in the EU.

All the analysis was based on mortality data extracted from the Eurostat Statistics Database for the period 1997-2008. There is no complete data availability for all the countries in the EU and for all the mortality indicators used. In particular the regional analysis of inequalities was restricted to some extent, because for many EU Member States there were no NUTS II level regional mortality data.

The analysis and the associated comparisons concluded to a detailed description of the performance of each indicator, based on existing data. An attempt was also made to discuss some of the proposed measures in the light of data that will soon become available. This was done were it was considered meaningful.

Health Inequalities in the EU as a whole

The analysis of Infant Mortality (IMRs) and Mortality levels at later ages (SDRs for age<65,), revealed "low" but "statistically significant" variations among the EU Member States. In that sense, the inequality in health as it is summarized by the indicators tested is small but considered very likely to be a real one, and not a result of random variations.

The following Figures (Figure 11 & 12) present a comparison of the performance of the applied indicators on the IMR and SDR data for the period 1997-2008.

- It is evident that *"Two different patterns are observed"*

The application of P_{75}/P_{25}[15] to the Infant mortality rates (IMRs) revealed a low downward trend during the study period. But the pattern estimated by the P_{90}/P_{10} ratio is different. It begins with a sudden drop in the years 1997, 1998, continuous with a small irregular pattern without any apparent trend and finishes with an increase from 2003 onwards. This is of course mostly due to the sensitivity of this indicator to extreme values (of mortality rates, in this case).

It is more safe to rely on the results of the P_{75}/P_{25} inter-quintiles index, since the results with this indicator are in agreement with the results using the rest of the applied indicators. The *CV*, Standard deviation of logs and the Gini coefficient reveal the same "low level" inequality, along with a light downward trend during 1997 - 2008 (see Figure 11 for details).

The analysis of the Standardized mortality rates (SDRs) shows the same levels of inequality but in all cases the existing trend reveals a steady but very slight increase during the study period 1997 - 2008. Figure 12 summarizes the results of this analysis. SDRs data for the time period of study are very smooth and because of this, all the applied indices of inequalities reveal the same slightly increasing pattern, without any significant variations between the indicators (even with the inter-quintiles index of P_{90}/P_{10} which is more sensitive to extreme values).

[15] It is worth to remind that this indicator take account of a small group of countries - the ones more close to the average infant mortality level)

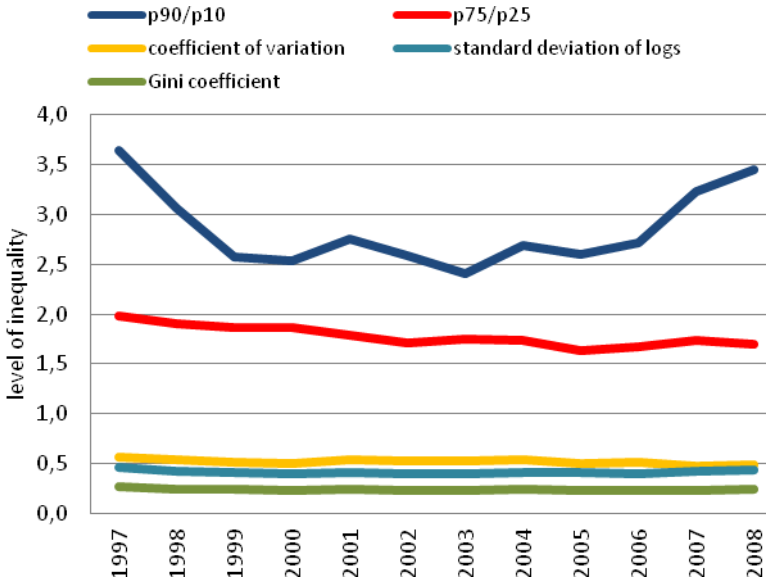


Figure 11: Trends in Health Inequalities as measured by selected inequality indicators based on Infant Mortality Rates for the period 1997-2008 and EU 27 data.

(Data Source: Eurostat)

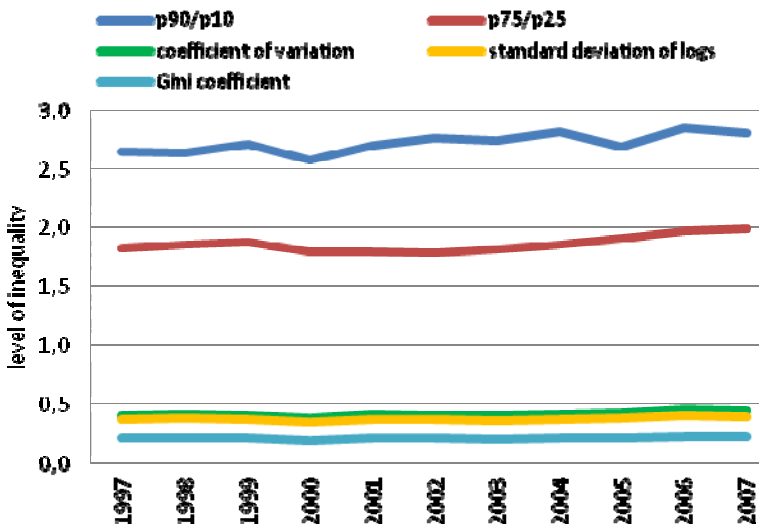


Figure 12: Trends in Health Inequalities as measured by selected inequality indicators based on Standardized Mortality Rates for the period 1997 - 2008 and EU 27 data.

(Data Source: Eurostat)

The analysis of the Life Expectancy rates showed the differences in life expectancy between different groups of European countries and also the differences when taking into account demographic characteristics such as gender. The following Figure reveals a significant gap between the EU as whole and groups of countries in the EU. This is expected to be reflected into significant differences (inequalities) among members of the EU when performing a regional level analysis. A significant increasing trend is also apparent in the evolution of Life Expectancy through time.

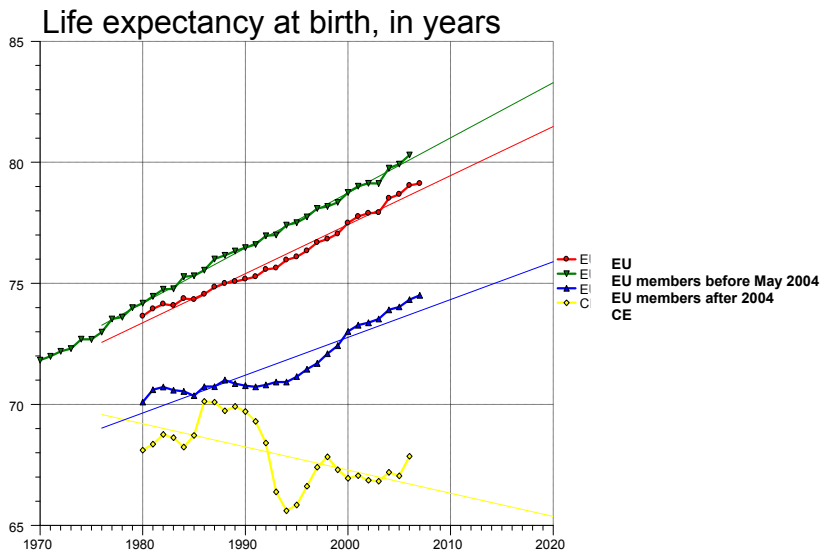


Figure 13: Trends in life expectancy at birth, by groups of countries and the EU as a whole (Source: Estimates based on WHO-HFA data base, 2009)

With regard to the difference in absolute life expectancy (at the age of 65) between males and females in the EU population it is shown that, during the period 2004 – 2007, this is consistently at almost 3 years more for the female population, in both the EU 25 and EU 27 countries.

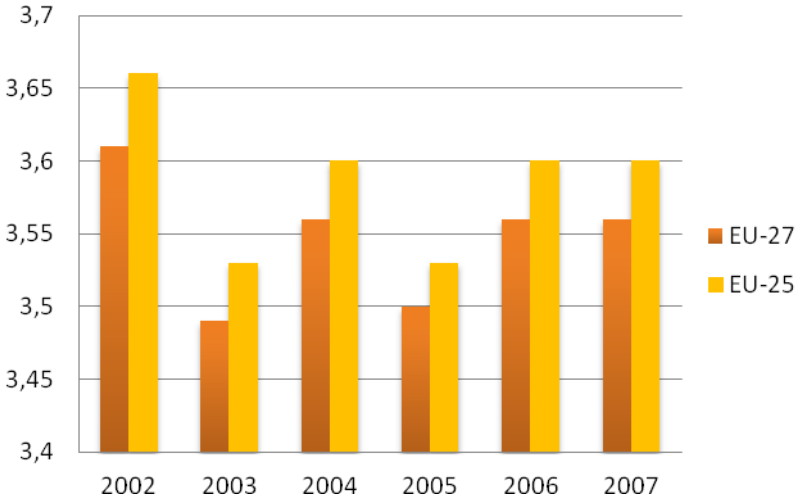


Figure 14: Life Expectancy (absolute) gap of the EU population's Males & Females at age of 65 (Data Source: EUROSTAT)

The above mentioned difference (gap) presents no increasing or decreasing trend in most of the EU Members States, except for the cases of Estonia and Bulgaria which present an increasing pattern and the cases of Belgium, Denmark and Greece which present a decreasing pattern (see Figure 15).

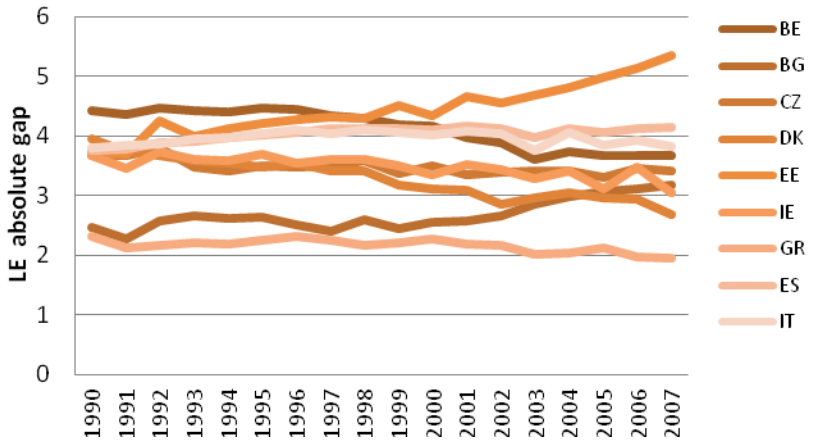


Figure 15: Life Expectancy (absolute) gap for the population at age of 65 of selected EU countries (Data Source: EUROSTAT)

Recently, much interest has been drawn in the study of mortality differences by selected social groups. Life expectancy by educational attainment is a very important indicator of socio-economic inequalities in health (see Corsini V., 2010). Based on the available data (some EU Member States and Norway), a systematic relationship between educational attainment and mortality can be observed. Life expectancy is lower among persons with the lowest educational attainment and increases with educational level. Moreover, these differences are more pronounced for men than for women. These effects are of course due to relations of education with income, life style, access to health care, etc (see the above mentioned work for details).

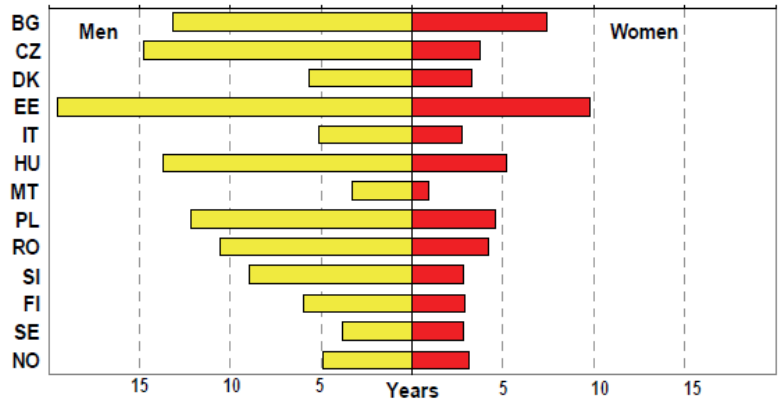


Figure 16: Life expectancy gaps between high and low educational attainment at age 30, women and men, 2007 (Source: Corsini, V. 2010, Statistics in Focus, EUROSTAT)

Although the study of socioeconomic mortality inequalities presents much interest, the current data availability poses many restrictions.

The use of the HLYs indicator may reveal different aspects of the existing inequalities. Figure 17 presents an analysis performed with HLYs data at the age of 65 for the period 1997 to 2007. The comparison is performed also with respect to the gender of the population and for

the EU as a whole. As it is observed, there exists an increasing trend of “low level health inequalities”. No differences are observed with respect to the gender of the population. Males and Females present the same levels of inequality when using the P_{75}/P_{25} or P_{90}/P_{10} ratio.

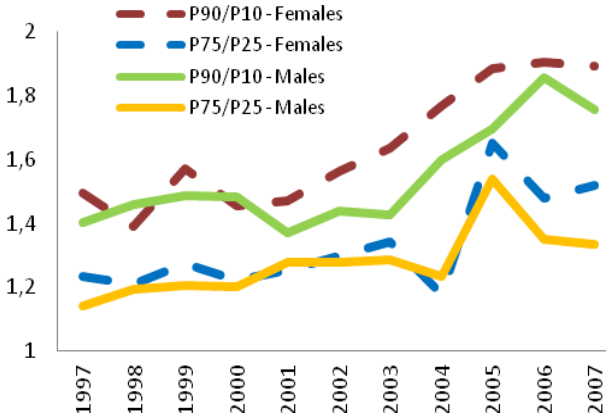


Figure 17: Trends of Health Inequalities based on HLYs at age of 65 for the period of 1997-2007 and 15 EU countries based on the inter-quintiles ratio – Inequality index: Inter-quintile index

(Data Source: Eurostat)

Health inequalities in terms of the HLYs indicator at the age of 65 are increasing during the period of 1997 to 2007. The inter quintiles or quintiles ratios offer mostly “easiness” to the estimation and the interpretation of health inequalities. This is a very much “needed” characteristic for an inequality indicator but in some mortality data cases this may not be enough. We should compare this picture with other measures offering more “standardization”. This is a concept that was first discussed in the Coefficient of Variation (CV) and the Standard Deviation. With standardized measures, the observed variations are expected to be more reliable than the ones shown in Figure 17.

Figure 18 shows this application of CV and Slog. It is interesting to note that the “real” levels of inequality appear lower now. Again, it is evident that there are no differences between the two genders in the EU population. The values of the CV are quite close. In general, we observe similar trend patterns to the ones shown with the inter-quintiles ratios, for the infant mortality rates data, the standardized mortality rates data and the HLYs.

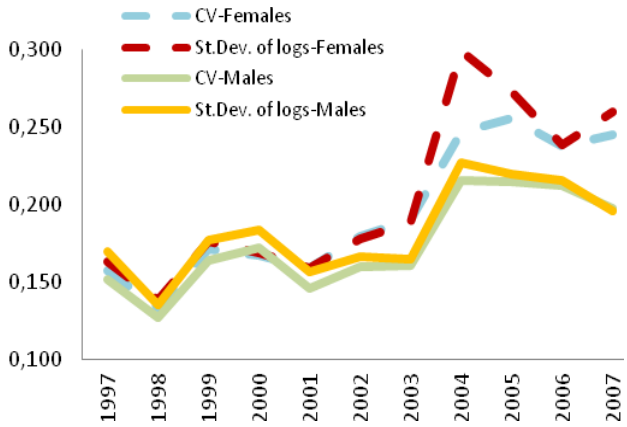


Figure 18: Trends in Health Inequalities based on HLYs at age of 65 for the period of 1997-2007 and 15 EU countries based on variance measures.

(Data Source: Eurostat)

The main difference is in the concept of "standardization" that has been introduced for the estimation of health inequalities. Both the applied dispersion measures (CV and Slog) normalize to some extent the variations captured by the inter-quintiles ratios. The application of the CV and other dispersion measures uses the whole mortality distribution and also filters-out any effects due to a few extreme values of mortality in the EU population.

The same benefits (and more) arise by the application of a more sophisticated inequality measure such as the Gini coefficient. The selection of the Gini coefficient contributes much more to the interpretation of the health inequalities, also due to the graphical representation with the Lorenz inequality curve. Its performance was additionally evaluated through a comparison with selected indicators from the Entropy family. Previous research (e.g., Schoen R. 2008) has revealed that when analyzing mortality data, especially with respect to monitoring of trends, the Gini coefficient and selected entropy indicators (e.g. Entropy *H*, or Theil, *T*, see Annex I and Table A1) estimate similar and reliable trend patterns.

This report gives some emphasis to the family of entropy indicators which are increasingly applied by the researchers involved in the field of socioeconomic inequalities in health (see, Bacallao, J, Castillo , et.al. 2002).

Due to the different scale of measurement of each inequality indicator used in this part of the analysis, a small difference between the Gini and the Entropy family of indicators appears (see Figures 19 & 20). This is not to be interpreted as showing differences in the "magnitude of health inequality" in the EU and the associated trends.

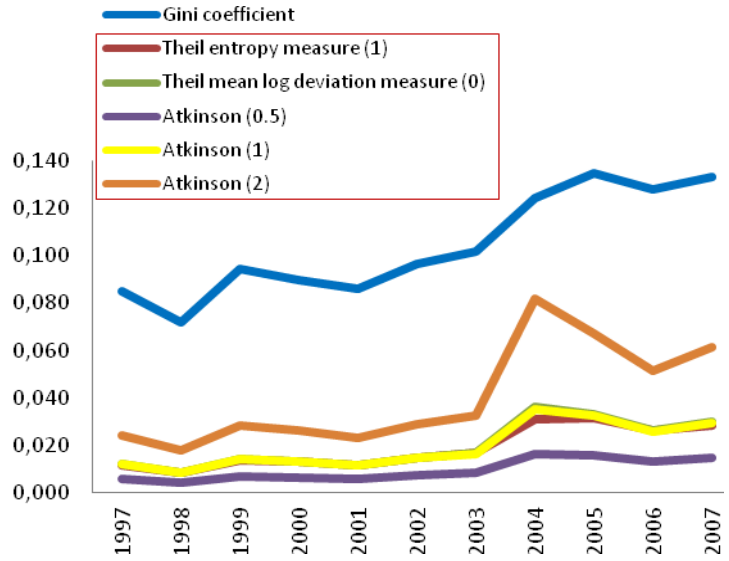


Figure 19: Trends of Health Inequalities based on HLYs at age of 65 of the female population for the period of 1997-2007 and 15 EU countries based on Gini index and selected entropy type indicators.

(Data Source: Eurostat)

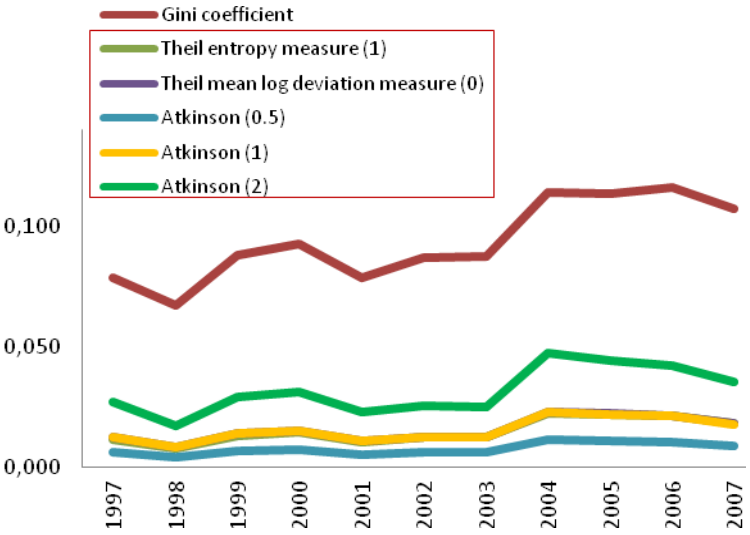


Figure 20: Trends of Health Inequalities based on HLYs at age of 65 of male population for the period of 1997-2007 and 15 EU countries based on Gini index and selected entropy type indicators.

(Data Source**:** Eurostat)

Summarizing, we can say that the most common outcome of the application of the selected indicators is the increasing trend of health inequalities during 1997 and 2008. This applies for all mortality data used (IMRs, SDRs and Life expectancy) and also for the HLYs data. No significant differences are observed between the two genders.

However, it must be emphasized that this increasing trend does not also imply high inequalities. The trend pattern is far from reaching those high levels of inequality measured in terms of mortality in the EU, an observation that must be taken into account by policy makers in the area.

Health Inequalities in the EU countries and Regions

A Key finding of the previous analysis was the absence of significant differences among the EU citizens in terms of their mortality pattern. It is however interesting to study these variations in a deeper analysis of the EU population, as this is commonly done with regional populations (NUTS II regions of the EU).

Based on the Infant Mortality Rates of the NUTS II regions in the EU, the same indices were calculated for each EU Member State. The results are presented only for the 17 EU Member States that provide a sufficient regional analysis of their data.

No trend is presented for almost all EU countries with both the P_{75}/P_{25} and the P_{90}/P_{10} inter-quintiles indices (see Figure 21 and Annex II). In terms of the estimated inequality level, the values of the P_{75}/P_{25} index for most of the countries examined vary from 1 to 2, as in the case of the *EU as a whole*. The same applies for the P_{90}/P_{10} index where the values usually vary between 1,5 and 3 as this is shown in Annex III. In other words, we observe low level inequalities and even almost equality in some cases. It is important to note again that the analysis presented refers only to the EU Member States that provide data for their regions and for almost all years in the study period. Therefore, for some slight differences that are present when comparing with the EU total, it is reasonable to assume that these are caused by the inequality levels of the rest of the EU 27.

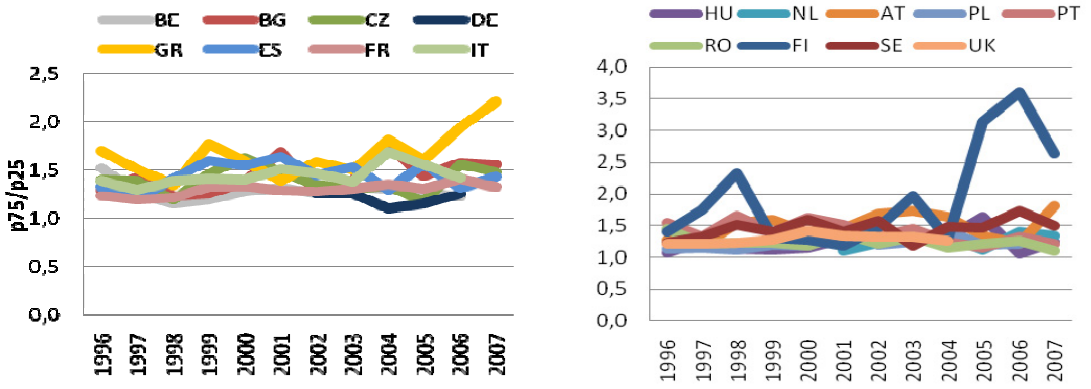


Figure 21: Trends of Health Inequalities of 17 EU countries as measured by the p75/p25 inter quintile ratio and based on Infant Mortality Rates (IMRs) of the NUTS II regions and the period 1996-2007 (Data Source: Eurostat)

The existence of no significant variability and the absence of any substantial health inequalities between the NUTS II regions of the EU is also verified by the Standardized Mortality Rates (SDRs), as shown in Annex III.

It is evident that,

- No trend exists between 1996 and 2006 for 10 European countries.
- No significant variation exists. Most of the cases are represented with almost straight lines.

- Health is almost equally distributed among the individuals of the EU regions.

These comments stand also for Belgium, Bulgaria, Italy, Poland, Romania, and Slovakia. The application of the same inequality index to the Life expectancy data of the EU regions does not tell us anything new for health inequalities in the EU regions. As it is presented in Figures A2 and A3 in ANNEX II, divergences (inequalities) in Life expectancy at birth and at the age of 65 do not exhibit a time trend. But it is worth to comment on the variability that is observed. Only in the cases of Poland and Portugal is an increase apparent. In general, all the inter-quintiles ratios suggest that no significant inequalities exist during the period 1997 to 2008.

The application of the Coefficient of Variance suggests the same low inequalities with a slight increasing pattern for most of the EU Member states. In the cases of Finland and Belgium, we observe larger inequalities than in the Czech republic and Hungary (see Figure 22). The application of the CV to the Life Expectancy and the Standardized Death Rates (at age of 65) leads to the same conclusion on the absence of some kind of trend pattern.

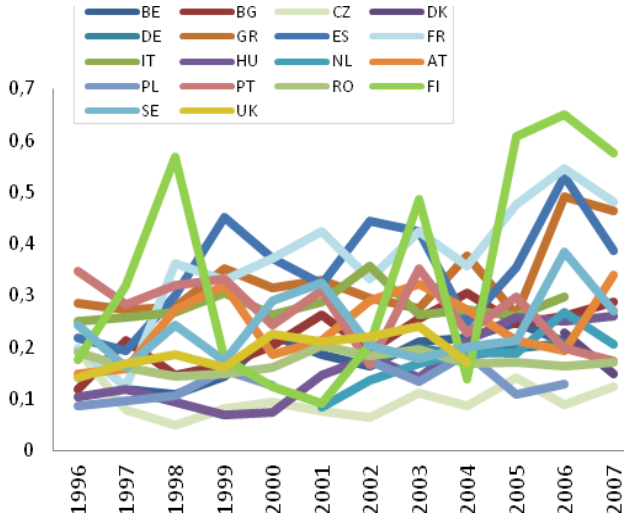


Figure 22: Trends of Health Inequalities measured by the CV on Infant Mortality Rates (IMRs) for the NUTS II Regions of 17 EU members and the period 1996-2007

(Data Source: Eurostat)

Due to the large data variability, the application of the Gini coefficient is expected to perform better with the above mentioned data. As it is presented in Figure 23 and in Annex II, the low inequalities or almost equalities are again verified. The maximum Gini values appear in the cases of Slovakia and Finland (values close to 0,2) and constitute the most recent representation of Gini based health inequalities (values refer to the year 2007). Regarding the rest of the Gini values and years, inequality levels vary from very low values (e.g. 0,01) to slightly higher values (e.g. 0,10).

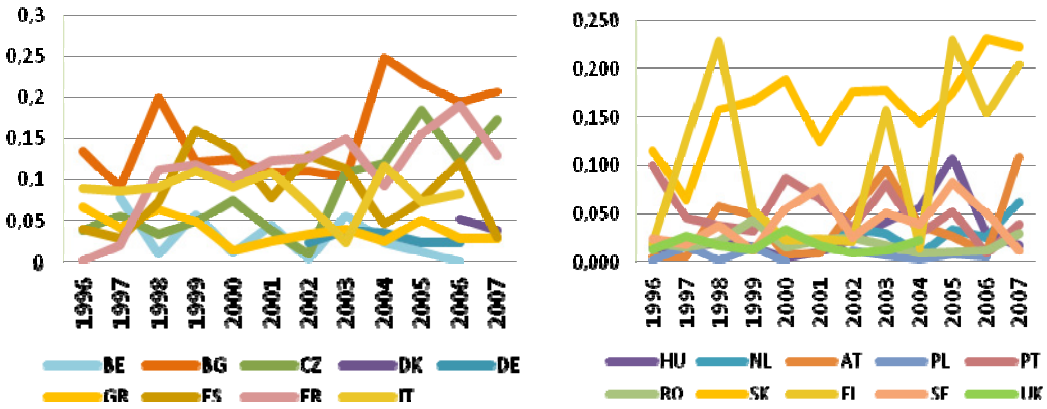


Figure 23: Health inequalities measured by the Gini coefficient on the Infant Mortality Rates (IMRs) for the NUTS II regions of 19 EU members and the period 1996-2007 (Data Source: Eurostat)

The interpretation of inequality levels in all countries is consistent with what was mentioned for the EU in total. In all countries, the values of the Gini coefficient vary from “very low” (corresponding to almost equality) to values close to 0,25 (corresponding to low inequalities). Some countries present an increasing and/or very fluctuating pattern. In Slovakia, France and Italy, the level of inequality steadily increases, but is still very small to be significant. In Netherlands and Bulgaria we observe much variation, which does not allow the extraction of any meaningful inequality pattern.

All the applied inequality indices can of course be used for ranking purposes. This means that we can rank the EU Member States in terms of their levels of inequality and also study this ranking with respect to time. Most recent applications base their analysis of ranks on the Gini coefficient (see e.g. Petrie, D. and Tang, K.K., 2008)

The Gini coefficient values were used to rank 19 EU countries based on their health inequalities. The country with the highest rank presents the highest levels of inequalities. As Figure 24 summarizes, some of the countries receive almost the same rank throughout the study period of 1996 to 2007. E.g. Bulgaria usually presents the highest inequalities, which implies a rank value close to 19. On the other hand, Austria, Romania and Portugal appear to have very low inequality or almost equality and are ranked in the first positions.

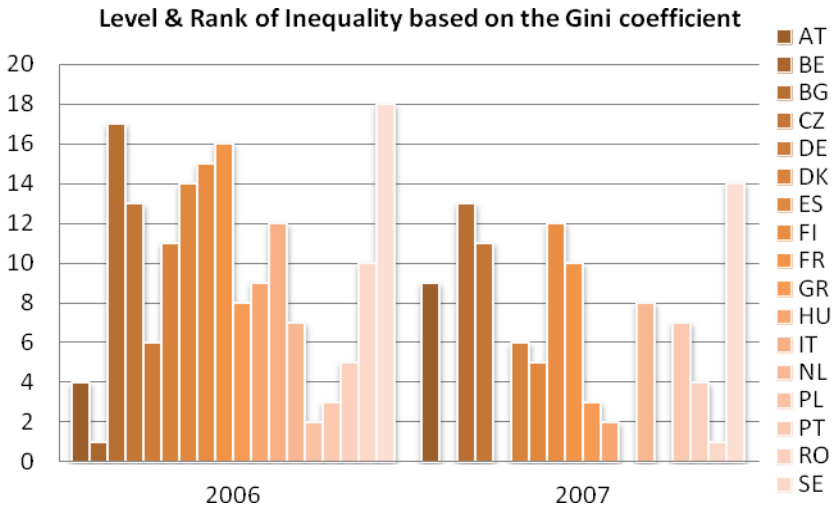


Figure 24: Ranking of 18 EU members by inequality in terms of Infant Mortality , Recent experience, 2006 & 2007

(Source: Own calculations based on Eurostat Mortality data)

The same rankings are revealed in the case of inequalities in terms of Standardized Mortality Rates and/or Life Expectancy (see also Annex III). Petrie, D. and Tang, K.K., (2008) suggested a variation of the calculation of the Gini index in the case of health data. This variation introduces a standardization of Gini's measurement in the case of countries that present large variations in health or significant inequalities. The following Figure shows a hypothetical example with two countries exhibiting very different health patterns.

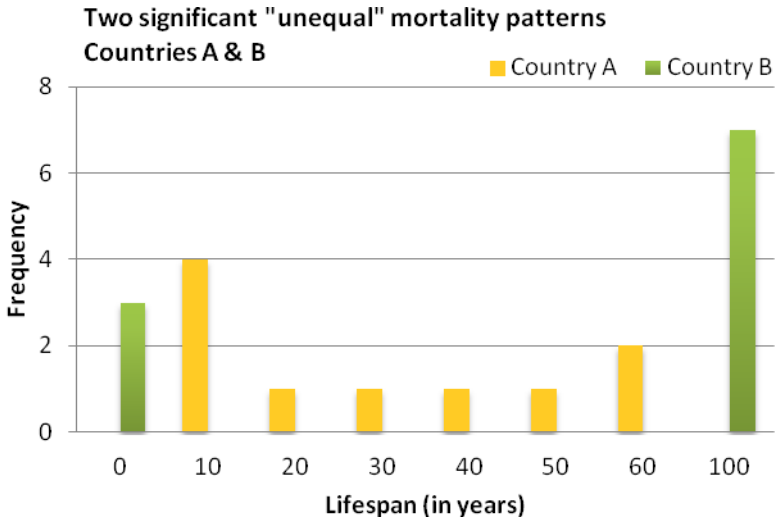


Figure 25: Comparison of inequality level in terms of mortality between two hypothetical countries A & B with significant different health patterns.

(Source: Petrie, D. and Tang, K.K., 2008)

The analysis presented in this report revealed that in the case of the EU and its Member States for the period 1996 to 2008, variations of any observed pattern and inequality are not high valued. Because of this, no *standardization* of the Gini coefficient is used. However, this standardization solution would be useful in cases with significant variations in health (see the hypothetical example in Figure 25). Further enlargements of the EU may bring in the analysis

such cases. In that case, this standardization will allow to estimate the true level of inequality, in the framework of the application of appropriate techniques for tackling inequalities in health.

3.3 Inequalities in Perceived Health Status and other Self Assessed Morbidity by SES groups in the EU

Health inequalities are most frequently investigated in association with socio-economic classes. It is therefore very important and also very interesting to investigate the effects on health of socioeconomic characteristics of individuals in the EU. Several attempts have been made so far by the OECD, EUROSTAT and other international organizations to harmonise the indicators used for the measurement of socioeconomic characteristics, more widely known as SES characteristics.

Based on such indicators, the second part in the analysis focused in the study of Self Reported Health and Morbidity (self reported), with respect to the various socioeconomic groups that are formed in the EU society.

The social variables most commonly used in the empirical literature include the educational level, the occupational class and the income category, which are also classed among the "upstream" determinants of health (see Turrell G, Oldenburg B, McGuffog I, Dent R., 1999). For example, Wilkinson, R., and Pickett, K. (2010), find strong evidence of a relationship between income inequality and the health levels of a population.

It should be emphasised that the choice of the social grouping can affect the results. In early studies, these variables were not harmonised. As a consequence, substantial problems were observed while comparing the results of various national studies. Eurostat's efforts towards harmonization of the classification of socio-economic status have most contributed to more valid and reliable comparisons among the EU Member States.

- ***Educational level*** is often measured by a hierarchical variable taking different values for educational attainment. The International Standard Classification of Education (ISCED) is the most commonly used classification. At the broader level, it distinguishes education attained by the individuals into four main categories corresponding to: elementary, lower secondary, upper secondary and tertiary level.
- ***Occupational class*** is measured on the basis of the International Standard Classification of Occupation (ISCO) which distinguishes between: i) farmers, ii) unskilled and skilled manual workers, iii) self-employed, iv) lower non- manual workers and v) upper non-manual workers.
- Finally, ***Income*** is by definition the classifier of individual or household economic well being. Equivalence scales are used to standardise income according to the size of the household and its composition in terms of young, adult and elderly members. The entire

economic population can be divided according to income into five major groups (quintiles) or ten groups (quintiles).

Income or income related groups interest most of the researchers that are involved in the field of Health inequalities. E.g, Olsen, K., Dahl, SA (2007) conclude to a very strong relation between socioeconomic development (as this is measured by GDP per capita) and Self assessed health of the individuals. Based on their findings, an increase in socioeconomic status usually implies an improvement of the individual's health status. Income related groups usually refer to the allocation of individuals into the "poor" and the "non poor" social groups, or to the people that "make ends meet in their daily lives easily" or not, etc.

Also, previous research suggests (see e.g. Gravelle, H. et.al. 2002, Kawachi, I., Kennedy, B, 1997) that, especially in countries with high income per capita, there is a strong effect of income into people's health, in terms of mortality. Because of the significant relation between morbidity and especially self-perceived morbidity to an individual's mortality, it is reasonable to examine also the relation between self perceived health and the income distribution. This is one of the aims in the analysis in this part. Other interesting results also suggest that people belonging to low socioeconomic groups usually underreport their health status in a self-health evaluation (see, e.g. O'Donnell, O., Proper, C., 1991).

The most valuable source for the examination of the socioeconomic characteristics in the EU is the collection of instruments of the EHSS, especially the ones using the MEHM (see Figure 2), such as the EU SILC.

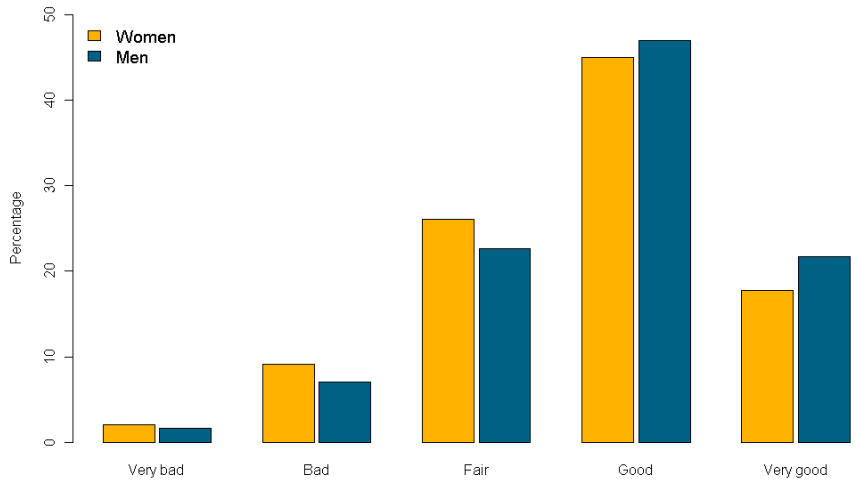


Figure 26: Self-perceived health by gender, % of respondents (Source: EUROSTAT, Statistics in Focus, 24/2009, Data from EU SILC 2007)

As seen in Figure 26, most people in the EU 25 and in 2007 judged their health level as "Good". Far less were the ones judging their health level as "Very Bad". The differences were almost the same in both genders. This observation is in agreement with the findings of the analysis on mortality inequalities, as presented in the previous section of this report.

- *Such differences provide a descriptive analysis of possible health inequalities.*
- *Can the observed differences say anything about the socioeconomic health inequalities in the EU?*

Such questions are answered by the analysis that will be presented. Additional sources that were used were the European Social Survey (henceforth: ESS) and the Survey on Health, Ageing and Retirement in Europe (henceforth: SHARE).

The SHARE data provide also the opportunity to study possible inequalities for specific health aspects such as depression, that the EU SILC and the ESS do not measure. The possibility of making comparisons between these 3 survey tools is restricted since the sampling frames, the coding of similar questions and other aspects are much different. The attempted comparisons in this report are done with caution and the various restrictions are mentioned. In any case, such comparisons are useful.

A recent analysis of the capability of these survey tools to measure health status and capture differences that may conclude to inequalities showed that SHARE produces a very similar distribution of health status to the one measured by the EU SILC and the ESS (see, Börsch-Supan, A. and F. Mariuzzo, 2005).

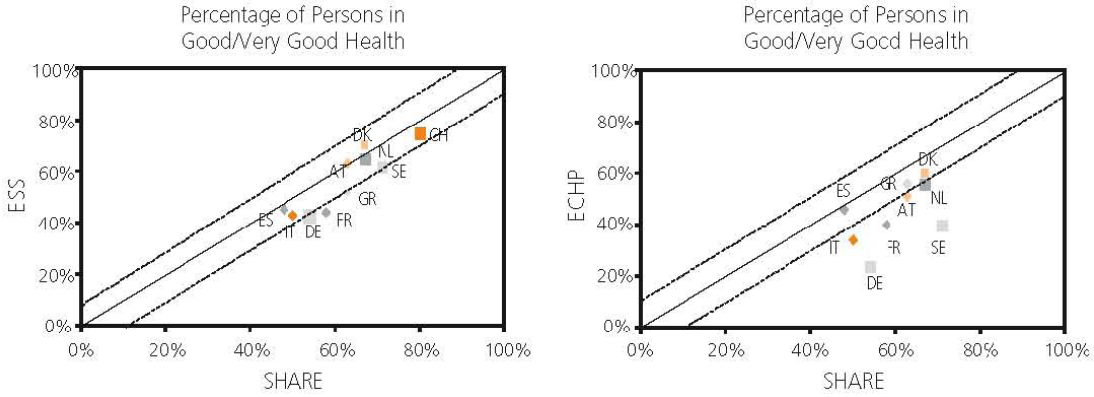


Figure 27: Comparison of ECHP, ESS and SHARE in terms of Self Perceived Health. (Source: Börsch-Supan, A. and F. Mariuzzo, 2005)

Based on the analysis in this work, ESS and SHARE report almost the same distribution of SPH. This is not the case with ECHP and SHARE, where the ECHP usually gives lower figures for the health status (the same applies for the EU SILC, successor of the ECHP). There seem however to be consistent differences. It is therefore considered of interest to test the capabilities of all three survey tools in the analysis of health inequalities in terms of the SPH and also with respect to activity limitations and chronic illness data.

3.3.1 Proposed Indicators

The investigation of inequalities in morbidity and self-perceived health requires a different approach than the one for the comparison of mortality across the EU area and its regions. A major reason for this differentiation is that, whereas data on mortality are naturally given as aggregates, data on morbidity and self-perceived health are available at the individual level through the various surveys such as the EU SILC and the ESS. This change in the data leads to a change in the range of indicators that are available for consideration.

- As in the case of the investigation of inequalities with respect to mortality, it seems desirable to see whether a simple indicator suffices for the measurement of health inequalities with respect to social groups. Mackenbach and Kunst (1997) argue in favour of using simple and straightforward measures instead of more sophisticated ones which have a complex interpretation and are therefore more likely to be misunderstood. The **Odds Ratio *(OR)*** is probably the only indicator among those that have been tested in this report that most users of health statistics are familiar with. Although far less simple in concept than the coefficient of variation (*CV*) and other simple measures, it is put in the same class with them, because it is a general statistical tool and not one that has its origins in the study of inequality.
- The same reasons for proposing the examination of the Gini coefficient (with mortality data) apply here for the proposal of using the Concentration Index. The **Concentration Index *(CI)*** quantifies the degree of inequality between socioeconomic groups with a given health status variable, for example the self perceived health status (see Kakwani, Wagstaff, and van Doorslaer 1997). In the field of health economics, it has been used for the measurement and comparison of degrees of socioeconomic-related inequality (see O'Donnell, 2008). Recent research on the application of this indicator (see Allin, S., Masseria, C. 2009, or Koolman, X., 2006) is also focused on the study of inequalities in terms of "unmet need for health care" through the use of the CI index and also a corrected version of this that was suggested by Erreygers G. (2009). As researchers suggest the CI and in some cases the Erreygers' correction of this indicator apply adequately for the analysis of differences in terms of unmet need for medical examination and/or dental examination in the EU member states as these are measured by the EU-SILC..

It is interesting to note that Wagstaff et al. (1991) claimed that,

the CI and the Relative Index of Inequality (RII) are the only methods likely to present an accurate picture of socioeconomic inequalities in health.

- The application of selected indicators from the *Entropy type family of indicators* appears also very promising. An increasing number of researchers apply this kind of indicators, in the place of the more traditional ones. **Atkinson (*A*)** alternative to the CI, **Theil's (*T*)**

variation of the entropy and also the **Entropy measure (*H*)** of Shannon are introduced in this analysis, both for the measurement of inequality and the monitoring of trends.

Based on the results of this research, we conclude to the use of the following inequality indicators (a more detailed description of these indicators together with their characteristic properties is presented in ANNEX II: TABLES and Table A1)

Odds Ratios (*OR*)

The **Odds Ratio *(OR)*** is considered as one of the main contenders for adoption as an indicator of inequality. It occupies a very prominent place in the statistical analysis of data in the health sciences and is well-known as an applied research tool in the social sciences in general (see Mackenbach and Kunst, 1997). It is usually expressed by:

$$OR = \frac{\frac{p_i}{(1-p_i)}}{\frac{p_j}{(1-p_j)}} = \frac{p_i(1-p_j)}{p_j(1-p_i)}$$

In the above, p_i is the percent of individuals belonging to the i-th social group (usually the lowest in "status", for example in the lowest income quintile) and p_j is the percent of individuals belonging to the *j-th* social group (usually the highest in "status", for example in the highest income quintile). Therefore, OR represents the odds of being in the lowest status group divided by the odds of being in the highest status.

As in the case of the investigation of inequalities with respect to mortality, it seems desirable to see whether such an indicator suffices for the measurement of health inequalities with respect to social groups. The advantages and the disadvantages of such a selection are gathered in the following SWOT analysis Table (Table 6).

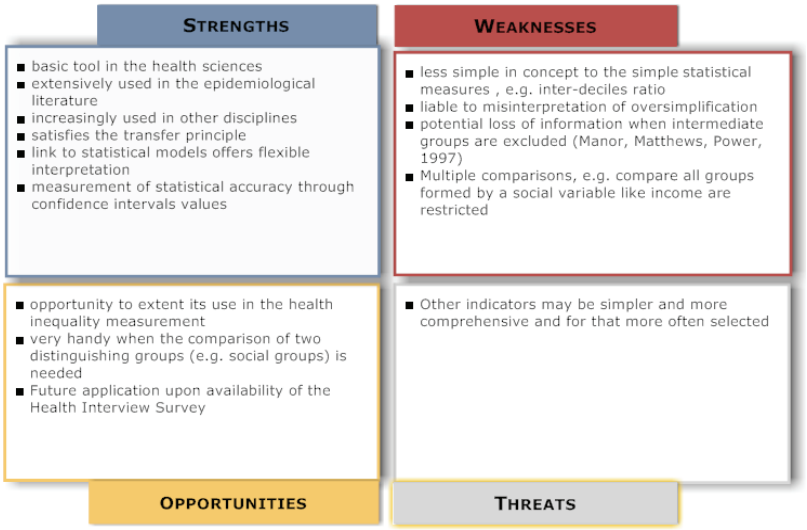


Table 6: SWOT Analysis for the Odds Ratios (see Manor, O., et.al. 1997)

The Concentration Index (*CI*)

As already noted, the **Concentration Index *(CI)*** measures the degree of inequality between socioeconomic groups with respect to a given health status variable, for example the self perceived health status (Kakwani, Wagstaff, and van Doorslaer 1997). In the field of health economics, it has been used for the measurement and comparison of degrees of socioeconomic-related inequality (see O'Donnell, et.al. 2008). Its applications are numerous, and vary depending on the specific mortality and morbidity issues addressed. Its calculation depends on the kind of data used (individual or aggregate data). Based on the latter, it is usually expressed as:

Formula for *individual data*,

$$CI = \frac{2Cov\left(H_i, \frac{R_i}{\mu}\right)}{\mu}$$

where $\mathbf{H_i}$ is the health situation of the i-th individual, $\mathbf{R_i}$ is the living standards distribution, with *i=1* for the poorest and *i=N* for the richest and *μ* the average health level.

Formula for *aggregate data*,

$$CI = (p_1 L_2 - p_2 L_1) + (p_2 L_3 - p_3 L_2) + \cdots$$

where *p* is the cumulative percent of the people ranked by economic status, L_i is the corresponding concentration curve ordinate and *T* the number of SES groups.

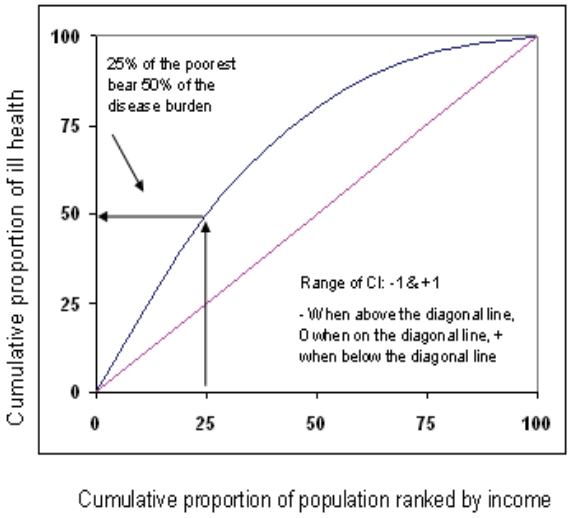


Figure 28: Example of a Concentration Curve of ill health vs income level (Source: Review and Analysis of Existing Measurement Approaches, SANCO2008C404Lot 1_SI2.530184)

The CI has direct extensions to decomposition analysis which are quite promising and very useful because they provide a more clear understanding of how several factors affect inequality (see Speybroeck et al, 2010). A much interesting note for policy oriented monitoring comes from Koolman and van Doorslaer (2004) who suggest that multiplying the value of the concentration index by 75 gives an estimation about the percentage of the health variable (including health care) that may be redistributed from the richer half to the poorer half of the population in order to approach distributions of perfect equity. It is also interesting to note that Wagstaff et al. (1991) claimed that the *CI* and the Relative Index of Inequality (*RII*) are the only methods likely to present an accurate picture of socioeconomic inequalities in health. The advantages and the disadvantages of the CI are gathered in the following SWOT analysis Table (Table 7).

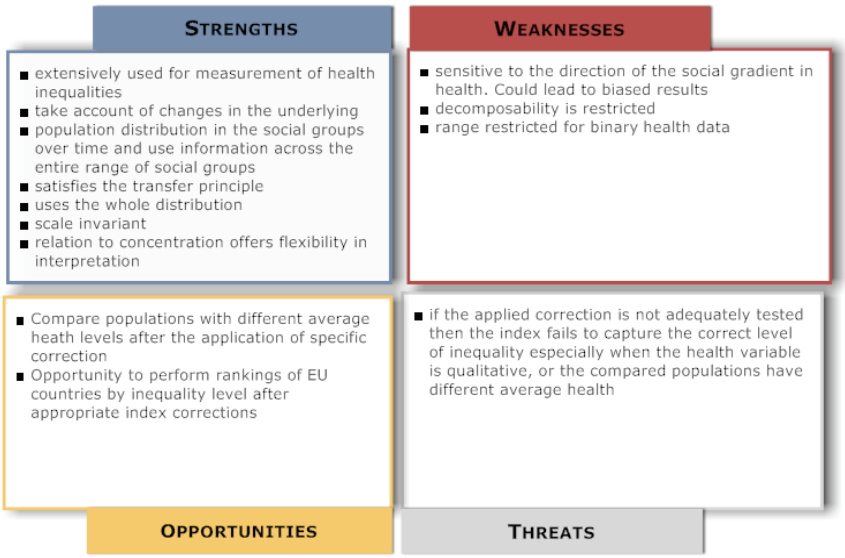


Table 7: SWOT analysis for the Concentration Index

It is important to note that the Concentration Index depends only on the relationship between the health variable and the rank of the living standards variable (for example, income) and not on the variation in the living standards variable itself. Essentially, this means that a change in the income distribution and inequality possibly will not affect the *CI* measure of the underlying health inequality.

Entropy type indicators (Theil's "*T*", Atkinson's "*A*" variants)

These are based on the concept of "entropy". According to information theory, "maximum entropy" occurs in a society when all resources are equally distributed among its members. In a hypothetical society where everything is equal (perfect equality), such indices would take values close to zero. However, resources are unequally distributed among the citizens of a society and some groups of people tend to differentiate themselves in terms of income or health, from the rest of the population. The larger this differentiation, the higher is the actual entropy in the society.

The variations of the entropy-type indices that were investigated in the context of this project are the following:

1. Shannon's *Entropy* measure (see Shannon, C.E., 1948),

$$H = -\sum_{i=1}^{n} x_i \ln x_i$$

And two indices constructed upon the idea of the Entropy measure:

2. *Atkinson's index* of inequality (see Atkinson,A.B.,1970),

$$A = \begin{cases} 1 - \frac{1}{\mu}\left(\frac{\sum_{i=1}^{n} X_i^{1-\varepsilon}}{n}\right)^{\frac{1}{1-\varepsilon}} & 0 \leq \varepsilon < 1 \\ 1 - \frac{1}{\mu}\left(\frac{\prod_{i=1}^{n} X_i}{n}\right)^{\frac{1}{n}} & \varepsilon = 1 \end{cases}$$

3. *Theil's index* of inequality (see Theil, H. 1967) – general formulation,

$$T = \frac{1}{n\mu}\sum_{i=1}^{n} x_i \log\left(\frac{x_i}{\mu}\right)$$

where n, is the number of social groups, μ, is the overall average health, and x_i is the average health in each social group. Selected variants of the Theil index are given below:

- Theil index of inequality with *parameter value equal to 0*, $T_0 = \frac{1}{n}\sum_{i=1}^{n} \ln\left(\frac{\overline{x}}{x_i}\right)$
- Theil index of inequality with *parameter value equal to 1*, $T_1 = \frac{1}{n}\sum_{i=1}^{n} \frac{\overline{x}}{x_i} \ln\left(\frac{\overline{x}}{x_i}\right)$

where x_i is the health of the *i-th* person, $\overline{x}$ is the average health and *n* is the number of individulas. In other words,

- If everyone has the same health (perfect equality) then the entropy index is equal to zero (0).
- On the contrary, if one person "has all the health" (perfect inequality), then the entropy index is equal to the quantity *log(n)*.

The advantages and the disadvantages of such a selection are gathered in the following SWOT analysis Table (Table 8).

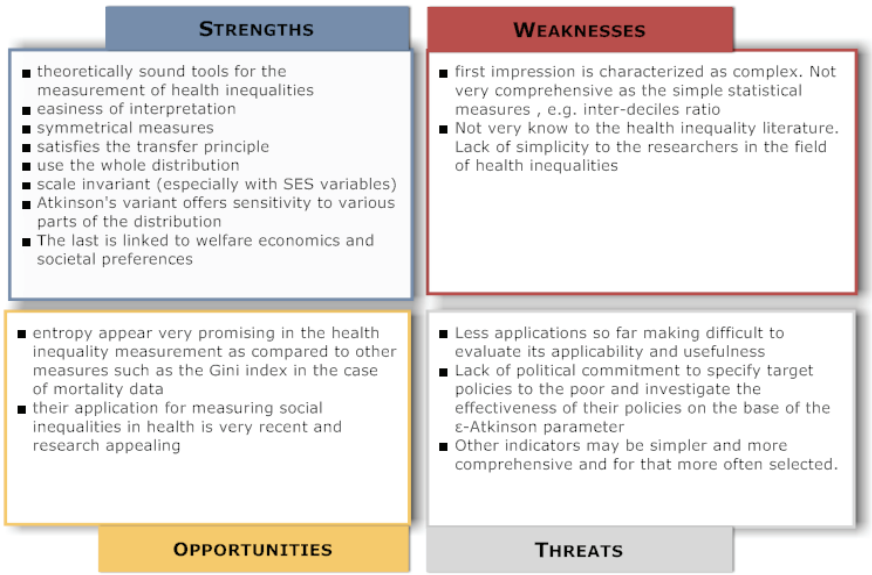


Table 8: SWOT analysis for selected Entropy type indices[16]

As already mentioned, an increasing number of researchers apply this kind of indicators in the place of more traditional ones. **Atkinson (*A*)** alternative to the CI, **Theil's (*T*)** variation of the entropy are introduced in this analysis both for the measurement of inequality and the monitoring of trends.

Value range and Cut-Off points of the proposed indicators

The following Figure is an illustrative presentation of the value range of some of the selected potential inequality indicators, with data on SPH and other Self Reported Morbidity data. The interpretation of the results of the analysis that follows is based on this classification of values.

In general, *large values indicate high levels of inequalities*. This applies for most of the indices proposed in this report.

The Odds Ratios (OR) differ much in the interpretation and are not presented in this figure. Since they commonly represent the odds of being in the lowest status group divided by the odds of being in the highest status one, the usual interpretation is as follows:

- Values below 1 (*OR<1*) indicate significant inequalities in favour of the higher status group (this was a very common case in our analysis).
- Values over 1 (*OR>1*) indicate significant inequalities in favour of the lower status group.
- Values equal to 1 (*OR=1*) or close to 1 (*OR→1*) indicate equal distribution of health among all the individuals.

Apart from the Odds Ratios, the other indicators follow the rule:

"*larger values indicate larger differences in health and associated larger inequalities*".

[16] Schoen R. A transition based approach to measuring inequality, demographic research, vo.. 19,(49), pp. 1727-1748

The following Figure (Figure 29) illustrates the value ranges of the rest of the proposed indicators, except from the Odds Ratios.

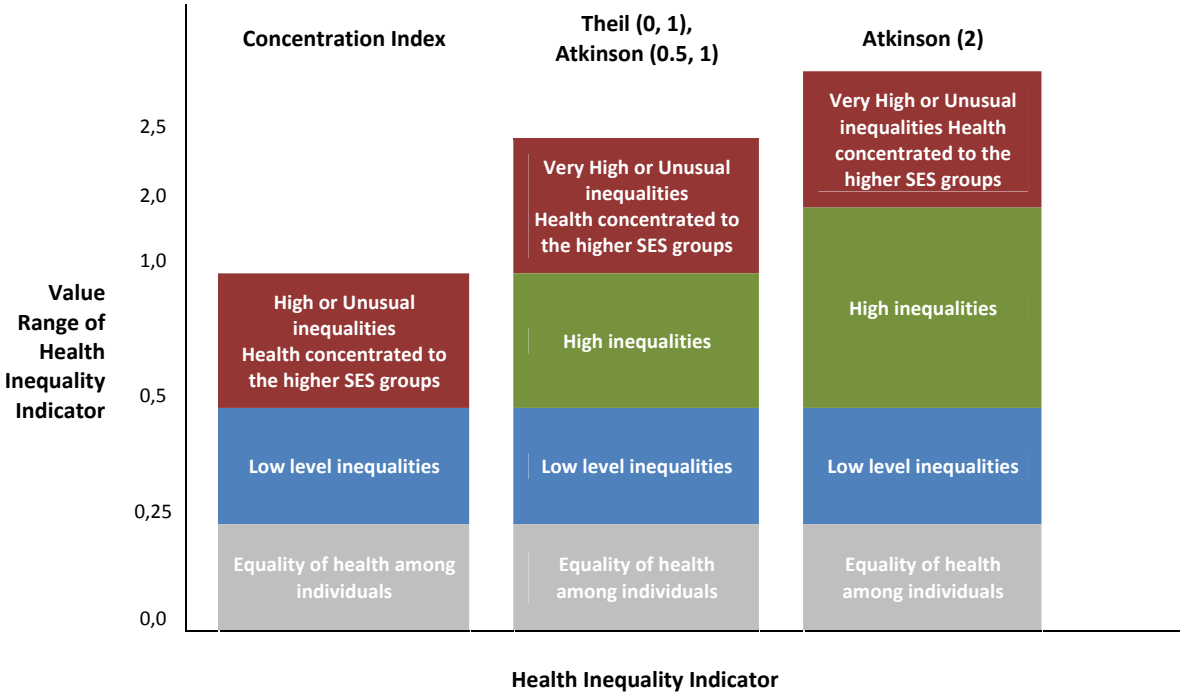


Figure 29: Indicative values and range of values for selected inequality indicators in Self-Perceived Health & Disability.

To test the statistical significance of the presented results, confidence intervals were calculated based on the corresponding theoretical setting of each indicator (e.g. confidence intervals of the Odds Ratios are based on the theory of logistic regression). Authors usually do not present confidence intervals for an entropy type index like Theil, since the only method of obtaining such values is based on bootstrap techniques. There are various disputes between the authors on this matter. This report does not provide confidence intervals for the entropy indices but it manages to present their consistency with the statistically significant results of the other proposed solutions. Anyway, it is appropriate to calculate confidence intervals when applying Theil's or Atkinson's index as the only solution.

To summarize, we conclude that the Odds Ratios present the most adequate solution to the problem of measuring inequalities with respect to social categories. The reasoning for this selection lies mostly with the easiness in carrying out all possible paired-comparisons between social groups. An additional reason is their relation to statistical modelling techniques (e.g. logistic regression) that can provide more detailed interpretation of inequalities in terms of specific factors and covariates. More specifically, the logistic regression model attempts primarily to estimate the effects of categorical variables (which can be SES categories) on a

categorical outcome (which can be the self assessed health status), optionally controlling for effects of other covariates.

The well known in the literature Relative index of inequality (RII) and Slope index of inequality (SII) are similar solutions, that are also related to statistical modelling techniques (linear regression). However, their application poses certain restrictions, notably the applied modeling technique needs to insert a quantitative variable in order to estimate health inequality. This is not a natural approach in the case of SES characteristics.

The reasoning for selecting more than one indicator solution that was applied in this study for mortality inequalities, applies also in the analysis socioeconomic inequalities in health. Therefore, it was considered important to suggest an additional measure that could verify the performance of the Odds Ratios and also offer additional insights in the study of health inequalities. As already commented, the measurement of inequalities in Self-Perceived health and Morbidity requires a different approach. It is of the same importance to be able to compare two distinct social groups (e.g., poor vs. non poor) and to measure variations within the whole range of categories of a social variable. As it was verified by the evaluation and the analysis based on EU data (see next Chapter) the existence of inequality is captured also in the same way by the Concentration index and the Entropy type indices. The latter are not widely known to researchers, and appear somewhat complex. On the other hand, the Concentration Index is a very familiar tool in the study of the socio-economic aspects of health inequalities. The CI performs adequately, as also verified by the evaluation and analysis presented in this report. The CI has also a graphical interpretation which is appealing and in some cases appears to be the most important aspect in monitoring for policy-making. However, the entropy type indices (especially the Theil's index) although relatively complex, can also perform adequately and in many cases even better, with all kinds of existing EU data on self-perceived health, morbidity and disability. For these reasons, and given the increasing familiarity of researchers with Entropy type indicators, it is proposed to always accompany the application of the Odds Ratios with Entropy type indicators.

3.3.2 Inequalities in the EU - Analysis of trends

A significant relation between health and income level is observed for the EU as a whole and in Member States, for the period 2004 - 2008. Subsequently, significant inequalities are observed between the people that belong to the high income categories (5^{th} income quintile, upper income) and the ones belonging to the lowest income categories (1^{st} income quintile, lower income). The following set of Figures (Figure 30) presents the above for most of the EU Member States. The OR for the EU total is less than 0,4 suggesting the above mentioned large inequalities. Only the case of Poland is close enough to the value of 1, revealing equality in

health between the extreme income groups. In most of the cases the OR values are low, with result to this low value of 0,4 for the EU as a whole.

For reasons of illustration, the countries are clustered based on the similarity of their pattern across time. Group (a) clusters together the countries of Portugal, Denmark and others that present no trend between 2004 and 2008 and no significant fluctuations in the values of OR which range between 0,1 and 0,5. Group (b) gathers the cases of Luxembourg, Austria and many others which exhibit a slight downward trend through the study period. In this last group (Group c), only in the case of Hungary and Greece we find a slightly increasing trend. The corresponding values of the Odds Ratios are given in Annex II.

The EU as a whole is affected by all the previous and presents a clear "downward" trend which in terms of inequalities indicates significant increasing inequalities in SPH with respect to income (see again Figure 30)

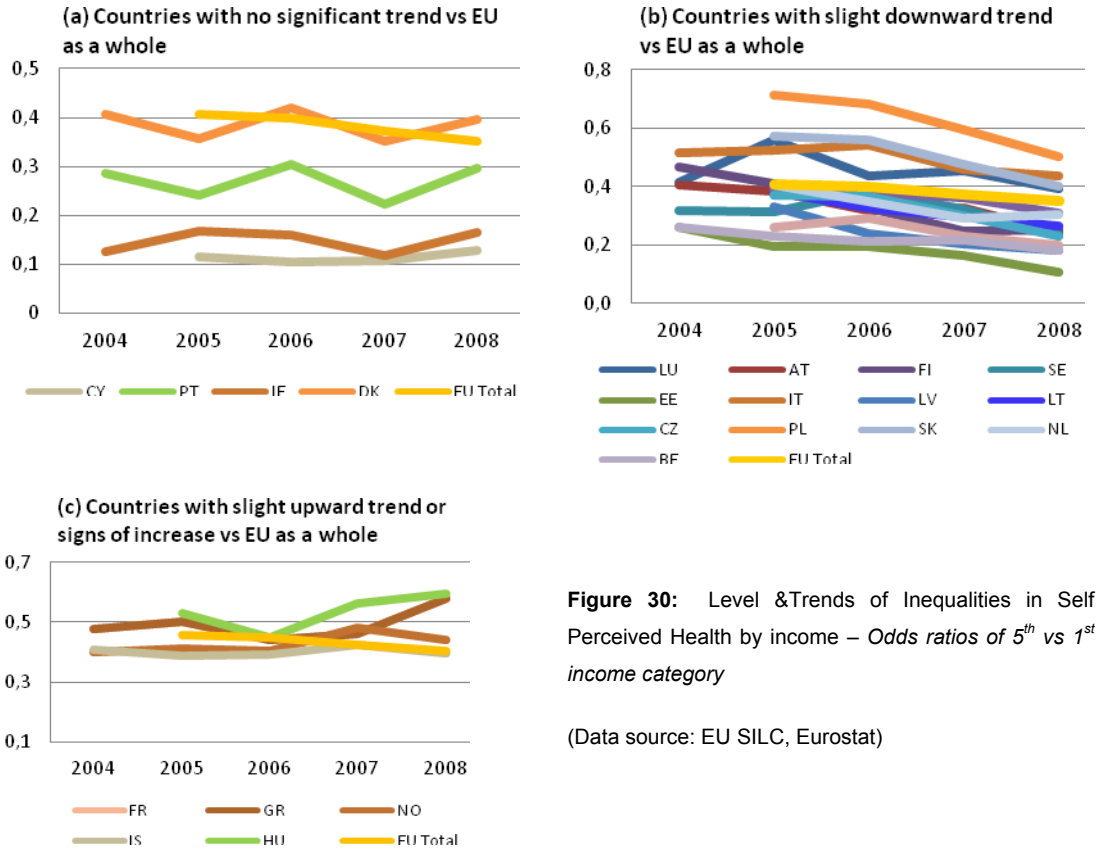


Figure 30: Level &Trends of Inequalities in Self Perceived Health by income – *Odds ratios of 5th vs 1st income category*

(Data source: EU SILC, Eurostat)

The values of OR for the EU as a whole range from a value of 0,424 in 2005 to 0,420 in 2006, 0,392 in 2007 and 0,357 in 2008 (see Table 9). It is evident that there is a consistent decrease in the ORs and equivalently a consistent increase in health inequalities over time. A value of ORs close to 0,4 and based on the method for its calculation (recall that in our calculations the higher 5th income group is represented in the denominator of the ratio) means that there is a

60% difference between the two groups of population (5th and 1st income groups) in their self-assessed health status. There is an increase of almost 7% to 9% in the Self perceived Health inequalities during the last two years of the study.

Year	2005	2006	2007	2008
EU as a whole	0,424	0,420	0,392	0,357
% of ORs decrease over time	-	-0,9%	-6,7%	-8,9%
% of Health inequalities increase over time	-	0,9%	6,7%	8,9%

*EU total was not calculated for the year 2004 because of the small participation of countries

Table 9: Variation of Self Perceived Health inequalities with respect to income quintiles in the EU as a whole. Odds Ratios estimations (Data Source: EUROSTAT, EU SILC)

The large inequalities in the Self-Perceived Health are also verified in most of the countries that have participated in the 1st and the 2nd wave of SHARE (see Figure 31 and Table 10). In the case of countries such as Austria, Denmark, Spain, and others, we observe an Odds Ratio between 0,25 and 0,5 suggesting high inequalities of Self-assessed health with respect to income. In other words, *more people with high income judge their health status as good or very good, relatively to the ones with low income*.

As for the EU as a whole and for both SHARE waves the following conclusions are drawn:

- High inequalities with respect to income (net or gross) are present. Odds ratios are close to a value below 0,4 in both waves of the survey..
- OR is almost stable to a value of 0,45 for the case of SPH by education, suggesting also high level inequalities. Similar conclusions are drawn when comparing individuals that have the ability to “make ends meet” in their daily lives, or not.

It is important to note that not many countries have so far participated in the SHARE and also significant changes have been made in the questionnaires that may affect the previous findings and other comparisons that will follow. For example, one main difference between the two waves is the change in the response scale in the question on SPH. Therefore, all these comparisons are presented only for descriptive purposes.

Odds Ratios based on SHARE Net worth income quintiles &SPH						
Country	2004/2005			2006/2007		
	OR	95% C.I.		OR	95% C.I.	
AT	0,357	0,3538	0,3598	0,320	0,3174	0,3224
BE	0,342	0,3396	0,3446	0,324	0,3209	0,3263
CZ	-	-	-	0,308	0,3060	0,3102
DE	0,267	0,2666	0,2679	0,289	0,2885	0,2898
DK	0,204	0,2014	0,2058	0,181	0,1789	0,1831
ES	0,509	0,5068	0,5102	0,528	0,5262	0,5297
FR	0,326	0,3245	0,3265	0,397	0,3959	0,3984
GR	0,244	0,2420	0,2454	0,280	0,2776	0,2816
IT	0,303	0,3018	0,3035	0,380	0,3785	0,3807
NL	1,191	1,1840	1,1976	0,236	0,2344	0,2379
PL	-	-	-	0,342	0,3402	0,3429
SE	0,857	0,8515	0,8636	0,221	0,2194	0,2233

Table 10: Inequalities in Perceived Health by income level – *Odds ratios of 5th vs 1st income quintile* (Data source: SHARE, Data from SHARE are estimates based on "net worth income quintiles")

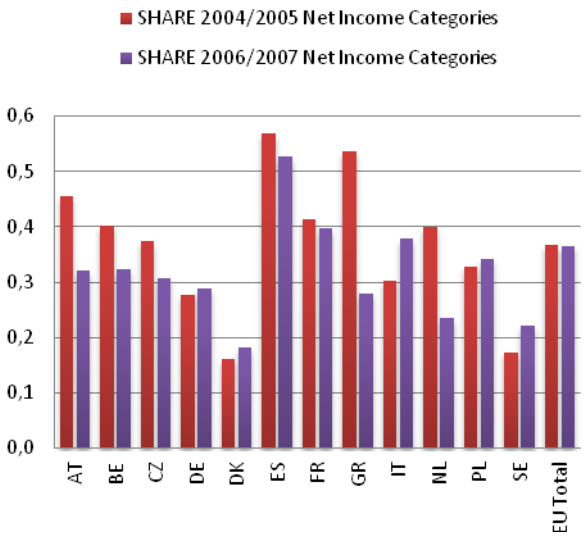


Figure 31: Inequalities in Perceived Health by income level – *Odds ratios of 5th vs 1st income quintile* – Comparison of SILC and SHARE data measurement (Data source: SHARE)

Income related inequalities were also estimated through the use of the Concentration Index (CI). As it is already described in the previous reports of the project (see Task 3 and Task 1 report)[17] and also in various research articles such as the ones in Erreygers G.(2009), Konings P., et. al (2010), and Tsimpos (2010), this indicator enjoys much popularity as a socioeconomic health inequality measure. As a concept and measure, it is strongly related to the Gini coefficient and the Lorenz inequality curve. In that sense it is mostly needed to plug-in the income quintile data. Values of the CI were calculated for the SPH levels of the EU citizens as measured by the EU-SILC. As the following Figure (Figure 32) shows, there exist low level inequalities in the EU Member States during the period of 2004-2008. A slight increase is observed in most of the EU 27 members during the study period. This increase suggests that more health is concentrated to persons that belong to the upper income levels of the population. In most of the EU Member States, the value of CI varies from 0,02 to 0,1. Extreme cases are suggested by Estonia and Portugal where CI values are above the value of 0,1. The value for the EU total is 0,07 without significant variations with respect to time. It is worth mentioning that an index such as the CI uses the whole distribution of the data, and, in that

[17] "Proposals & Recommendations, Report_SANCO2008C404Lot 1_SI2.530184", "Review and Analysis of Existing Measurement Approaches, Report_SANCO2008C404Lot 1_SI2.530184"

sense, describes the differences among all social categories (e.g. income quintiles) at once. Therefore, the results are not expected to coincide with the ones produced with the ORs. The results with the CI are on the contrary expected to be similar with the ones obtained with the Entropy family of indices which also make use of the whole distribution.

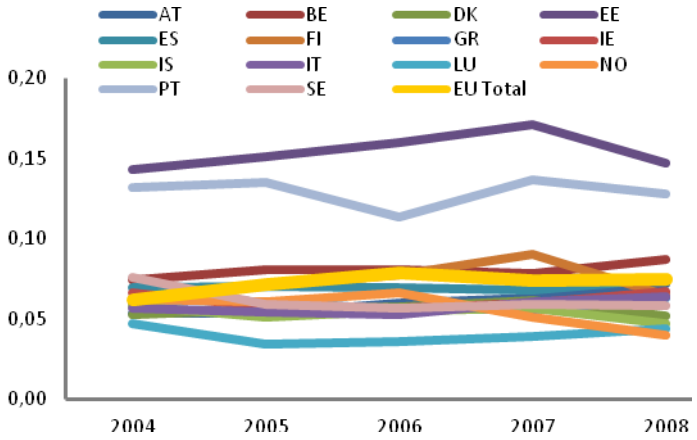


Figure 32: Concentration Indices for Self-perceived health and Income level for selected EU Member States for the period 2004-2008.

(Data Source: EUROSTAT, EU-SILC)

In order to quantify the contribution of other social differences in Self Perceived Health inequalities, the analysis continued by examining variables such as the Education and Activity status. The following Figure is a snapshot of the EU situation as measured by the EU SILC 2007. It is evident that:

- Significant inequalities exist between the people that have a tertiary level education and those that have not. The former tend to judge their health as good or very good more often than the latter. Previous studies (see Raalte, V.A., Kunst, A., Mackenbach , J., 2009, Mackenbach , J., et.al., 2008) have also revealed that self-reported health is poorer in the lowest educational group as compared to the highest educational one.

Health differences between high and low educational levels measured by ORs can be attributed to the indirect effects of the level of education on health.

For the EU as a whole the OR value is close to 0,4. Similar values to the EU total are observed in the cases of Austria, Belgium, Latvia and Finland (see Figure 33). Only in cases such as in Germany and Slovenia there seems to be more health equality with respect to education level (OR close to 0,8 and 1).

- Also high are the health inequalities observed with respect to the Activity status in terms of the Self Perceived Health. In the majority of the EU Member States, the differences are translated into values of ORs a little larger than 0,2. Based on this result, it is suggested that people that belong to the Active population group differ much in terms of their self assessed health from the inactive ones (see Figure 33, and also Table A23,A24 of Annex II).

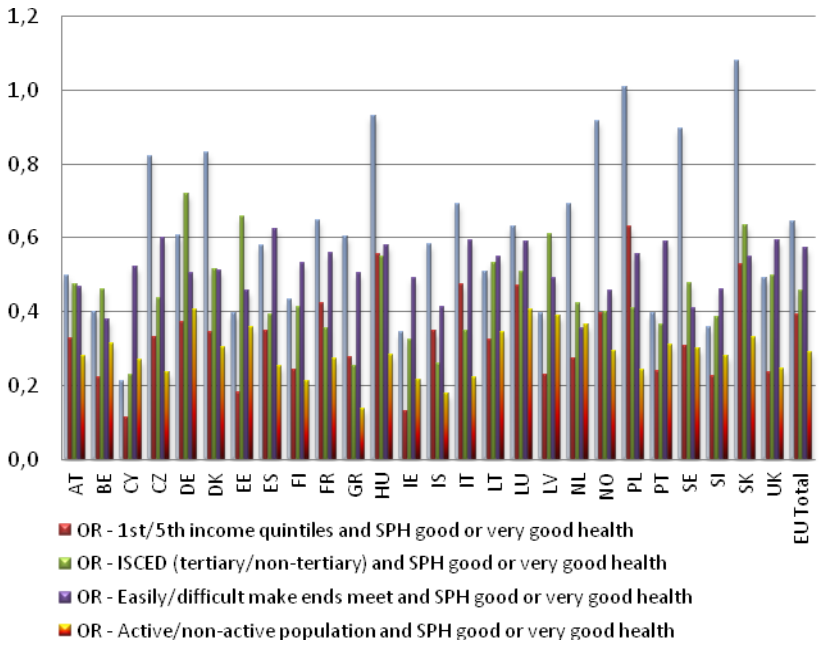


Figure 33: Odds Ratio for SPH ("good or very good health") by SES group, for the EU 27
(Source: EUSILC 2007)

Socioeconomic inequalities in terms of other health indicators such as the existence of a chronic illness, limitations in activities (AL) due to health problems do not change the picture shown in all these results. For example, low level inequalities exist in cases of chronic illness with respect to the education or income of the individual. An increase in these inequalities is again evident from 2004 to 2008 (see Figure 34, and also Tables A25, A26 of Annex II). In other words, people with a low education (non tertiary level), or a low income report more often the existence of a chronic illness (see also Figures A10 in Annex II).

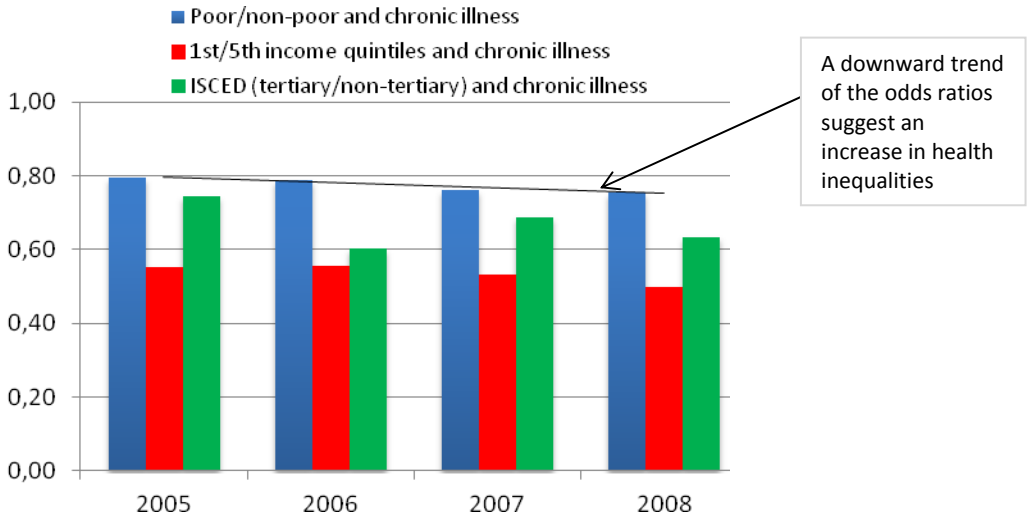


Figure 34: Inequalities in case of chronic illness statements by selected SES variables – *Odds ratios of 5th vs 1st income category* (Data source: EU SILC, Eurostat)

The same levels of inequality appear also in the study of Activity Limitations based on data from the EU SILC. Limitations in activities (AL) as these are measured by the existence of a health problem for at least the last 6 months, affect people's lives to a variable extent. This is translated into differences-inequalities in some cases, due to the strong correlation of this variable with social variables such as educational level or income. The application of the Odds Ratio with the two SHARE waves data also revealed some interesting inequalities in the EU (see Annex III for more details). In general,

- *it is more usual for an individual with non tertiary education having a health problem that poses restrictions into his/her daily activities to judge the existing activity limitations as severe. The same also applies for people with low income.*

The SHARE does not collect data from all EU Member States (as for example the EU SILC), and its application is not yet set to a regular basis. Furthermore, it targets a specific non-general population (individuals aged 50 or over). It is still however a valuable instrument. For example. as Börsch-Supan, A. and F. Mariuzzo. (2005) showed, the results of SHARE seem to coincide significantly to the ones obtained with the EU SILC and the ESS in some cases. This was also verified in our analysis. Furthermore, SHARE is a health oriented survey that measures also additional aspects of self assessed health or morbidity that may be considered in the future as possible extension to the EHSS and the MEHM. Odds Ratios were calculated for the EU total with measurements of Depression levels, Mobility limitations, Limitations with activities of daily living (adl), Limitations with instrumental activities of daily living (iadl), etc. The same levels of inequalities as in the case of Self-Perceived Health are observed also with these health variables (see Table A12 of Annex II) .

The statistical analysis so far described the socioeconomic health inequalities in terms of EU SILC and SHARE measurements and the index of Odds Ratios. The use of the European Social Survey (ESS) is also much promising, as this is increasingly selected by researchers in the field of health measurement. An indicative work is the recent one by Olsen, K., Dahl, SA (2007) which uses the 2003 SPH data from the ESS and a specific modelling approach in order to study individual and country level characteristics that influence health. This analysis focuses mostly on the extraction of trends appearing in the data.

High inequalities between the various social groups in terms of self-assessed health are also verified using the ESS data. The larger inequalities are the ones observed between people that "feel difficult about household's income" and those not declaring such difficulty. This inequality is also characterized by a slight decrease over the years of the study (the OR values vary from 0,33 in 2002 to 0,37 in 2008).

In general, people that feel difficult about the income of their household are more likely to judge their health below the levels of "good or very good". The conclusions regarding inequalities with respect to the educational level (tertiary vs. non tertiary) are similar. Here the level of

inequality in terms of the Odds Ratios varies between 0,45 in 2002 to 0,46 in 2008). A slight decreasing trend is exhibited by the OR values that refer to the comparison between active and non-active population with respect to their self-perception of health. These vary from 0,36 in 2002 to 0,32 in 2008 and suggest the opposite, meaning a slight increase of inequalities.

With regard to the activity limitations, it is verified by the results that people belonging to the non active population tend to judge their health below the average levels and also are more likely to report severe activity limitations. Odds Ratios show a slight downward trend when comparing the active and the non-active population. This indicates a small increase in the estimated inequalities during the period of analysis, 2002 to 2008. Figures 35 and 36 (and also Tables A27, A28 of Annex II respectively) show these results.

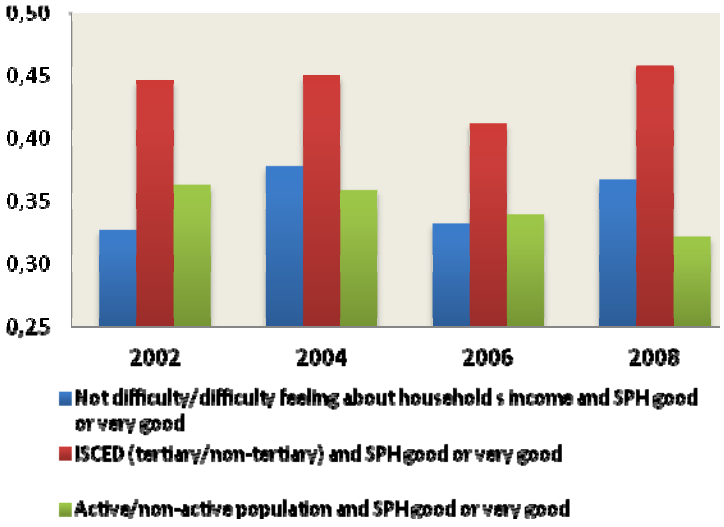


Figure 35: Trends of Inequalities based on Self Perceived Health (SPH) vs SES groups calculated by the Odds Ratios

(Data Source: ESS 2002-2008)

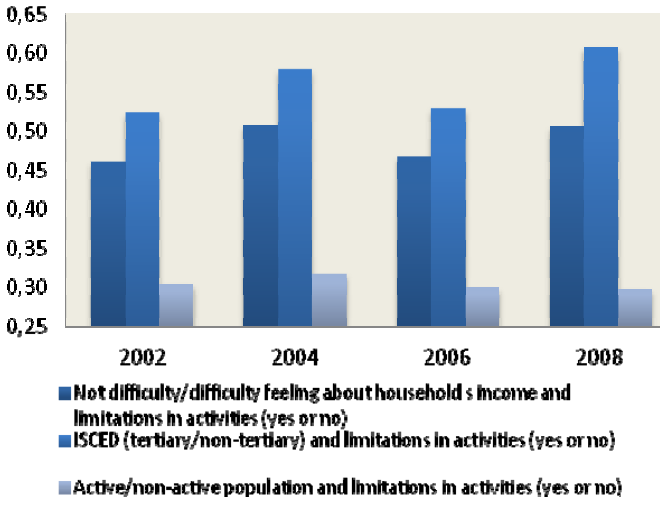


Figure 36: Trends of Inequalities based on Activity Limitations (AL) vs SES groups calculated by the Odds Ratios

(Data Source: ESS 2002-2008)

Olsen, K., Dahl, SA (2007) agree that education has a positive effect on health. This report adds to this finding, by concluding that this positive effect remains stable (i.e. without any significant trend) in the EU through the years. Also based on previous work, it is now evident, from all the years of analysis of the ESS data, that Economic satisfaction (as this is translated by the level of feeling difficulties with the household's income) is strongly related to health. People that feel good with the income of their household and in general are economically satisfied, are more likely to report better health and this association remains stable with respect to time.

It is important to make the following clarification regarding the interpretation of trends based on selected inequality indicators:

- A downward trend in the Odds Ratios calculated in this report is equivalent to an increase in health inequalities.
- On the contrary, it is an upward trend in the Concentration index and any of the Entropy type indices that indicates an increase in heath inequalities.
- As Figure 29 (of section 3.3.1) shows, all indices applied except from the Odds Ratios follow the rule "larger values, higher differences in health, larger inequalities".

As Figure 37 shows, the application of Theil's entropy type index with EU SILC data for the whole time period of 2004 to 2008 reveals an upward trend, slight in most cases, more clear in some.

In general, as regarding the entropy type indices the following rule applies:

- If everyone has the same health, then the index will be equal to zero.
- If health is concentrated to a few individuals then the value of the index will be larger than 1 or 2 in most of the cases. In the extreme case where only one person has "all the heath" the value of Theil's index is *ln(n)* (n equals the size of the sample or the population).

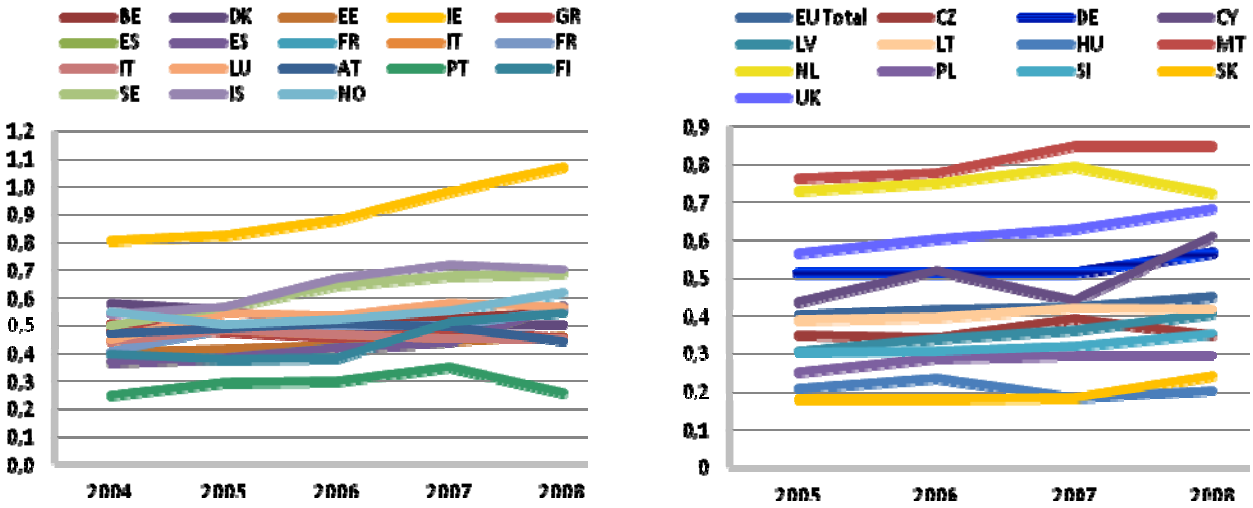


Figure 37: Trend of inequalities in Self Perceived Health in the EU 27 and EU members based on the Theil index (0), Period 2004-2008 (Source: EU SILC aggregate data, Eurostat Statistics Database)

It is made evident from Figure 37 that:

- Not all countries have the same inequality levels.
- Most of the countries present an increase (increasing trend) during the years (from 2005 to 2008)

Netherlands, United Kingdom, Spain, Sweden, Ireland and Iceland show larger inequalities in Self Perceived Health as compared to e.g. Poland, Slovakia, Malta, Germany or Slovakia.

It is evident that such differences can be attributed to specific geographical areas of the EU. E.g. the previous differences can be summarised as differences between countries in the Northern Europe and countries in Central or Eastern Europe. A recent study of Eikemo T.A., (2008) estimated significant inequalities between such areas in terms of Self Perceived Health levels.

All these cases are also characterized by an increasing trend during the years but this increase does not lead to an increase of the gap between them. In other words, the difference in Self-Perceived health inequality between these EU countries tends to remain the same during the years. Finally, there are cases of EU members that have low or higher health inequalities but exhibit no trend, such as Norway, Greece, Italy and Austria. Again the application of the analysis with data on the self-perceived health from SHARE leads to similar findings (see Annex III).

It is interesting to compare the values of Theil's index with those of the Atkinson index (especially with the index parameter $\varepsilon=1$, see Section 3.3.1 for details). All 3 indices produce similar results. Of course, it is not possible to compare the two successive SHARE waves but the three indices can be compared separately within each wave. The following Table 11

presents the values of Theil's and Atkinson's (1) indicators for selected countries that participated in both SHARE waves and for the EU total in each wave.

Country	Theil (1)		Theil(0)		Atkinson (1)		Index Interpretation
	2004/5	2006/7	2004/5	2006/7	2004/5	2006/7	
AT	0,078	0,101	0,084	0,113	0,081	0,107	Low level inequalities Similar to the EU total
DE	0,068	0,109	0,073	0,122	0,070	0,115	Low level inequalities Similar to the EU total
SE	0,103	0,128	0,110	0,142	0,105	0,132	Low level inequalities Above the EU total
NL	0,071	0,068	0,077	0,073	0,074	0,071	Low level inequalities Similar to the EU total
EU Total	**0,072**	**0,105**	**0,078**	**0,114**	**0,075**	**0,108**	**Low level inequalities**

Table 11: Comparison of Theil and Atkinson (0.5 and 1) values for the EU total and selected countries of the two waves of SHARE

Based on the 1st wave of SHARE, values of the Atkinson (1) and Theil indicators in Austria were a little higher (0,08) than the ones for the EU total (almost 0,075), suggesting low level inequalities but higher than in the EU as a whole. The conclusions are similar for Sweden, where the values of the indicators varied between 0,128 and 0,142 for the 2nd wave. The values of the Atkinson index for all selected parameter cases are summarized also in Annex III. The comparison of the Entropy type indices based on the SILC data revealed the same picture. The case of Iceland was again the one showing the most differences compared to the rest of the countries. We can also add Greece and Cyprus which also present higher inequalities in Self Perceived Health than the rest of EU countries.

The variation during the study period revealed no trends. In other words, the inequality patterns did not change. These are also graphically presented in Figure 38 that follows.

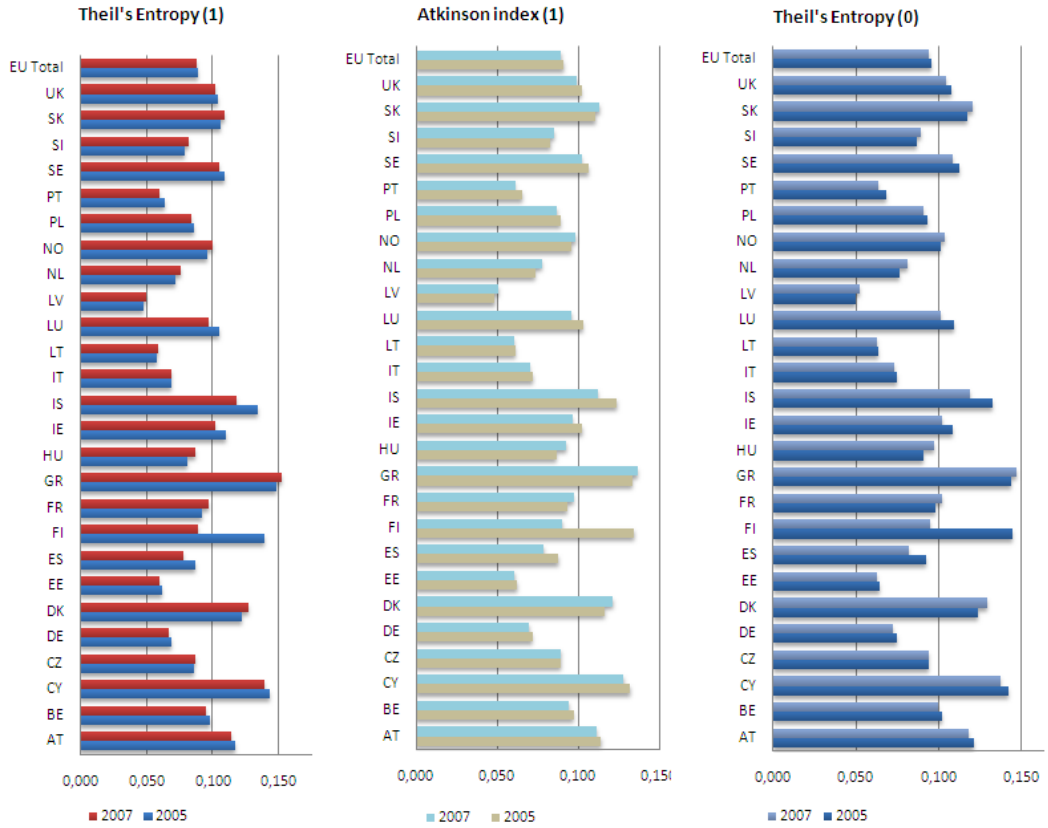
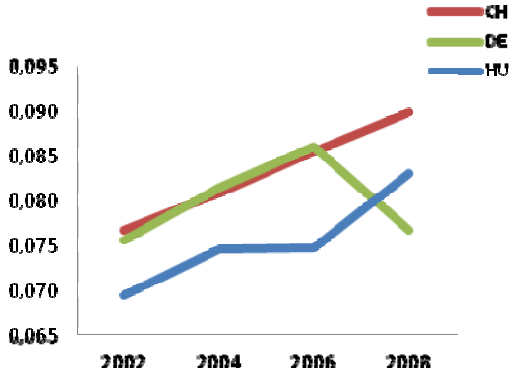


Figure 38: Theil and Atkinson index values for Self Perceived Health based on data of the EU SILC for the EU 27 (Data Source: EUROSTAT, EU SILC)

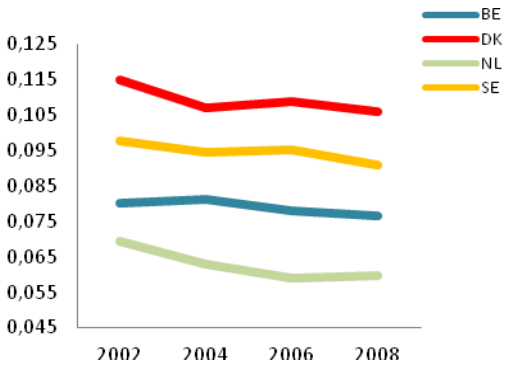
The non-significant trend is also verified by the 2003 – 2008 ESS data. It is however important to note that the number of the years is not adequate to study trends. The observed variations through the 4 years of the study are reflected into values of the Theil index between 0,08 and 0,09 and values of the Atkinson index between 0,045 and 0,17.

In terms of the *Theil's index* (see Figures 39, and Annex III):

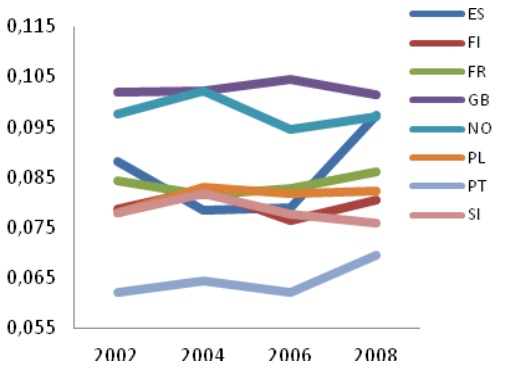
- Netherlands present a downward trend moving from 0,07 to 0,06. A downward trend suggests very low inequalities or almost equality of health among individuals.
- Hungary, on the contrary presents a steady increase from 0,07 to almost 0,085
- Portugal, presents an increase from 0,06 to almost 0,07
- Denmark, presents a steady decrease from 0,115 to almost 0,105



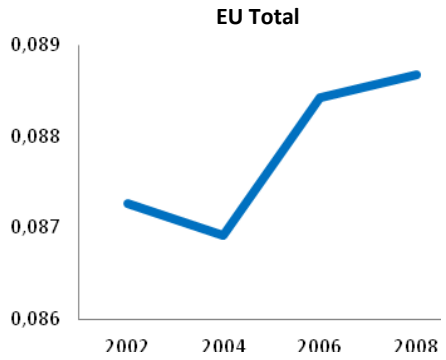
(a) : Countries with upward trend of health inequalities



(b) : Countries with downward trend of health inequalities



(c) : Countries without any significant trend or variation of health inequalities



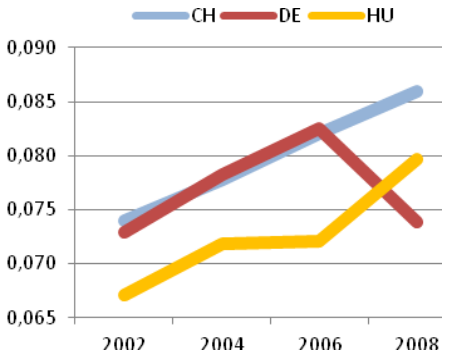
(d) : Trend of EU Total's health inequalities

Figure 39: Trends of Self Perceived Health Inequalities based on the Theil's index (0) for the EU as a whole and several member states and the period of 2002-2008 (Data Source: ESS of 2002-2008)

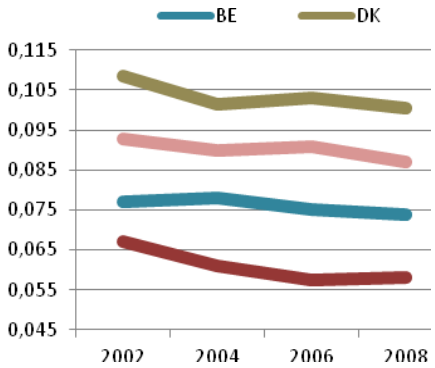
In terms of the *Atkinson's index* (see Figures 40 and also Annex III):

- Netherlands present a downward trend moving from 0,07 to 0,06. A downward trend suggests very low inequalities or almost equality.
- Hungary, on the contrary presents a steady increase from almost 0,065 to almost 0,08
- Portugal, presents a steady increase from 0,06 to almost 0,07
- Denmark, presents a steady increase from almost 0,110 to almost 0,100

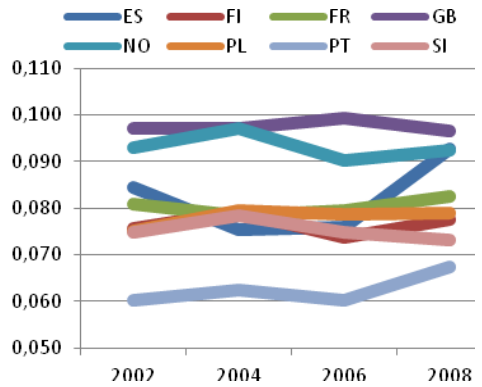
These comments refer only to the Atkinson index with parameter $\varepsilon=1$ which is almost similar to the Theil index. The Atkinson index for other parameter values (ε=0,5 and ε=2) estimates the same picture (see Annex III).



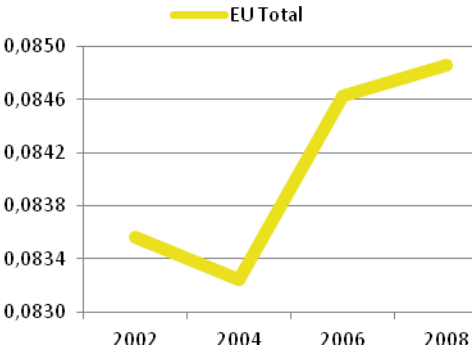
(a) : Countries with upward trend of health inequalities



(b) : Countries with downward trend of health inequalities



(a) **:** Countries without any significant trend or variation of health inequalities



(d) : Trend of EU Total's health inequalities

Figure 40: Trends of Self Perceived Health Inequalities based on the Atkinson index (1) for the EU as a whole and several member states and the period of 2002-2008 (Data Source: ESS of 2002-2008)

3.4 Inequalities in Disability & Activity Limitations by SES groups in the EU

The 2002 European Labour Force Survey" (EU LFS) included an ad-hoc module related to health conditions. The aim of this ad-hoc module was to study characteristics of people with disabilities with respect to their employment status. This "Employment of disabled people" module included variables regarding the existence of disability, the kind of disability, its cause, possible mobility restrictions etc. In this section, we present an analysis with these variables.

The findings should be interpreted with caution. As already noted in previous work[18] with these data, the differences that exist between the EU Member States in the definition of some key variables such as "disability" influence much the comparability of the data collected in this and similar surveys. This effect does appear in parts of the analysis conducted.

With respect to the EU LFS in general, we should note that this is a highly harmonized instrument within the EU (as already described in the Task 2 report of this project[19]), but the information on health it contains in its core module is quite limited. More specifically, this information refers to:

- Indirect measurements of health, mostly "sickness absence rates"
- Existence of "disability" in the current workplace or in the most recent one (last 6 months)

The part referring to the absence from work due to sickness has been recently analyzed, for purposes similar to the ones in the current report, by Mazzuco S., Surhcke M. (2009).

The data from the ad hoc module refer to disability rates that describe:

- The "prevalence of disability" by educational level, occupation, activity status, sex, age and other socio-demographic variables.
- and the "perceptual distribution" (percentages) by severity of disability and by socio-demographic variables.

A brief comparison of the EU Member States based on the data of the 2002 ad hoc module makes apparent the existence of bias in the results. This bias is caused by,

- the different perception of disability by the respondents in the various EU Member States, combined with the variety in the definitions (which are, among others, related to issues of access to social care).
- the differences between the public health systems in the EU Member States.
- the varying degrees of "generosity" in the national social protection systems.

As the literature on the subject of absence from the work environment due to sickness reveals (see e.g. Osterkamp & Rohn, 2007), the calculated sickness absence rates respond heavily to incentives set by the social security system in a country and **are unlikely to reflect the true level of public health**. More specifically, the more "generous" the social protection system is, the more likely workers are to claim sickness absence. The same apply for the incentives that influence the measurement of disability rates. The latter is also evident in the following Figure (Figure 41) which presents the proportion of people in the EU with a long standing health problem or disability based on the results of the 2002 LFS ad hoc module. The calculated prevalence rates in the EU Member States vary from around 6-7% to over 30%. The

[18] Final Report on "Men and Women with disabilities in the EU:Statistical Analysis of the LFS ad hoc module and the EU-SILC" (2007), Study carried out by Applica, CESEP, Alphametrics, Financed by DG Employment, Social Affairs and Equal Opportunities

[19] "Review & Analysis of EU Data Sources, Report_SANCO2008C404Lot 1_SI2.530184"

magnitude of this variation ensuresis a safe argument for the existence of a measurement bias.

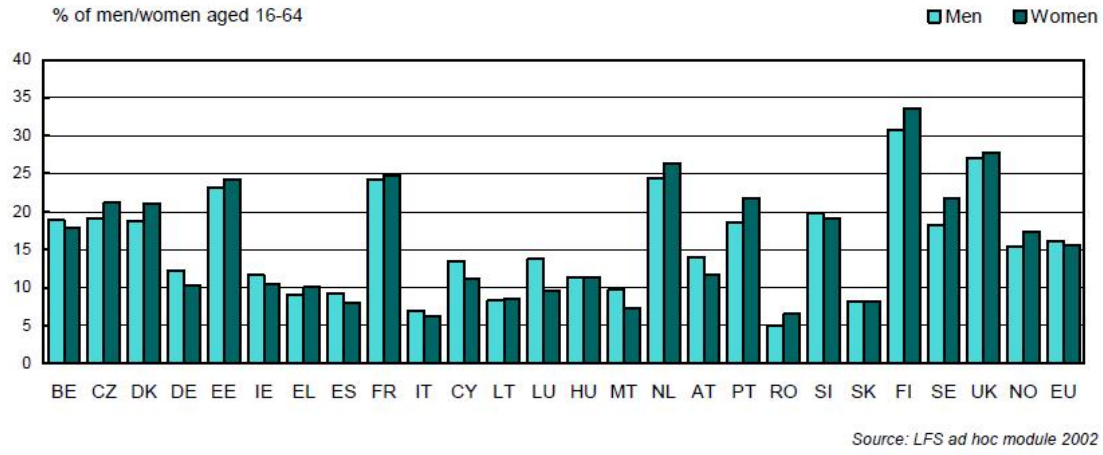


Figure 41: Prevalence of long-standing health problem or disability by sex, 2002

Source: Men and Women with disabilities in the EU: Statistical Analysis of the LFS ad hoc module and the EU-SILC, 2007[20]

In any case, this is a part expected to be much improved within the 2nd run of the similar LFS ad-hoc module which is predicted from Eurostat to take place in 2011[21]. A second run will offer the possibility of comparisons and the measurement of variations through time. Much of the bias will then be possible to filter-out and there will be opportunities for better evaluation of the examined health inequality indicators. In general, the existence of disability may affect much the behaviour of an individual in his/her occupation. It was also found that, significant differences appear when comparing individuals with tertiary level education with the rest.

- *It appears that people with non tertiary education are more likely to report disabilities with respect to their occupation. The application of Odds Ratios resulted to values much below 1 (which is the equality value).*

Figure 42 presents these results for the Percentage of disability. In all countries, the values are below the value of 1 (OR<1), suggesting inequality. For example, in Spain, Belgium and Cyprus we observed values below 0,4 which indicate that people with non tertiary education are more likely to report some kind of disability. Because of the differences in the definitions and the methods for measuring disability in the various EU Member States, we decided to exclude the calculation of the OR value for the EU as a whole, as this would be meaningless. The analysis was therefore restricted to the interpretation of the results at the country level.

[20] Final Report on "Men and Women with disabilities in the EU:Statistical Analysis of the LFS ad hoc module and the EU-SILC" (2007), Study carried out by Applica, CESEP, Alphametrics, Financed by DG Employment, Social Affairs and Equal Opportunities

[21] Commission Regulation (EU) No 317/2010, adopting the specifications of the 2011 ad hoc module on employment of disabled people for the labour force sample survey provided for by Council Regulation (EC) No 577/98.

Austria, Lithuania, and Romania are cases that give an OR value close to 0,9, very close to the equality line.

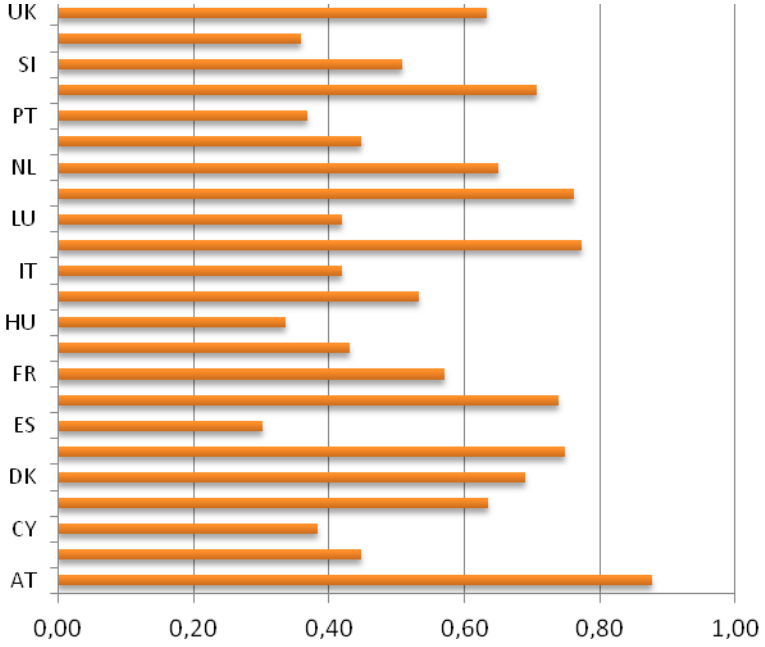


Figure 42: Odds Ratios of Percentage of Disability for individual with Tertiary vs Non Tertiary education, 23 European countries

(Data Source: EUROSTAT, LFS ad-hoc 2002)

Interesting inequalities appear when examining the statement of disabilities existence and the current activity status of the individuals (see for example Table A16 of Annex II). Due to the strong correlation of disabilities with activity status, it is worth describing the estimated inequalities with the ORs.

More specifically, the following Figure (Figure 43) presents the possible inequalities due to the existence of disabilities among the “employed”, people that were “unemployed” during the implementation of the survey (but recently employed) and people belonging to the inactive population category. As it is evident, the values of OR for the employed and also the unemployed when compared to the rest of the population are always below the equality line. This mainly suggests that individuals belonging to the “non-active population” are more likely to state the existence of a disability and dominate the calculation of the ORs. Hungary (OR=0,076 for the employed and OR=0,132 for the unemployed) and Slovakia (OR=0,130 for the employed and OR=0,258 for the unemployed) are characteristic cases of countries with high inequalities in terms of disabilities. It is expected for the values of ORs that compare the employed population with the rest (unemployed and inactive) to be far below the equality line (also some of the unemployed maybe presented high disability rates). It is reasonable to assume that when the inactive population takes the place of the numerator in the calculation of the ORs, then the resulting values will be far above the equality line. This result did not add any significant comment to the previous picture and for that it was omitted from the analysis.

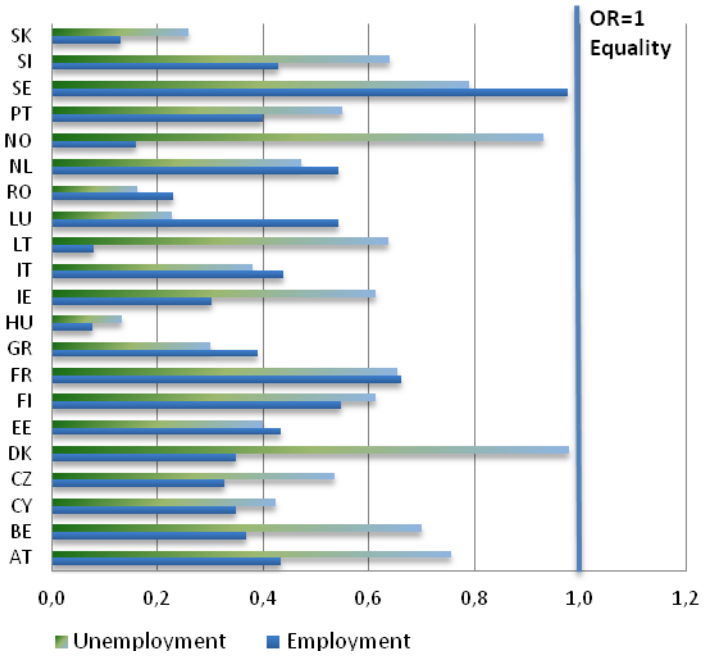


Figure 43: Odds ratios values of Percentage of Disability by activity status, 23 European countries

(Data Source: EUROSTAT, LFS ad-hoc 2002)

Similar comments can be provided for the comparison of the percentage of mobility restrictions due to disability by activity status. Here, in most of the cases, the values of OR are very close to the equality line. The cases of Belgium, Cyprus and Greece correspond to OR values close to 0,5 suggesting slight inequalities. More specifically, in these countries it is more probable for an individual with tertiary level education to report mobility restrictions in the working environment due to the existence of considerable or to some extent disability. The cases of Denmark and Slovakia result to values close to 2 suggesting low inequalities but opposite to the previous ones. Norway, Netherlands and Romania are the only 3 cases that present very high inequalities (with regard to the level of mobility restrictions. These findings are shown in the following Figure (Figure 44).

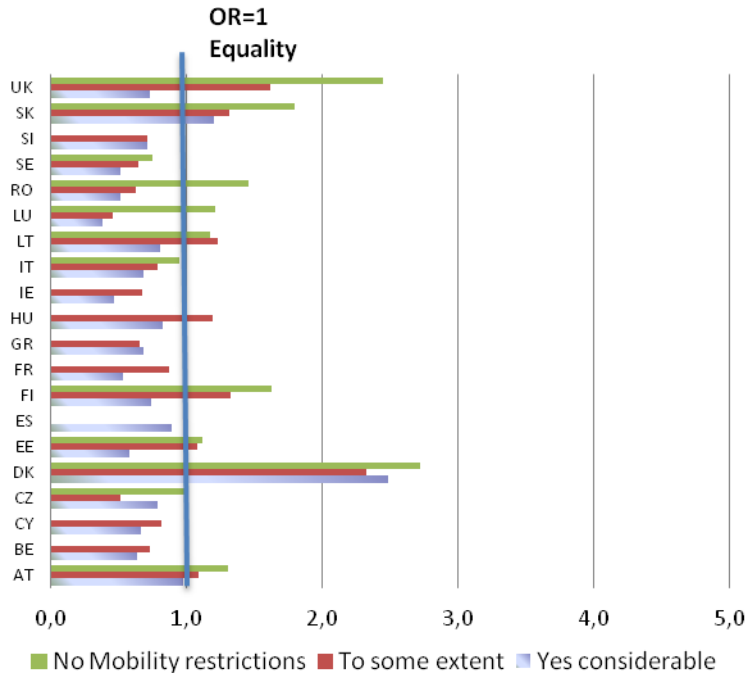


Figure 44[22]: Odds Ratios for individuals with Mobility restrictions due to disability by educational status (Tertiary vs Non Tertiary education), 23 European countries

(Data Source: EUROSTAT, LFS ad-hoc 2002)

Inequality within the distribution of disability among individuals is better revealed by indicators such as the ones of the entropy type. All entropy type indices result to values close to 0 (e.g. Theil(1)=0,109) when applied to the disability distribution of 2002. This suggests equality or near equality in most of the cases in the EU.

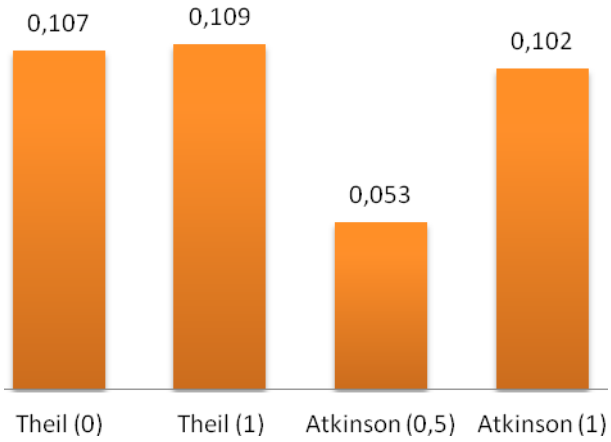


Figure 45: Percentage of disability in 23 EU countries of 2002 and the level of health inequality in terms of entropy type indices.

(Source: EUROSTAT, LFS ad-hoc 2002)

Based on the Perceptual distribution of the different types of disability there do not appear any significant inequalities, as is evident from Figure 46. Only the cases of "Heart, blood pressure, circulation problem", or "Chest or Breathing problem" or "Other longstanding health problem" present some interesting differences but these are not large enough to be interpreted as

[22] Norway, Netherlands and Romania are the only 3 cases that present striking inequalities without regarding the level of mobility restrictions.

inequalities. E.g. the Theil index (1) equals almost 0,1 for “Heart, blood pressure, circulation problems”, almost 0,07 for “Chest or Breathing problem”, and almost 0,08 for “Other longstanding health problem”.

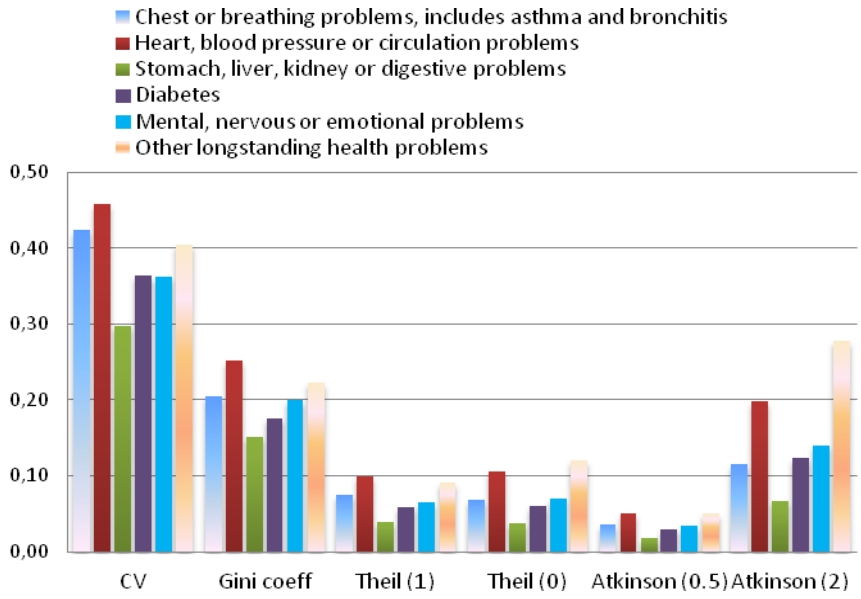


Figure 46: Selected inequality indices for Percentual distribution of types of disability, EU27, EU-LFS 2002

(Data Source: EUROSTAT, LFS ad-hoc 2002)

Figure 47 decribes the measured inequality level based on the degree of disability as this was reported by the respondents in the 2002 LFS ad-hoc module questionnaire. The degree of disability varies from “very severe” to “light” disability concluding to 4 distinct categories. It is reasonable to assume that the indices examined will result to higher values when the disability is less severe. This was indeed verified by all indices tested. In particular, the entropy type indices such as the Theil index resulted to values close to 0,12 (very severe disability) and almost 0,35 (Light disability). The Atkinson index (for parameter value equal to 2) varies from almost 0,3 (very severe disability) to almost 0,75 (Light disability) and is almost equivalent to the Gini index.

The addition of the CV and the Gini coefficient (which in this report were mostly used for the analysis of mortality) was done for reasons of comparison.

Summarizing, it is evident that there exist siginificant inequalities when comparing people that exhibit “light disabilities” with those having “severe disabilities”.

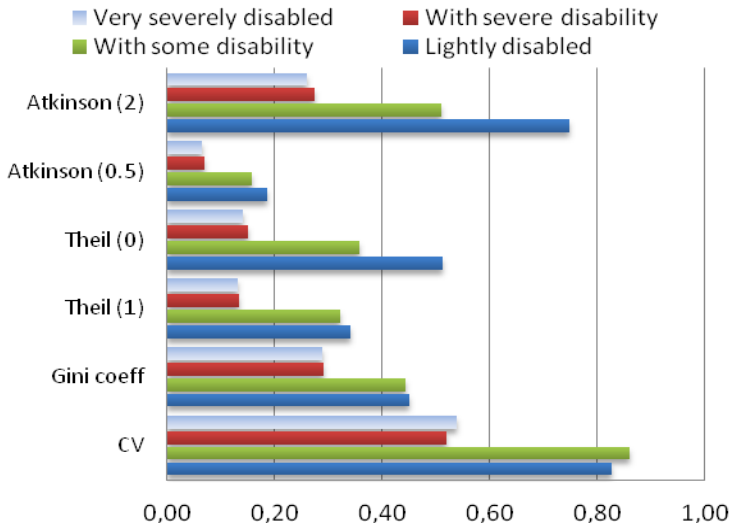


Figure 47: Selected inequality indices for Degree of Disability, EU27, EU-LFS 2002

(Data Source: EUROSTAT, LFS ad-hoc 2002)

Various "causes of disability" exist and their effects on disability percentages may indicate inequalities. This was tested with Entropy type indices. The observed values were quite small (close to zero) suggesting insignificant differentiations between the various causes of disability in the EU as a whole. Higher values and, consequently, possible inequalities appear only in the case of "work related causes". Figure 48 summarizes these results.

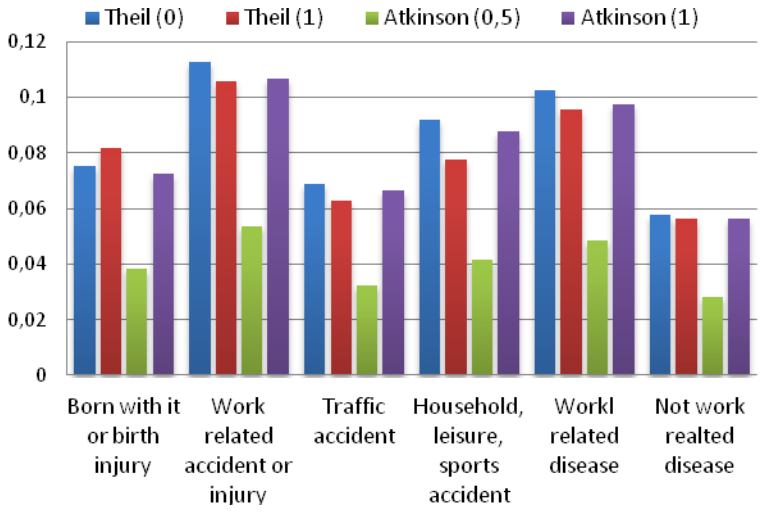


Figure 48: Entropy type indices by cause of disability for 23 EU members and year 2002

(Data Source: EUROSTAT, LFS ad-hoc 2002)

4. Concluding Remarks

In this report, inequalities in health with respect to mortality, morbidity, self perceived health, and disabilities in the EU are measured, based on proposals for the most suitable indicators. One of the main objectives of the European Commission is to "*develop headline indicators to monitor health inequalities, that can also show ways to developing in further the collection of data by age, gender, socio-economic status and various geographic dimensions of the EU population*". The study was conducted in three stages:

First, a detailed evaluation of measurement methods and health inequality indicators was carried out. This evaluation was conducted in the context of inequality measurement and with respect to health data collected (or planned to be collected). The health inequality indices were evaluated on the basis of their theoretical properties, their performance with EU health data and their potential for contribution in the study of trends in health inequalities. The report concludes by proposing the most adequate solutions for the study of health inequalities in the EU area, taking also into account possible uses with data that will be available soon in the future.

Second, an analysis of the level of inequality in health in the EU with respect to several variable breakdowns (e.g. social variables) was conducted:

- Mortality differences that revealed inequalities in the EU, accompanied by analysis at the regional and population groups level (NUTS II regions, cities and also smaller groups of population (e.g., migrants-non migrants).
- Inequalities in Self assessed health, as measured by the main survey instruments that cover many or all of the EU Member States: the EU SILC, the ESS, and the SHARE.
- Inequalities in terms of activity limitations, mobility restrictions and also more specific health issues such as depression.
- Differences in disability with respect to the employment status, as measured in the 2002 LFS ad-hoc module.

The main objective was to analyze in detail patterns of mortality and/or health in relation to socioeconomic features of individuals, based on the proposed indicators. This also served as an additional step in the evaluation of performance of these indicators. For example, both the EU SILC and the LFS can be used to construct a large variety of socioeconomic indicators. It should be noted that the SHARE data collection is a special case: It can lead to a much detailed analysis of health indicators, but its country and time coverage is limited. *All these tools however contribute to the measurement of socioeconomic health inequalities, each one from its own perspective and under its own limitations.*

Finally, the aim was to offer insights for the health inequalities in the EU as a whole and in its Member States. The intent was to investigate both the most recent picture and also trends across time. In this analysis we focused on:

- Inequalities in mortality in the EU, within the EU Member States and through time, and
- Socioeconomic inequalities in health through time.

Several researchers tried in the past to assess the patterns and trends in health inequalities, mostly the ones due to socioeconomic factors (see, Khang, Y.H. et.al. 2008, Mackenbach, J.P., et.al. 1997, Houweling, T.A., 2007). Researchers involved in the field of socioeconomic inequalities faced many difficulties with the comparability issues regarding the survey tools used (e.g. EU SILC, SHARE, etc). but were also much concerned with the ways of measuring the observed differences in health. As various researchers have suggested in the past (e.g. Wagstaff et. al., 1991) the conclusions reached by the various authors studying trends in health inequalities may vary depending on the type of the measure used. As Masseria, C (2009) also comments: "*the measurement and monitoring of inequalities in health over time and across countries is not straightforward since the choice of the measure will influence the results*". Therefore, the choice of the appropriate indicator for health inequality measurement is a fundamental issue, not only for the accurate estimation of the magnitude of inequalities, but also for the investigation of their variation through time.

Measurement of Inequalities in Mortality

The proposed measures range from "simple measures" such as the Life Expectancy gap or the inter-quintiles ratio, to more complex measures such as the Coefficient of Variance and the Standard deviation of log values, and finally to strict "inequality" measures such as the Gini coefficient. Theil and Atkinson indices were also selected from the Entropy family of indicators, as additional ways of measurement, and also as "reference points" for the performance of the other indicators. The selection of these followed a specific reasoning approach:

All the selected measures can contribute much to the measurement of inequalities in a certain time and also through time (monitoring of trends).

- The *Life Expectancy gap* is very simple in its application and interpretation and has been used recently in order to explore socioeconomic dimensions of the problem (for example, educational inequalities and relations with mortality).
- The *Inter-quintiles ratio* is a simple measure which performs adequately in cases of relatively smooth data. It compares two extremes of the distribution and in that sense it can be very useful when the need is for such comparisons only. Simplicity and ease of calculation are its most important advantages, and from this point of view, one can always apply it for reasons of verification of other results. But it fails to estimate correctly the level

of inequalities when comparing countries or regions with extreme variations. Also, in some cases it is not an appropriate tool for time comparisons.

- The *Coefficient of Variation* or any other *Standard deviation* measure are more accurate in cases of comparisons (for example among countries) which present high variability. Most importantly, these indicators facilitate country/ region comparisons and comparisons across time. Such measures make use of the whole health distribution, a very desirable characteristic in the analysis of mortality data.
- Finally the *Gini coefficient* is a strict inequality measure. It provides almost 100% accurate estimation in most of the cases, and it is easy to use when performing country, region or time comparisons. It also offers an appealing visual interpretation, since it is associated with the Lorenz curve. Furthermore, it almost always coincides in the results with other health inequality indicators such as the ones from the Entropy type family, that make use of the whole health distribution. As Regidor, E.(2004) suggests, the Gini index is most appropriate when the health variable is measured in an interval scale (e.g. Healthy Life Years) and usually does not perform adequately in the measurement of socioeconomic health inequalities.

Some ***key outcomes*** of this analysis were that:

- the selection of only one indicator for the health inequality measurement may not be the appropriate solution to the problem.
- The *Gini coefficient* is the most appropriate solution for measuring health inequalities in the EU when the data at hand refer to mortality, life expectancy and health expectancy rates.
- It is however recommended that a life expectancy gap analysis or the inter quintiles ratio is always applied, to verify Gini's estimations.

All the analysis was based on mortality data extracted from the Eurostat Statistics Database for the period 1997-2008. There is no complete data availability for all the countries in the EU and for all the mortality indicators tested. In particular, the regional analysis of inequalities was restricted to some extent, because for many EU Member States there were no NUTS II level regional mortality data. The results of our analysis are in agreement with previous research (e.g., Schoen R. 2008) which has shown that, when analyzing mortality data, especially with respect to the monitoring of trends, the Gini coefficient and entropy type indicators estimate similar and reliable patterns.

The analysis concluded led to the following general observations:

Inequalities in terms of mortality show a consistent increase over time (1996 or 1997 to 2008) but their level is not yet a "large level of inequality". All applied indicators coincide to the finding that with all used mortality data (IMRs, SDRs and Life expectancy) and also with HLYs data, no significant differences are observed between the two genders. An increasing trend is

present but not indicating high inequalities. The following Table (Table 12) summarizes these observations.

Health data	Health Inequality Indicator		
	Inter deciles ratio	**CV & S*log***	**Gini & Entropy type indices**
Infant mortality rates (IMRs)	P_{75}/P_{25}: low level health inequalities with a downward trend P_{90}/P_{10}: exhibits a different pattern. Presents more irregular variations	Due to standardization the observed variations are more reliable than the previous. Highlight that the real levels of inequality are lighter now. Again verified that there are no differences between the two genders in the EU population.	An increasing trend of health inequalities during 1997 and 2008. This suffices for all used mortality data (IMRs, SDRs and Life expectancy) and also the HLYs data. No significant differences are present between the two genders.
Standardized mortality rates (SDRs)	Low inequalities A steady but very slight increase during the study period of 1997 to 2008.		
Life Expectancy at birth and at age of 65	Same comments with the ones of the SDRs		
Healthy Life Years at birth and at age of 65	Health inequalities are increasing during the period of 1997 to 2007		

Table 12: Summary of conclusions on health inequalities in mortality in the EU

Based on the analysis of the NUTS II regional data, it appears that in almost all EU Member States, the inequality levels are similar as for the EU in total. Some countries present an increasing and/or very fluctuating pattern. In Slovakia, France and Italy, levels of inequality increase steadily but are still very small to be considered significant. The data in Netherlands and Bulgaria show much variability. Bulgaria is usually ranked 1st or 2nd in health inequalities. On the other hand, Austria, Romania and Portugal present very low inequalities or almost equality (and are ranked in the last places). The same rankings are found when examining inequalities in terms of Standardized Mortality Rates and Life Expectancy.

Finally, the measurement of mortality differences in relation to economic status, educational level, and other social characteristics is an issue of recent activity by researchers working in the field of health inequalities (see Corsini, V. 2010). The study of such issues is restricted by the limited data availability in the EU. It can however be the subject of further work, with the proposed indicators (especially the Gini coefficient which can incorporate such socioeconomic dimensions), in the near future, when more data become available.

Socioeconomic Health Inequalities

The main objective of this analysis was the comparison of differences in health with respect to various socioeconomic factors. Based on the evaluation and the application of the proposed indicators, we concluded that,

- The Odds Ratios present the most adequate solution to the problem of measuring inequalities with respect to social categories. The reasoning for this selection lies mostly with the easiness in carrying out all possible paired-comparisons between social groups. An additional reason is their use in statistical modelling techniques (e.g. logistic regression) that can provide more detailed interpretation of inequalities in terms of specific factors and covariates.
- The same levels of inequality are estimated by the Concentration index and the Entropy type indices. The Concentration Index is a very familiar tool in the study of the socio-economic aspects of health inequalities and performs adequately, as also verified by the evaluation and analysis presented in this report. It also has a graphical interpretation which is appealing and in some cases appears to be the most important aspect in monitoring for policy-making. The entropy type indices although relatively complex, can also perform adequately and in many cases even better, with all kinds of existing EU data on self-perceived health, morbidity and disability. It is proposed to always accompany the application of the Odds Ratios with one of these solutions.
- Significant inequalities were estimated in this part of the analysis, with respect to income level, activity status, educational level, etc. In general, “more health” is concentrated in the higher-level socioeconomic groups, characterized e.g. by higher (tertiary) education, or higher income, etc. In other words, for numerous EU members and the EU as a whole, health inequality is present and is in favour of individuals with higher socioeconomic status.

Further improvements in the measurement of health and extensions in the existing harmonized survey instruments (e.g. EU SILC) can only improve the measurement of health inequalities based on the tools suggested in this report.

With regard to disability rates as measured in the 2002 LFS ad hoc module, it appears that the distribution of disability presents equality or near equality in most of the cases in the EU (the analysis was mostly based on entropy type indices). The disability differences present a different pattern when associated with SES categories. For example, people with non tertiary education are more likely to report disabilities with respect to their occupation status. It is also evident that there exist siginificant inequalities when comparing people that exhibit “light or no disabilities” to those having “severe disabilities”. Caution is needed here however, because there is bias in the measurement of disability in the EU Member States, which poses restrictions in the interpretation of these and similar results. The situation will be partly improved with the 2nd run of the LFS ad hoc module which is estimated by Eurostat to be run in

2011. A second run will offer the possibility of comparisons and the measurement of variations through time.

Finally, the European Commission is very much interested in the possibilities of analyzing the differences that are observed between typical and vulnerable groups of the EU population, such as the migrants or ethnic minorities. Such differences can be studied in terms of the mortality rates in these groups, and also in terms of health inequalities related to socioeconomic characteristics. This part of the analysis is very much restricted due to the so far limited data availability in the EU.

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ANNEX I: Index of Tables & Figures

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ANNEX II: Tables

		Properties of Health Inequality Indicators			
		Scale Invariance	Pigou-Dalton	Sensitivity to transfers	Decomposition
Shannon's Entropy	$H = -\sum_{i=1}^{n} p_i \ln(p_i)$	Yes	Yes	Yes	Yes
Concentration Index	*For aggregated data:* $CI = (p_1 L_2 - p_2 L_1) + (p_2 L_3 - p_3 L_2) + \cdots + (p_{T-1} L_T - p_T L_{T-1})$ *For microdata:* $CI = \frac{2Cov\left(Y_i, R_i\right)}{\mu}$	No Yes	No Yes	No	No Yes
Gini coefficient	$G = 1 + \frac{\sum_{i=1}^{n}(Y_i + Y_{i-1})}{n}$ $\stackrel{or}{=} \frac{\sum_{i=1}^{n-1}(p_i + q_i)}{\sum_{i=1}^{n-1} p_i}$	Yes Yes	No Yes	No	No Limited No
Odds Ratios (*of i to j event*)	$OR = \frac{\frac{p_i}{(1-p_i)}}{\frac{p_j}{(1-p_j)}} = \frac{p_i(1-p_j)}{p_j(1-p_i)}$	Yes	No	No	No
Standard deviation of the logs	$S_{log} = \sqrt{\frac{\sum_{i=1}^{n}(\ln Y_i - \ln\mu)^2}{n}}$	Yes	No	No	No
Coefficient of Variation	$CV = \frac{\sigma}{\mu} = \frac{\sqrt{\frac{\sum_{i=1}^{n}(Y_i - \mu)^2}{n}}}{\mu}$	Yes	No	No	Limited
Mean Log Deviation	$MLD = \frac{1}{n}\sum_{i=1}^{n}\frac{\ln\mu}{Y_i}$ $MLD = Theil(0)$	Yes	Yes	No	Yes
Theil's Entropy	$\mathbf{Theil\ (0,5)}$ $\mathbf{Theil\ (1)}$	Yes	Yes		Yes
Atkinson's Index	$A = \begin{cases} 1 - \frac{1}{\mu}\left(\frac{\sum_{i=1}^{n} Y_i^{1-\varepsilon}}{n}\right)^{\frac{1}{1-\varepsilon}}, for\ \varepsilon \in [0,1) \\ 1 - \frac{1}{\mu}\left(\frac{\prod_{i=1}^{n} Y_i}{n}\right)^{\frac{1}{n}}, for\ \varepsilon = 1 \end{cases}$	Yes	Yes		Yes

Table A 1: Summary Table of Health inequalities Indices

Inequality based on Healthy life years at age of 65 of the female EU population											
Index of Inequality	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
p90/p10	1,494	1,390	1,570	1,453	1,471	1,563	1,636	1,768	1,881	1,904	1,890
p75/p25	1,233	1,209	1,275	1,220	1,253	1,297	1,341	1,179	1,652	1,480	1,519
Coeff. Of Variation (CV)	0,157	0,134	0,171	0,168	0,159	0,180	0,190	0,247	0,256	0,238	0,245
St. Dev. of logs (S_{log})	0,163	0,138	0,176	0,169	0,159	0,178	0,189	0,299	0,273	0,239	0,260
Gini coeff.	0,085	0,072	0,094	0,089	0,086	0,096	0,102	0,124	0,135	0,127	0,133
Theil (1)	0,012	0,008	0,014	0,013	0,012	0,015	0,017	0,031	0,031	0,026	0,029
Theil (0)	0,012	0,009	0,014	0,013	0,012	0,015	0,017	0,036	0,033	0,026	0,030
Atkinson (0.5)	0,006	0,004	0,007	0,007	0,006	0,007	0,008	0,017	0,016	0,013	0,015
Atkinson (1)	0,012	0,009	0,014	0,013	0,012	0,015	0,017	0,035	0,032	0,026	0,030
Atkinson (2)	0,024	0,018	0,029	0,026	0,023	0,029	0,033	0,082	0,067	0,052	0,061

Table A 2: Health inequalities calculated by the selected health inequality indicators for the HLYs at age of 65 and female population for the period 1997-2007 and the EU 15 (Data Source: Eurostat)

Inequality based on Healthy life years at age of 65 of the male EU population											
Index of Inequality	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
p90/p10	1,403	1,458	1,486	1,481	1,370	1,438	1,427	1,600	1,694	1,853	1,753
p75/p25	1,140	1,193	1,205	1,202	1,277	1,277	1,286	1,232	1,537	1,351	1,333
Coeff. Of Variation (CV)	0,152	0,127	0,164	0,172	0,146	0,160	0,161	0,216	0,215	0,213	0,197
St. Dev. of logs (S_{log})	0,170	0,135	0,177	0,183	0,156	0,166	0,165	0,227	0,220	0,215	0,196
Gini coeff.	0,078	0,067	0,088	0,093	0,079	0,087	0,087	0,114	0,113	0,116	0,107
Theil (1)	0,011	0,008	0,013	0,014	0,010	0,012	0,012	0,022	0,022	0,021	0,018
Theil (0)	0,012	0,008	0,014	0,015	0,011	0,013	0,012	0,023	0,022	0,021	0,018
Atkinson (0.5)	0,006	0,004	0,007	0,007	0,005	0,006	0,006	0,011	0,011	0,011	0,009
Atkinson (1)	0,012	0,008	0,014	0,015	0,011	0,012	0,012	0,023	0,022	0,021	0,018
Atkinson (2)	0,027	0,017	0,029	0,031	0,023	0,025	0,025	0,047	0,044	0,042	0,035

Table A 3: Health inequalities calculated by the selected health inequality indicators for the HLYs at age of 65 and male population for the period 1997-2007 and 15 EU Member States (Data Source: Eurostat)

Inequality based on Infant Mortality Rates (per 1000 live births) of the EU population											
Index of Inequality	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
p90/p10	3,643	3,064	2,568	2,537	2,750	2,579	2,410	2,686	2,600	2,714	3,222
p75/p25	1,980	1,898	1,867	1,867	1,791	1,714	1,750	1,737	1,632	1,676	1,735
Coeff. of Variation (CV)	0,572	0,539	0,515	0,501	0,542	0,528	0,523	0,541	0,508	0,514	0,483
St. Dev. of logs (S_{log})	0,459	0,427	0,417	0,398	0,413	0,403	0,403	0,409	0,408	0,397	0,423
Gini coeff.	0,269	0,249	0,244	0,232	0,243	0,236	0,236	0,241	0,236	0,232	0,239
Theil (1)	0,129	0,114	0,106	0,098	0,112	0,106	0,105	0,111	0,101	0,102	0,098
Theil (0)	0,116	0,101	0,095	0,087	0,097	0,092	0,092	0,095	0,090	0,089	0,092
Atkinson (0.5)	0,060	0,053	0,049	0,045	0,051	0,048	0,048	0,050	0,047	0,046	0,046
Atkinson (1)	0,109	0,096	0,090	0,084	0,093	0,088	0,088	0,091	0,086	0,085	0,088
Atkinson (2)	0,184	0,162	0,155	0,143	0,154	0,147	0,147	0,151	0,150	0,142	0,159

Table A 4: Health inequalities calculated by the selected health inequality indicators for the Infant Mortality Rates and for the period 1997-2007 and 15 EU Member States (Data Source: Eurostat)

Inequality based on Standardized Mortality Rates (age<65) of the EU population											
Index of Inequality	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
p90/p10	2,647	2,642	2,712	2,577	2,708	2,766	2,749	2,819	2,688	2,853	2,812
p75/p25	1,830	1,861	1,874	1,795	1,799	1,789	1,811	1,860	1,905	1,976	1,992
Coeff. of Variation (CV)	0,402	0,417	0,402	0,384	0,413	0,409	0,403	0,411	0,428	0,452	0,449
St. Dev. of logs (S_{log})	0,377	0,384	0,372	0,351	0,372	0,371	0,368	0,373	0,382	0,401	0,398
Gini coeff.	0,213	0,218	0,211	0,200	0,213	0,212	0,210	0,213	0,219	0,231	0,229
Theil (1)	0,073	0,077	0,072	0,066	0,075	0,074	0,072	0,075	0,080	0,089	0,087
Theil (0)	0,071	0,075	0,070	0,063	0,071	0,071	0,069	0,071	0,076	0,084	0,083
Atkinson (0.5)	0,036	0,037	0,035	0,032	0,036	0,036	0,035	0,036	0,038	0,042	0,042
Atkinson (1)	0,069	0,072	0,068	0,061	0,069	0,068	0,067	0,069	0,073	0,080	0,079
Atkinson (2)	0,127	0,131	0,124	0,111	0,124	0,123	0,121	0,124	0,130	0,142	0,140

Table A 5: Health inequalities calculated by the selected health inequality indicators for the Standardized Mortality Rates and for the period 1997-2007 and 15 EU Member States (Data Source: Eurostat)

HLYs at age of 65 by gender								
Year	**Female Population**				**Male Population**			
	P_{90}/P_{10}	P_{75}/P_{25}	*CV*	S_{log}	P_{90}/P_{10}	P_{75}/P_{25}	*CV*	S_{log}
1997	1,494	1,233	0,157	0,163	1,403	1,14	0,152	0,170
1998	1,39	1,209	0,134	0,138	1,458	1,193	0,127	0,135
1999	1,57	1,275	0,171	0,176	1,486	1,205	0,164	0,177
2000	1,453	1,22	0,168	0,169	1,481	1,202	0,172	0,183
2001	1,471	1,253	0,159	0,159	1,37	1,277	0,146	0,156
2002	1,563	1,297	0,180	0,178	1,438	1,277	0,160	0,166
2003	1,636	1,341	0,190	0,189	1,427	1,286	0,161	0,165
2004	1,768	1,179	0,247	0,299	1,6	1,232	0,216	0,227
2005	1,881	1,652	0,256	0,273	1,694	1,537	0,215	0,220
2006	1,904	1,48	0,238	0,239	1,853	1,351	0,213	0,215
2007	1,89	1,519	0,245	0,260	1,753	1,333	0,197	0,196

Table A 6:: Trends of Health Inequalities based on HLYs at age of 65 for the period of 1997-2007 and 15 EU Member States (Data Source: Eurostat)

Health Inequalities of 17 EU Member States as measured by the p75/p25 inter-quintiles ratio based on Infant Mortality Rates (IMRs) of NUTS II regions												
Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BE	1,5	1,3	1,1	1,2	1,3	1,3	1,3	1,3	1,3	1,3	1,2	-
BG	1,3	1,4	1,2	1,2	1,4	1,7	1,3	1,4	1,8	1,4	1,6	1,6
CZ	1,4	1,4	1,2	1,5	1,6	1,5	1,3	1,3	1,3	1,2	1,6	1,5
DK	-	-	-	-	-	-	-	-	-	-	2,2	1,6
DE	-	-	-	-	-	-	1,3	1,3	1,1	1,2	1,3	-
GR	1,7	1,5	1,3	1,8	1,6	1,4	1,6	1,5	1,8	1,6	1,9	2,2
ES	1,3	1,2	1,4	1,6	1,5	1,6	1,4	1,5	1,3	1,6	1,3	1,4
FR	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,3	1,4	1,3	1,4	1,3
IT	1,4	1,3	1,4	1,4	1,4	1,5	1,5	1,4	1,7	1,6	1,4	-
HU	1,1	1,3	1,1	1,1	1,2	1,3	1,3	1,3	1,3	1,6	1,1	1,3
NL	-	-	-	-	-	1,1	1,2	1,3	1,3	1,1	1,4	1,3
AT	1,3	1,2	1,5	1,6	1,4	1,4	1,7	1,7	1,6	1,3	1,2	1,8
PL	1,1	1,2	1,1	1,2	1,2		1,2	1,2	1,4	1,2	1,2	
PT	1,5	1,3	1,7	1,4	1,6	1,5	1,3	1,4	1,2	1,2	1,3	1,2
RO	1,4	1,2	1,2	1,2	1,2	1,4	1,2	1,3	1,1	1,2	1,3	1,1
FI	1,4	1,7	2,3	1,3	1,3	1,2	1,5	2,0	1,3	3,1	3,6	2,6
SE	1,2	1,3	1,5	1,4	1,6	1,4	1,6	1,2	1,5	1,5	1,7	1,5
UK	1,2	1,2	1,2	1,3	1,4	1,3	1,3	1,3	1,3	-	-	-

Table A 7: Health Inequalities of 17 EU Member States as measured by the p75/p25 inter quintile ratio and based on Infant Mortality Rates (IMRs) of the NUTS II regions and the period 1996-2007 (Data Source: Eurostat)

Gini coefficient values for the on the Infant Mortality Rates (IMRs) and for the NUTS II regions of 19 EU Members states period 1996-2007												
Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BE		0,078	0,011	0,059	0,011	0,044	0,004	0,057	0,024	0,013	0,000	-
BG	0,134	0,091	0,200	0,123	0,125	0,109	0,111	0,104	0,249	0,218	0,194	0,208
CZ	0,039	0,056	0,034	0,048	0,075	0,037	0,010	0,109	0,120	0,183	0,122	0,173
DK	-	-	-	-	-	-	-	-	-	-	0,051	0,038
DE	-	-	-	-	-	-	0,023	0,038	0,035	0,024	0,023	-
GR	0,067	0,041	0,064	0,049	0,015	0,025	0,033	0,040	0,025	0,051	0,028	0,029
ES	0,040	0,028	0,073	0,161	0,136	0,078	0,129	0,114	0,046	0,075	0,123	0,030
FR	0,002	0,021	0,112	0,118	0,100	0,123	0,127	0,149	0,092	0,156	0,190	0,130
IT	0,089	0,086	0,090	0,110	0,090	0,110	0,069	0,024	0,118	0,074	0,084	-
HU	0,015	0,016	0,020	0,016	0,004	0,011	0,025	0,041	0,057	0,107	0,030	0,017

NL	-	-	-	-	-	0,016	0,035	0,029	0,008	0,033	0,025	0,063
AT	0,005	0,005	0,059	0,048	0,009	0,010	0,054	0,096	0,037	0,027	0,010	0,109
PL	0,002	0,017	0,002	0,017	0,000	-	0,012	0,007	0,004	0,009	0,005	-
PT	0,099	0,045	0,038	0,033	0,087	0,067	0,035	0,082	0,029	0,052	0,010	0,038
RO	0,021	0,017	0,022	0,043	0,016	0,023	0,025	0,018	0,010	0,011	0,012	0,029
SK	0,116	0,066	0,159	0,167	0,189	0,124	0,177	0,178	0,143	0,175	0,231	0,223
FI	0,019	0,127	0,228	0,053	0,022	0,024	0,021	0,158	0,014	0,230	0,155	0,205
SE	0,025	0,019	0,038	0,012	0,057	0,077	0,025	0,051	0,038	0,083	0,051	0,013
UK	0,014	0,027	0,018	0,014	0,034	0,018	0,009	0,012	0,023	-	-	-

Table A 8: Health inequalities measured by the Gini coefficient on the Infant Mortality Rates (IMRs) for the NUTS II regions of 19 EU Member States and the period 1996-2007 (Data Source Eurostat)

Sample Size of EU SILC (per country and year)					
EU Member	2004	2005	2006	2007	2008
AT	4521	10419	14883	13391	10955
BE	5275	9974	14292	12322	12154
CY	-	8997	11069	8470	8090
CZ	-	8628	17830	19384	22754
DE	-	24982	31717	26291	24336
DK	6866	11901	14549	11610	11545
EE	3993	9643	15741	11971	10851
ES	15355	30375	34183	28656	30082
FI	11200	22961	28039	21773	21131
FR	10273	18769	24726	20357	20125
GR	6252	12381	15112	12346	14123
HU	-	14791	19902	18490	18710
IE	5477	12032	14634	10892	10116
IS	6667	6670	8563	6567	6618
IT	24204	47311	54512	44629	44286
LT	-	9929	12134	10913	10473
LU	3572	7535	10242	7913	7638
LV	-	7913	10892	9270	10910
NL	-	17852	23092	19623	19519
NO	6046	11913	15178	11706	10897
PL	-	37671	44157	34888	33801
PT	4989	10706	12042	9947	10101

SE	5478	12191	17043	14204	14889
SI	-	23862	31276	24730	25005
SK	-	12879	15138	12573	14098
UK	-	20115	22542	17484	16825
EU Total	**120168**	**422400**	**533488**	**440400**	**440032**

* BG RO MT participated only in the last wave. For this reason they are not presented
(-): cases of countries that have not participated in these waves of the ESS

Table A 9: Sample sizes of the EU SILC waves from 2004 to 2008 for the EU Member States and the EU total

(Source: Eurostat)

Sample Size of the ESS (per country and year)				
EU Member	**2002**	**2004**	**2006**	**2008**
AT	2257	2256	2405	-
BE	1899	1778	1798	1760
BG	-	-	1400	2230
CH	2040	2141	1804	1819
CY	-	-	995	1215
CZ	1360	3026	-	2018
DE	2919	2870	2916	2751
DK	1506	1487	1505	1610
EE	-	1989	1517	1661
ES	1729	1663	1876	2576
FI	2000	2022	1896	2195
FR	1503	1806	1986	2073
GB	2052	1897	2394	2352
GR	2566	2406	-	2072
HR	-	-	-	1484
HU	1685	1498	1518	1544
IE	2046	2286	1800	-
IL	2499	-	-	2490
IS	-	579	-	-
IT	1207	-	-	-
LU	1552	1635	-	-
LV	-	-	-	1980
NL	2364	1881	1889	1778
NO	2036	1760	1750	1549
PL	2110	1716	1721	1619

PT	1511	2052	2222	2367
RO	-	-	-	2146
RU	-	-	2437	2512
SE	1999	1948	1927	1830
SI	1519	1442	1476	1286
SK	-	1512	1766	1810
TR	-	1856	-	2416
UA	-	2031	2002	1845
EU Total	**42359**	**47537**	**43000**	**54988**

(-): cases of countries that have not participated in these waves of the ESS

Table A 10: Sample sizes of the ESS waves of 2002,2004,2006,2008 for the European countries and the EU total (Source: Eurostat)

Sample Size of SHARE (per country and year)		
EU Member	**2004/5 1st wave**	**2006/7 2nd wave**
AT	1893	1341
DE	3008	2568
SE	3053	2745
NL	2979	2661
ES	2396	2228
IT	2559	2983
FR	3193	2968
DK	1707	2616
GR	2898	3243
CH	1004	1462
BE	3827	3169
IS(1)	2598	-
CZ(2)	-	2830
PL(2)	-	2467
EU Total	**31115**	**33281**

(1): Iceland participated only in the first wave of SHARE,
(2): Czech republic & Poland participated only in the 2nd wave of SHARE.

Table A 11: Sample information of the SHARE waves of 2004/,2006/7 (Source: Eurostat)

Sample Size of LFS core and ad-hoc module of 2002 (per country)		
Country	**Sample**	**Ad Hoc module Sample (People aged 16 to 64)**
AT	47236	31041
BE	27834	18387
CY	10667	6965
CZ	62091	42048
DK	16081	10506
EE	4948	3276
ES	172552	113267
FI	42743	27067
FR	175939	110287
GR	77451	49454
HU	82904	54295
IE	105569	68835
IT	193444	126935
LT	12993	8907
LU	13429	8480
RO	41697	27389
NL	97594	68535
NO	20838	18734
PT	45617	28878
SE	55380	52820
SI	19766	14373
SK	29420	20403
UK	136156	85052
EU Total	**1492349**	**995934**

Table A 12: Sample information of the LFS core and ad-hoc module of 2002

Values of Concentration index on Self-Perceived Health and Income distribution						
Country	**2005**			**2007**		
	CI	**95% Conf. Interval**		**CI**	**95% Conf. Interval**	
AT	0,053	0,0457	0,0610	0,063	0,0562	0,0704
BE	0,080	0,0729	0,0879	0,078	0,0710	0,0848
CY	0,102	0,0947	0,1100	0,094	0,0858	0,1014
CZ	0,085	0,0725	0,0974	0,098	0,0901	0,1065
DE	0,065	0,0589	0,0716	0,085	0,0776	0,0918

DK	0,056	0,0444	0,0668	0,061	0,0493	0,0732
EE	0,151	0,1369	0,1654	0,171	0,1576	0,1840
ES	0,070	0,0648	0,0758	0,068	0,0622	0,0738
FI	0,071	0,0610	0,0813	0,090	0,0792	0,1016
FR	0,051	0,0451	0,0578	0,055	0,0485	0,0613
GR	0,060	0,0543	0,0666	0,056	0,0498	0,0625
HU	0,077	0,0650	0,0887	0,067	0,0564	0,0770
IE	0,057	0,0514	0,0628	0,060	0,0514	0,0687
IS	0,051	0,0367	0,0648	0,057	0,0422	0,0713
IT	0,054	0,0481	0,0602	0,061	0,0552	0,0659
LT	0,111	0,0947	0,1272	0,126	0,1110	0,1411
LU	0,035	0,0230	0,0462	0,039	0,0279	0,0505
LV	0,145	0,1252	0,1641	0,163	0,1429	0,1826
NL	0,060	0,0503	0,0690	0,082	0,0709	0,0932
NO	0,060	0,0489	0,0721	0,051	0,0412	0,0611
PL	0,023	0,0175	0,0292	0,035	0,0283	0,0408
PT	0,135	0,1220	0,1480	0,137	0,1226	0,1513
SE	0,059	0,0492	0,0687	0,059	0,0499	0,0677
SI	0,153	0,1378	0,1692	0,138	0,1231	0,1522
SK	0,058	0,0482	0,0674	0,074	0,0638	0,0832
UK	0,074	0,0688	0,0788	0,065	0,0595	0,0702
EU Total	0,072	0,0700	0,0732	0,074	0,0719	0,0752

Table A 13: Values of Concentration index on Self-Perceived Health and Income distribution (Data Source: EU SILC 2005, 2007)

Odds Ratios values for SPH with respect to income level (1st income quintile vs 5th income quintile)					
Country	2004	2005	2006	2007	2008
BE	0,271 [0,269-0,272]	0,240 [0,239-0,242]	0,221 [0,220-0,222]	0,223 [0,222-0,225]	0,189 [0,188-0,190]
BG	-	-	-	-	0,236 [0,235-0,237]
CZ	-	0,385 [0,383-0,387]	0,389 [0,387-0,391]	0,330 [0,328-0,332]	0,247 [0,246-0,248]
DK	0,399 [0,395-0,404]	0,384 [0,380-0,388]	0,421 [0,417-0,425]	0,343 [0,340-0,347]	0,375 [0,372-0,379]
EE	0,279 [0,276-0,283]	0,207 [0,204-0,209]	0,210 [0,207-0,212]	0,180 [0,177-0,182]	0,113 [0,111-0,114]
IE	0,137 [0,136-0,139]	0,178 [0,176-0,180]	0,173 [0,171-0,175]	0,129 [0,128-0,131]	0,174 [0,171-0,176]
GR	0,249 [0,248-0,251]	0,272 [0,271-0,274]	0,280 [0,278-0,281]	0,278 [0,276-0,279]	0,322 [0,320-0,324]
ES	0,365 [0,364-0,366]	0,332 [0,331-0,333]	0,329 [0,328-0,330]	0,347 [0,346-0,348]	0,243 [0,242-0,244]

IT	0,540 [0,539-0,541]	0,543 [0,542-0,544]	0,564 [0,563-0,565]	0,475 [0,474-0,476]	0,458 [0,457-0,459]
CY	-	0,121 [0,119-0,124]	0,111 [0,108-0,113]	0,112 [0,109-0,114]	0,134 [0,131-0,137]
LV	-	0,372 [0,368-0,375]	0,262 [0,260-0,265]	0,227 [0,225-0,230]	0,204 [0,202-0,206]
LT	-	0,433 [0,430-0,437]	0,364 [0,361-0,366]	0,325 [0,323-0,328]	0,296 [0,294-0,299]
LU	0,442 [0,431-0,452]	0,579 [0,565-0,593]	0,436 [0,425-0,447]	0,470 [0,459-0,482]	0,410 [0,400-0,420]
HU	-	0,510 [0,508-0,513]	0,433 [0,431-0,435]	0,556 [0,554-0,559]	0,590 [0,587-0,593]
NL	-	0,379 [0,377-0,381]	0,356 [0,354-0,359]	0,272 [0,271-0,274]	0,292 [0,291-0,294]
AT	0,410 [0,408-0,412]	0,401 [0,399-0,403]	0,326 [0,325-0,328]	0,328 [0,327-0,330]	0,252 [0,251-0,254]
PL	-	0,753 [0,751-0,755][	0,720 [0,718-0,721]	0,630 [0,628-0,631]	0,533 [0,532-0,534]
PT	0,305 [0,303-0,306]	0,263 [0,262-0,264]	0,322 [0,321-0,324]	0,238 [0,237-0,239]	0,318 [0,317-0,320]
RO	-	-	-	-	0,541 [0,540-0,543]
SK	-	0,618 [0,614-0,621]	0,614 [0,610-0,618]	0,527 [0,524-0,531]	0,436 [0,434-0,439]
FN	0,417 [0,413-0,420]	0,357 [0,354-0,361]	0,304 [0,301-0,307]	0,244 [0,242-0,246]	0,236 [0,234-0,238]
SE	0,310 [0,308-0,312]	0,325 [0,323-0,328]	0,355 [0,352-0,358]	0,308 [0,305-0,310]	0,220 [0,218-0,221]
UK	-	0,219 [0,218-0,220]	0,237 [0,237-0,238]	0,235 [0,234-0,236]	0,207 [0,206-0,207]
IS	0,317 [0,302-0,332]	0,318 [0,302-0,334]	0,297 [0,283-0,312]	0,349 [0,334-0,365]	0,314 [0,300-0,329]
NO	0,346 [0,343-0,350]	0,368 [0,365-0,372]	0,335 [0,332-0,339]	0,396 [0,392-0,400]	0,370 [0,367-0,374]
EU Total	-	0,424 [0,423-0,424]	0,420 [0,420-0,421]	0,392 [0,391-0,392]	0,357 [0,357-0,358]

Note: 95% Confidence Intervals are presented in brackets

Table A 14: Values of Odds Ratio for self assessed health vs income for the EU as a whole and EU Member States (Data Source: Eurostat statistics Database, EU SILC)

EU Total values of Odds Ratios based on SHARE data					
Self Assessment Health Variable	**SHARE waves**	**1st/5th gross income quintiles**	**1st/5th net worth income quintiles**	**ISCED tertiary/non-tertiary educ.**	**Easily/difficult make ends meet**
Chronic conditions	**2004/5**	0.536 [0,5352 - 0,5365]	0.522 [0,5213 - 0,5226	0.654 [0,6537 - 0,6551]	0.737 [0,7344 - 0,7356]
	2006/7	0.52 [0,5199 - 0,5211]	0.526 [0,5251 - 0,5263]	0.544 [0,5439 - 0,5450]	0.640 [0,6396 - 0,6405]
# of reported Symptoms	**2004/5**	0.552 [0,5515 - 0,5529]	0.5 [0,4991 - 0,5003]	0.582 [0,5811 - 0,5823]	0.640 [0,6398 - 0,6408]
	2006/7	0.512 [0,5116 - 0,5128]	0.509 [0,5088 - 0,5100]	0.572 [0,5712 - 0,5723]	0.598 [0,5976 - 0,5985]
Mobility limitations	**2004/5**	0.419 [0,4185 - 0,4195]	0.384 [0,3837 - 0,3847]	0.4954 [0,4950 - 0,4960]	0.617 [0,6162 - 0,6172]
	2006/7	0.337 [0,3367 - 0,3374]	0.3475 [0,3471 - 0,3478]	0.416 [0,4158 - 0,4166]	0.519 [0,5189 - 0,5197]

Limitations with activities of daily living (ADL)	**2004/5**	0.568 [0,5667 - 0,5689]	0.316 [0,3151 - 0,3163]	0.444 [0,4433 - 0,4451]	0.593 [0,5921 - 0,5935]
	2006/7	0.442 [0,4408 - 0,4423]	0.304 [0,3030 - 0,3040]	0.410 [0,4088 - 0,4103]	0.637 [0,6361 - 0,6374]
Limitations with instrumental activities of daily living (IADL)	**2004/5**	0435 [0,4347 - 0,4361]	0.316 [0,3156 - 0,3166]	0.391 [0,3899 - 0,3913]	0.580 [0,5796 - 0,5808]
	2006/7	0.337 [0,3366 - 0,3377]	0.279 [0,2784 - 0,2792]	0.338 [0,3372 - 0,3383]	0.586 [0,5855 - 0,5865]
Depressions level (EURO-D scale)	**2004/5**	0.502 [0,5012 - 0,5025]	0.452 [0,4516 - 0,4528]	0.512 [0,5114 - 0,5128]	0.464 [0,4632 - 0,4640]
	2006/7	0.491 [0,4906 - 0,4918]	0.441 [0,4404 - 0,4416]	0.497 [0,4963 - 0,4974]	0.419 [0,4183 - 0,4190]

Note: 95% Confidence Intervals are presented in brackets

Table A 15: Values of the Odds Ratio for the EU as a whole and selected categories of self assessed health and SES variables (Data Source: SHARE 1st and 2nd Wave, 2004/5, 2006/7)

Odds Ratios of the Existence of Disability (%) by Education and Activity status			
Country	**Education**	**Activity status**	
	Tertiary/NonTertiary	**Employed**	**Unemployed**
AT	0,876	0,434	0,754
BE	0,447	0,366	0,700
CY	0,384	0,348	0,422
CZ	0,635	0,326	0,535
DK	0,690	0,347	0,978
EE	0,748	0,433	0,400
ES	0,302	-	-
FI	0,739	0,546	0,612
FR	0,571	0,660	0,654
GR	0,430	0,390	0,300
HU	0,336	0,076	0,132
IE	0,534	0,302	0,613
IT	0,419	0,437	0,379
LT	0,773	0,078	0,636
LU	0,419	0,542	0,228
RO	0,761	0,228	0,162
NL	0,651	0,541	0,472
NO	0,448	0,160	0,930
PT	0,369	0,399	0,550
SE	0,707	0,976	0,789
SI	0,509	0,427	0,639

SK	0,360	0,130	0,258
UK	0,634	-	-

Table A 16: Odds Ratios for the Existence of Disability (%) by Education and Activity status (Data Source: LFS ad-hoc 2002, Eurostat)

Odds Ratios for individuals with Mobility restrictions by educational status Tertiary vs Non Tertiary education			
Country	Yes considerable	To some extent	No Mobility restrictions
AT	0,98	1,09	1,31
BE	0,63	0,73	-
CY	0,66	0,81	-
CZ	0,78	0,51	1,00
DK	2,48	2,32	2,72
EE	0,58	1,08	1,11
ES	0,89	-	-
FI	0,74	1,32	1,62
FR	0,53	0,87	-
GR	0,69	0,65	-
HU	0,82	1,19	-
IE	0,46	0,67	-
IT	0,68	0,79	0,95
LT	0,81	1,22	1,17
LU	0,38	0,45	1,21
RO	0,51	0,62	1,46
NL	*	*	*
NO	*	*	-
PT	*	*	-
SE	0,51	0,64	0,74
SI	0,71	0,71	-
SK	1,20	1,31	1,79
UK	0,73	1,61	2,44

* Values of OR far greater than 1 indicating striking inequalities

Table A 17: Odds Ratios for individuals with Mobility restrictions due to disability by educational status (Tertiary vs Non Tertiary education), 23 EU Member States (Data Source: LFS ad hoc 2002, Eurostat)

Odds Ratios of Percentage of Disability with respect to the education level and activity status			
Country	Education	Activity status	
	Tertiary/NonTertiary	Employment	Unemployment
AT	0,876	0,434	0,754
BE	0,447	0,366	0,700
CY	0,384	0,348	0,422
CZ	0,635	0,326	0,535
DK	0,690	0,347	0,978
EE	0,748	0,433	0,400
ES	0,302	*	*
FI	0,739	0,546	0,612
FR	0,571	0,660	0,654
GR	0,430	0,390	0,300
HU	0,336	0,076	0,132
IE	0,534	0,302	0,613
IT	0,419	0,437	0,379
LT	0,773	0,078	0,636
LU	0,419	0,542	0,228
RO	0,761	0,228	0,162
NL	0,651	0,541	0,472
NO	0,448	0,160	0,930
PT	0,369	0,399	0,550
SE	0,707	0,976	0,789
SI	0,509	0,427	0,639
SK	0,360	0,130	0,258
UK	0,634	*	*

*small sample size,

Table A 18: Odds Ratios of Percentage of Disability with respect to the education level and activity status, 23 EU Member States (Data Source: LFS ad hoc 2002, Eurostat)

Odds Ratios of the percentages of individuals with “Considerable restrictions” by Activity status		
Country	Employment	Unemployment
AT	0,78	2,26
BE	0,24	0,30
CY	0,07	0,15

CZ	2,41	0,37
DK	0,15	*
EE	0,34	0,02
ES	1,27	1,00
FI	*	1,00
FR	*	1,00
GR	0,13	1,00
HU	*	1,00
IE	0,10	1,00
IT	*	1,00
LT	*	1,00
LU	0,22	1,00
RO	1,14	1,00
NL	*	1,00
NO	*	1,00
PT	*	1,00
SE	*	1,00
SI	0,27	1,00
SK	3,10	1,00

* Values of OR far greater than 1 indicating striking inequalities

Table A 19: Odds Ratios for individuals with Considerable Mobility restrictions due to disability by activity status (Employed population), 23 European countries (Data Source: LFS ad hoc 2002, Eurostat)

Odds Ratios of the percentages of individuals with "Mobility restrictions of some extent" by Activity status		
Country	Employment	Unemployment
AT	*	1,91
BE	0,45	0,71
CY	0,14	0,70
CZ	*	0,68
DK	0,65	*
EE	1,90	0,12
FI	*	*
FR	*	*
GR	0,58	0,46
HU	4,03	1,85
IE	0,43	0,47

IT	1,91	1,37
LT	1,44	1,73
LU	*	0,76
RO	1,47	0,84
NL	*	*
NO	*	*
PT	*	0,90
SE	*	*
SI	0,39	0,77
SK	1,87	0,75

* Values of OR far greater than 1 indicating striking inequalities

Table A 20: Odds Ratios for individuals with Considerable Mobility restrictions due to disability by activity status (Unemployed population), 23 European countries (Data Source: LFS ad hoc 2002, Eurostat)

Indicator	p90p10	p75p25	Relative Mean Dev.	CV	Slogs	Gini	Theil0	Theil1	Atk0.5	Atk1	Atk2
p90p10	1										
p75p25	,791**	1									
Relative Mean Dev.	,980**	,815**	1								
CV	,966**	,702*	,959**	1							
Slogs	,899**	,551	,883**	,972**	1						
Gini	,983**	,761**	,982**	,993**	,945**	1					
heil0	,946**	,658*	,934**	,994**	,990**	,980**	1				
Theil1	,905**	,582	,884**	,974**	,998**	,949**	,992**	1			
Atk0.5	,917**	,604*	,905**	,981**	,996**	,961**	,995**	,997**	1		
Atk1	,914**	,589	,892**	,978**	,998**	,955**	,994**	1,000**	,998**	1	
Atk2	,862**	,493	,837**	,947**	,995**	,912**	,974**	,994**	,987**	,992**	1

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Table A 21: Pearson Correlations between health inequality indicators for Healthy Life Years (age of 65, females) in the EU

Indicator	p90p10	p75p25	Relative Mean Dev.	CV	Slogs	Gini	Theil0	Theil1	Atk0.5	Atk1	Atk2
p90p10	1										
p75p25	,343	1									
Relative Mean Dev.	,599*	,848**	1								
CV	,140	,557	,775**	1							
Slogs	,918**	,521	,765**	,328	1						

Gini	,783**	,678*	,923**	,622*	,938**	1					
Theil0	,474	,667*	,930**	,927**	,655*	,868**	1				
Theil1	,755**	,665*	,936**	,701*	,901**	,990**	,916**	1			
Atk0.5	,621*	,682*	,951**	,827**	,799**	,951**	,975**	,978**	1		
Atk1	,749**	,672*	,940**	,716**	,892**	,986**	,923**	,999**	,981**	1	
Atk2	,908**	,532	,784**	,370	,998**	,950**	,687*	,918**	,824**	,911**	1

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Table A 22: Pearson Correlations between health inequality indicators for Infant Mortality Rates in the EU

Table A 23: Odds Ratio for SPH ("good or very good health") by SES group, for the EU 27 (Source: EUSILC 2007)

Country	1st/5th income quintiles and SPH good or very good			ISCED (tertiary/non-tertiary) and SPH good or very good		
	OR	95% Conf. Interval		OR	95% Conf. Interval	
AT	0,33	0,327	0,330	0,47	0,470	0,475
BE	0,22	0,222	0,225	0,46	0,458	0,461
CY	0,11	0,109	0,114	0,23	0,226	0,235
CZ	0,33	0,328	0,332	0,44	0,434	0,438
DE	0,37	0,373	0,374	0,72	0,719	0,720
DK	0,34	0,340	0,347	0,52	0,512	0,519
EE	0,18	0,177	0,182	0,66	0,652	0,663
ES	0,35	0,346	0,348	0,39	0,393	0,394
FI	0,24	0,242	0,246	0,41	0,409	0,415
FR	0,42	0,422	0,424	0,35	0,353	0,355
GR	0,28	0,276	0,279	0,25	0,250	0,253
HU	0,56	0,554	0,559	0,55	0,545	0,549
IE	0,13	0,128	0,131	0,33	0,322	0,328
IS	0,35	0,334	0,365	0,26	0,248	0,271
IT	0,47	0,474	0,476	0,35	0,346	0,347
LT	0,33	0,323	0,328	0,53	0,528	0,534
LU	0,47	0,459	0,482	0,51	0,498	0,519
LV	0,23	0,225	0,230	0,61	0,605	0,615
NL	0,27	0,271	0,274	0,42	0,419	0,423
NO	0,40	0,392	0,400	0,40	0,396	0,403
PL	0,63	0,628	0,631	0,41	0,409	0,411
PT	0,24	0,237	0,239	0,37	0,364	0,368
SE	0,31	0,305	0,310	0,48	0,474	0,480
SI	0,23	0,222	0,229	0,38	0,379	0,389
SK	0,53	0,524	0,531	0,63	0,631	0,638
UK	0,23	0,234	0,236	0,50	0,496	0,498
EU Total	0,39	0,391	0,392	0,46	0,457	0,457

Table A 24: Odds Ratio for SPH ("good or very good health") by SES group, for the EU 27 (Source: EUSILC 2007)

Country	Easily/difficult make ends meet and SPH good or very good			Active/non-active population and SPH good or very good		
	OR	95% Conf. Interval		OR	95% Conf. Interval	
AT	0,47	0,464	0,467	0,28	0,279	0,281
BE	0,38	0,379	0,381	0,31	0,311	0,313
CY	0,52	0,512	0,527	0,27	0,267	0,273
CZ	0,60	0,598	0,601	0,24	0,235	0,237
DE	0,51	0,505	0,506	0,41	0,405	0,406
DK	0,51	0,508	0,515	0,30	0,302	0,305
EE	0,46	0,454	0,461	0,36	0,356	0,362
ES	0,62	0,623	0,625	0,25	0,252	0,253
FI	0,53	0,527	0,534	0,21	0,209	0,212
FR	0,56	0,560	0,561	0,27	0,273	0,274
GR	0,50	0,502	0,507	0,14	0,138	0,139
HU	0,58	0,577	0,581	0,28	0,282	0,284
IE	0,49	0,489	0,495	0,21	0,213	0,216
IS	0,41	0,401	0,425	0,18	0,173	0,184
IT	0,59	0,591	0,593	0,22	0,220	0,221
LT	0,55	0,544	0,551	0,34	0,343	0,347
LU	0,59	0,579	0,601	0,41	0,400	0,412
LV	0,49	0,487	0,495	0,39	0,385	0,390
NL	0,35	0,353	0,355	0,36	0,363	0,366
NO	0,46	0,455	0,461	0,29	0,292	0,296
PL	0,55	0,553	0,555	0,24	0,242	0,242
PT	0,59	0,589	0,592	0,31	0,309	0,310
SE	0,41	0,408	0,412	0,30	0,300	0,303
SI	0,46	0,454	0,464	0,28	0,278	0,283
SK	0,55	0,546	0,551	0,33	0,328	0,331
UK	0,59	0,591	0,593	0,25	0,246	0,246
EU Total	0,57	0,571	0,571	0,29	0,291	0,291

Table A 25: Odds ratios of chronic illness statements by income category (5th vs 1st income category) (Data source: EU SILC 2004-2006, Eurostat)

2004				2005			2006		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
AT	0,70	0,693	0,701	0,62	0,617	0,624	0,53	0,527	0,533
BE	0,40	0,402	0,406	0,36	0,359	0,362	0,31	0,307	0,310
CY	-	-	-	0,24	0,231	0,240	0,21	0,209	0,217
CZ	-	-	-	0,39	0,390	0,394	0,46	0,456	0,461
DE	-	-	-	0,49	0,488	0,490	-	-	-
DK	0,59	0,585	0,597	0,61	0,608	0,619	0,60	0,598	0,608
EE	0,40	0,392	0,402	0,27	0,262	0,269	0,24	0,232	0,238
ES	0,45	0,453	0,455	0,43	0,429	0,431	0,45	0,453	0,455
FI	0,45	0,449	0,456	0,46	0,457	0,465	0,36	0,359	0,366
FR	0,61	0,609	0,612	0,70	0,700	0,702	0,69	0,684	0,687
GR	0,30	0,303	0,307	0,37	0,371	0,375	0,36	0,357	0,361
HU	-	-	-	0,62	0,622	0,627	0,52	0,515	0,520
IE	0,21	0,207	0,210	0,28	0,281	0,286	0,30	0,299	0,304
IS	0,54	0,514	0,559	0,49	0,472	0,517	0,44	0,417	0,455
IT	0,63	0,627	0,630	0,63	0,628	0,630	0,67	0,673	0,676
LT	-	-	-	0,46	0,453	0,461	0,46	0,457	0,464
LU	0,78	0,762	0,800	0,74	0,722	0,759	0,70	0,686	0,722
LV	-	-	-	0,49	0,488	0,498	0,37	0,370	0,378
NL	-	-	-	0,56	0,554	0,560	0,51	0,512	0,517
NO	0,49	0,481	0,490	0,48	0,476	0,485	0,43	0,426	0,434
PL	-	-	-	1,03	1,029	1,034	1,00	1,000	1,005
PT	0,44	0,443	0,447	0,44	0,434	0,438	0,48	0,475	0,479
SE	0,53	0,527	0,533	0,60	0,600	0,607	0,65	0,650	0,658
SI	-	-	-	0,42	0,417	0,431	-	-	-
SK	-	-	-	0,72	0,714	0,724	0,79	0,780	0,791
UK	-	-	-	0,44	0,439	0,441	0,39	0,394	0,395
EU Total	0,54	0,535	0,537	0,55	0,553	0,554	0,56	0,555	0,556

Table A 26: Odds ratios of chronic illness statements by income category (5th vs 1st income category) (Data source: EU SILC 2007, 2008, Eurostat)

2007				2008			
Country	OR	95% Conf. Interval		Country	OR	95% Conf. Interval	
AT	0,59	0,584	0,591	AT	0,54	0,539	0,545
BE	0,34	0,334	0,337	BE	0,33	0,327	0,330
CY	0,22	0,219	0,227	CY	0,21	0,209	0,217
CZ	0,39	0,385	0,389	CZ	0,32	0,318	0,321
DE	0,51	0,507	0,508	DE	-	-	-
DK	0,60	0,598	0,609	DK	0,49	0,488	0,497

EE	0,22	0,221	0,227	EE	0,16	0,155	0,159
ES	0,44	0,440	0,442	ES	0,41	0,405	0,406
FI	0,35	0,346	0,352	FI	0,40	0,397	0,403
FR	0,71	0,705	0,707		-	-	-
GR	0,35	0,351	0,355	GR	0,43	0,426	0,431
HU	0,68	0,674	0,681	HU	0,77	0,769	0,776
IE	0,30	0,297	0,302	IE	0,33	0,325	0,330
IS	0,55	0,527	0,577	IS	0,57	0,544	0,588
IT	0,66	0,663	0,666	IT	0,65	0,653	0,656
LT	0,38	0,374	0,381	LT	0,32	0,320	0,326
LU	0,87	0,853	0,895	LU	0,75	0,734	0,771
LV	0,28	0,273	0,278	LV	0,24	0,240	0,245
NL	0,47	0,466	0,471	NL	0,50	0,498	0,503
NO	0,55	0,545	0,555	NO	0,44	0,441	0,449
PL	0,87	0,869	0,873	PL	0,76	0,758	0,762
PT	0,35	0,349	0,352	PT	0,43	0,429	0,433
SE	0,61	0,608	0,616	SE	0,54	0,537	0,544
SI	0,36	0,352	0,363	SI	-	-	-
SK	0,54	0,534	0,541	SK	0,51	0,508	0,515
UK	0,38	0,379	0,381	UK	0,42	0,421	0,423
Total	0,53	0,531	0,532	RO	0,67	0,672	0,677
-	-	-	-	BG	0,36	0,361	0,365
-	-	-	-	Total	0,50	0,499	0,500

Table A 27: Odds Ratios of Self Perceived Health (SPH) data vs SES groups (Data Source: ESS 2002-2008)

2008									
	Not difficulty/difficulty feeling about household's income and SPH good or very good			ISCED (tertiary/non-tertiary) and SPH good or very good			Active/non-active population and SPH good or very good		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,49	0,381	0,620	0,47	0,359	0,613	0,31	0,249	0,393
CH	0,30	0,222	0,407	0,48	0,345	0,655	0,37	0,287	0,470
DE	0,53	0,431	0,655	0,81	0,683	0,952	0,46	0,397	0,544
DK	0,58	0,350	0,956	0,56	0,425	0,736	0,33	0,262	0,422
ES	0,45	0,375	0,552	0,41	0,317	0,538	0,22	0,189	0,268
FI	0,49	0,377	0,632	0,44	0,356	0,539	0,32	0,266	0,383
FR	0,50	0,390	0,631	0,47	0,384	0,584	0,41	0,339	0,489
GB	0,46	0,374	0,577	0,50	0,403	0,612	0,31	0,258	0,376
HU	0,49	0,399	0,600	0,50	0,368	0,669	0,29	0,231	0,352
NL	0,30	0,221	0,409	0,51	0,389	0,660	0,35	0,282	0,438

NO	0,38	0,250	0,568	0,45	0,344	0,586	0,35	0,277	0,447
PL	0,33	0,265	0,413	0,44	0,333	0,586	0,34	0,273	0,412
PT	0,43	0,361	0,504	0,34	0,261	0,450	0,25	0,207	0,292
SE	0,36	0,253	0,505	0,59	0,458	0,750	0,37	0,294	0,461
SI	0,32	0,227	0,460	0,35	0,244	0,498	0,34	0,268	0,423
EU Total	**0,37**	**0,347**	**0,391**	**0,46**	**0,432**	**0,489**	**0,32**	**0,306**	**0,339**

2006									
	Not difficulty/difficulty feeling about household's income and SPH good or very good			**ISCED (tertiary/non-tertiary) and SPH good or very good**			**Active/non-active population and SPH good or very good**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,40	0,311	0,507	0,37	0,275	0,485	0,35	0,278	0,434
CH	0,44	0,317	0,597	0,40	0,282	0,564	0,35	0,272	0,451
DE	0,49	0,405	0,591	0,87	0,739	1,032	0,46	0,395	0,536
DK	0,41	0,264	0,651	0,60	0,455	0,785	0,35	0,271	0,442
ES	0,45	0,350	0,572	0,42	0,315	0,554	0,35	0,290	0,428
FI	0,51	0,389	0,677	0,31	0,245	0,397	0,28	0,228	0,340
FR	0,44	0,345	0,558	0,46	0,367	0,576	0,40	0,330	0,481
GB	0,47	0,379	0,594	0,45	0,359	0,552	0,30	0,248	0,359
HU	0,46	0,370	0,564	0,47	0,344	0,630	0,24	0,194	0,299
NL	0,38	0,287	0,492	0,53	0,411	0,685	0,29	0,234	0,358
NO	0,35	0,251	0,499	0,45	0,346	0,587	0,34	0,265	0,423
PL	0,31	0,250	0,377	0,21	0,139	0,306	0,34	0,282	0,419
PT	0,32	0,271	0,389	0,34	0,254	0,457	0,32	0,267	0,380
SE	0,42	0,301	0,581	0,59	0,459	0,746	0,37	0,294	0,455
SI	0,24	0,167	0,338	0,31	0,221	0,441	0,38	0,307	0,471
EU Total	**0,33**	**0,313**	**0,354**	**0,41**	**0,387**	**0,440**	**0,34**	**0,323**	**0,357**

2004									
	Not difficulty/difficulty feeling about household's income and SPH good or very good			**ISCED (tertiary/non-tertiary) and SPH good or very good**			**Active/non-active population and SPH good or very good**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,40	0,311	0,508	0,41	0,308	0,551	0,32	0,250	0,400
CH	0,39	0,294	0,511	0,41	0,276	0,603	0,28	0,222	0,358
DE	0,55	0,452	0,666	0,71	0,588	0,861	0,45	0,382	0,520
DK	0,51	0,319	0,815	0,54	0,396	0,731	0,35	0,271	0,446
ES	0,44	0,342	0,568	0,43	0,319	0,572	0,38	0,310	0,469
FI	0,65	0,504	0,841	0,42	0,338	0,527	0,34	0,280	0,408
FR				0,46	0,361	0,579	0,33	0,271	0,401
GB	0,48	0,377	0,608				0,31	0,251	0,380
HU	0,47	0,381	0,579	0,50	0,373	0,669	0,32	0,262	0,400
NL	0,41	0,320	0,534	0,58	0,451	0,736	0,40	0,326	0,490
NO	0,37	0,269	0,511	0,53	0,416	0,676	0,36	0,290	0,453
PL	0,33	0,272	0,405	0,41	0,290	0,568	0,40	0,326	0,482

PT	0,37	0,308	0,446	0,32	0,234	0,441	0,32	0,266	0,381
SE	0,43	0,317	0,590	0,65	0,514	0,822	0,44	0,355	0,538
SI	0,40	0,294	0,544	0,25	0,168	0,387	0,45	0,362	0,555
EU Total	**0,38**	**0,356**	**0,403**	**0,45**	**0,421**	**0,484**	**0,36**	**0,342**	**0,379**

2002									
	Not difficulty/difficulty feeling about household's income and SPH good or very good			**ISCED (tertiary/non-tertiary) and SPH good or very good**			**Active/non-active population and SPH good or very good**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,31	0,241	0,410	0,47	0,357	0,626	0,30	0,235	0,374
CH	0,28	0,200	0,384	0,43	0,288	0,637	0,34	0,269	0,437
DE	0,53	0,434	0,654	0,73	0,604	0,871	0,46	0,393	0,531
DK	0,43	0,278	0,658	0,44	0,298	0,658	0,36	0,279	0,462
ES	0,58	0,458	0,725	0,41	0,298	0,559	0,30	0,241	0,363
FI	0,65	0,502	0,852	0,43	0,342	0,553	0,39	0,322	0,472
FR				0,44	0,342	0,570	0,40	0,321	0,490
GB	0,53	0,403	0,688	0,57	0,444	0,724	0,33	0,273	0,405
HU	0,30	0,244	0,367	0,43	0,323	0,580	0,35	0,290	0,432
NL	0,31	0,232	0,406	0,55	0,438	0,703	0,33	0,269	0,400
NO	0,47	0,344	0,649	0,40	0,307	0,523	0,29	0,233	0,355
PL	0,38	0,321	0,458	0,39	0,294	0,510	0,45	0,376	0,535
PT	0,33	0,268	0,417	0,38	0,262	0,556	0,28	0,225	0,345
SE	0,44	0,321	0,609	0,47	0,369	0,594	0,42	0,346	0,519
SI	0,32	0,241	0,431	0,34	0,224	0,509	0,51	0,409	0,632
EU Total	**0,33**	**0,308**	**0,349**	**0,45**	**0,418**	**0,479**	**0,36**	**0,346**	**0,383**

Table A 28: Odds Ratios of Activity Limitations (AL) data vs SES groups (Data Source: ESS 2002-2008)

2008									
	Not difficulty/difficulty feeling about household's income and limitations in activities (yes or no)			**ISCED (tertiary/non-tertiary) and limitations in activities (yes or no)**			**Active/non-active population and limitations in activities (yes or no)**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,54	0,418	0,690	0,58	0,444	0,755	0,29	0,231	0,372
CH	0,34	0,255	0,463	0,68	0,513	0,901	0,35	0,273	0,438
DE	0,46	0,369	0,568	0,87	0,727	1,041	0,35	0,298	0,420
DK	0,58	0,357	0,948	0,72	0,560	0,924	0,40	0,321	0,503
ES	0,43	0,344	0,547	0,26	0,170	0,410	0,12	0,092	0,155
FI	0,50	0,386	0,649	0,53	0,432	0,656	0,36	0,299	0,432
FR	0,42	0,330	0,545	0,45	0,349	0,571	0,35	0,284	0,430
GB	0,66	0,524	0,828	0,56	0,449	0,690	0,24	0,192	0,288
HU	0,49	0,391	0,610	0,48	0,339	0,692	0,16	0,126	0,210
NL	0,32	0,236	0,438	0,70	0,547	0,892	0,34	0,275	0,424

NO	0,30	0,197	0,444	0,42	0,325	0,555	0,30	0,232	0,376
PL	0,41	0,322	0,511	0,62	0,459	0,848	0,29	0,231	0,369
PT	0,40	0,327	0,491	0,36	0,243	0,548	0,23	0,185	0,293
SE	0,53	0,374	0,746	0,66	0,527	0,827	0,44	0,355	0,541
SI	0,28	0,199	0,390	0,45	0,301	0,670	0,25	0,192	0,324
EU Total	**0,51**	**0,475**	**0,538**	**0,61**	**0,570**	**0,649**	**0,30**	**0,282**	**0,315**

2006									
	Not difficulty/difficulty feeling about household's income and limitations in activities (yes or no)			**ISCED (tertiary/non-tertiary) and limitations in activities (yes or no)**			**Active/non-active population and limitations in activities (yes or no)**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,49	0,378	0,632	0,44	0,328	0,590	0,36	0,282	0,453
CH	0,55	0,405	0,750	0,46	0,339	0,622	0,35	0,274	0,436
DE	0,56	0,462	0,684	0,97	0,809	1,161	0,34	0,289	0,406
DK	0,52	0,329	0,819	0,62	0,472	0,808	0,29	0,231	0,376
ES	0,36	0,274	0,481	0,24	0,147	0,400	0,15	0,113	0,202
FI	0,60	0,455	0,800	0,43	0,338	0,541	0,32	0,264	0,396
FR	0,46	0,360	0,600	0,55	0,422	0,712	0,39	0,315	0,483
GB	0,56	0,446	0,705	0,47	0,376	0,578	0,18	0,151	0,224
HU	0,46	0,367	0,566	0,31	0,206	0,459	0,20	0,159	0,260
NL	0,44	0,338	0,581	0,59	0,455	0,753	0,30	0,245	0,374
NO	0,51	0,359	0,721	0,55	0,431	0,707	0,36	0,290	0,456
PL	0,36	0,292	0,452	0,27	0,168	0,422	0,30	0,240	0,378
PT	0,27	0,221	0,336	0,22	0,129	0,370	0,28	0,229	0,352
SE	0,45	0,330	0,625	0,61	0,488	0,761	0,41	0,330	0,497
SI	0,24	0,175	0,336	0,36	0,242	0,527	0,30	0,238	0,382
EU Total	**0,47**	**0,440**	**0,499**	**0,53**	**0,494**	**0,567**	**0,30**	**0,283**	**0,316**

2004									
	Not difficulty/difficulty feeling about household's income and limitations in activities (yes or no)			**ISCED (tertiary/non-tertiary) and limitations in activities (yes or no)**			**Active/non-active population and limitations in activities (yes or no)**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,44	0,341	0,569	0,52	0,387	0,698	0,28	0,220	0,365
CH	0,49	0,374	0,644	0,70	0,510	0,949	0,38	0,306	0,474
DE	0,61	0,500	0,754	0,79	0,637	0,972	0,35	0,293	0,415
DK	0,40	0,250	0,630	0,46	0,334	0,639	0,36	0,281	0,466
ES	0,37	0,273	0,502	0,30	0,179	0,493	0,22	0,161	0,299
FI	0,60	0,465	0,782	0,51	0,408	0,641	0,37	0,306	0,450
FR	-	-	-	0,59	0,448	0,778	0,28	0,220	0,351
GB	0,54	0,421	0,688	-	-	-	0,21	0,169	0,265
HU	0,53	0,421	0,659	0,53	0,375	0,754	0,17	0,128	0,216
NL	0,45	0,344	0,578	0,56	0,434	0,719	0,37	0,304	0,461
NO	0,53	0,386	0,741	0,59	0,469	0,751	0,33	0,268	0,417
PL	0,35	0,284	0,441	0,39	0,254	0,593	0,26	0,209	0,332
PT	0,29	0,227	0,361	0,29	0,171	0,494	0,19	0,144	0,247

SE	0,47	0,345	0,639	0,64	0,507	0,801	0,51	0,420	0,629
SI	0,52	0,384	0,698	0,53	0,356	0,794	0,40	0,317	0,501
EU Total	**0,51**	**0,476**	**0,543**	**0,58**	**0,538**	**0,625**	**0,32**	**0,300**	**0,337**

2002									
	Not difficulty/difficulty feeling about household's income and limitations in activities (yes or no)			**ISCED (tertiary/non-tertiary) and limitations in activities (yes or no)**			**Active/non-active population and limitations in activities (yes or no)**		
Country	OR	95% Conf. Interval		OR	95% Conf. Interval		OR	95% Conf. Interval	
BE	0,35	0,265	0,458	0,52	0,392	0,701	0,31	0,242	0,395
CH	0,36	0,262	0,499	0,63	0,450	0,868	0,32	0,257	0,405
DE	0,62	0,499	0,771	0,78	0,636	0,962	0,32	0,273	0,386
DK	0,46	0,299	0,699	0,51	0,354	0,731	0,32	0,254	0,414
ES	0,41	0,318	0,533	0,19	0,108	0,334	0,13	0,097	0,182
FI	0,54	0,414	0,706	0,61	0,480	0,774	0,35	0,290	0,432
FR	-	-	-	0,40	0,292	0,561	0,33	0,252	0,420
GB	0,60	0,457	0,793	0,51	0,396	0,668	0,22	0,176	0,271
HU	0,32	0,255	0,394	0,47	0,327	0,671	0,21	0,162	0,263
NL	0,32	0,244	0,426	0,58	0,454	0,728	0,33	0,274	0,406
NO	0,35	0,257	0,481	0,42	0,319	0,546	0,33	0,263	0,403
PL	0,33	0,273	0,410	0,39	0,272	0,548	0,28	0,227	0,347
PT	0,31	0,235	0,418	0,07	0,000	0,271	0,19	0,133	0,260
SE	0,50	0,362	0,690	0,58	0,459	0,724	0,42	0,341	0,510
SI	0,44	0,329	0,577	0,30	0,182	0,487	0,42	0,333	0,532
EU Total	**0,46**	**0,432**	**0,493**	**0,52**	**0,486**	**0,566**	**0,30**	**0,288**	**0,323**

ANNEX III: Figures

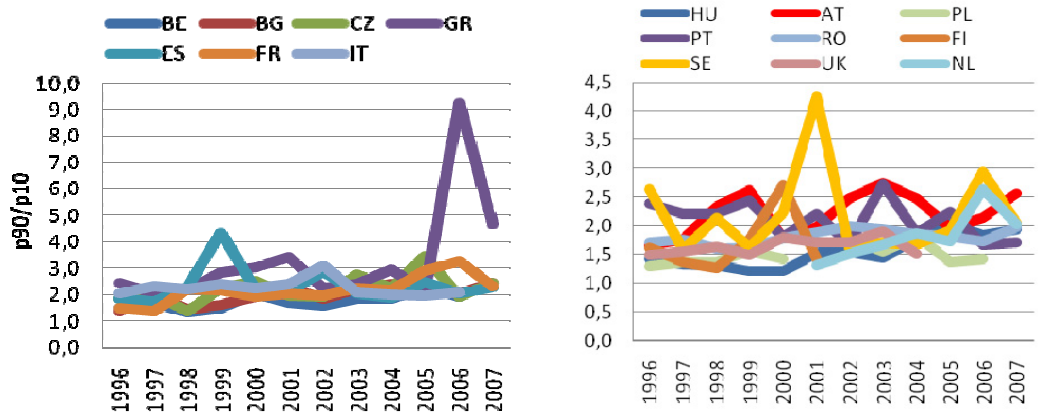


Figure A 1: Trends of Health Inequalities of 16 EU countries as measured by the p90/p10 inter quintile ratio and based on Infant Mortality Rates (IMRs) of the NUTS II regions and the period 1996-2007 (Data Source: Eurostat)

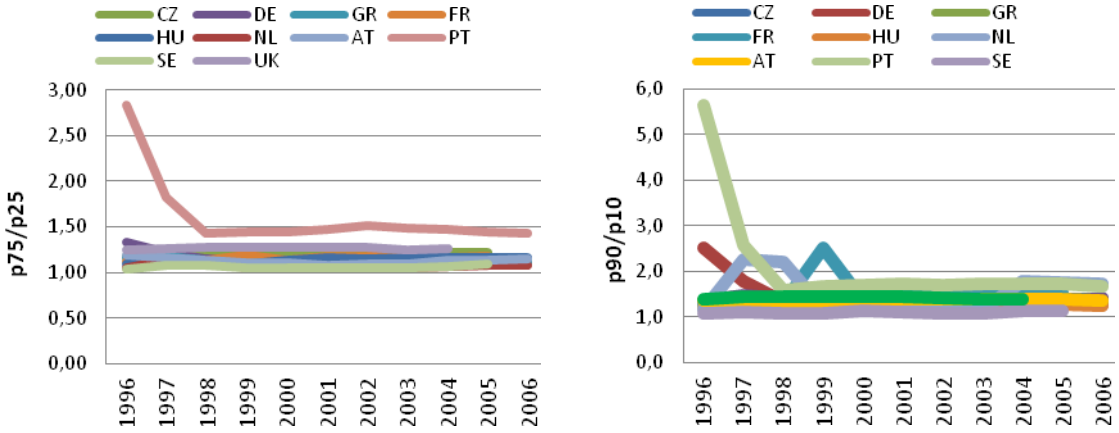
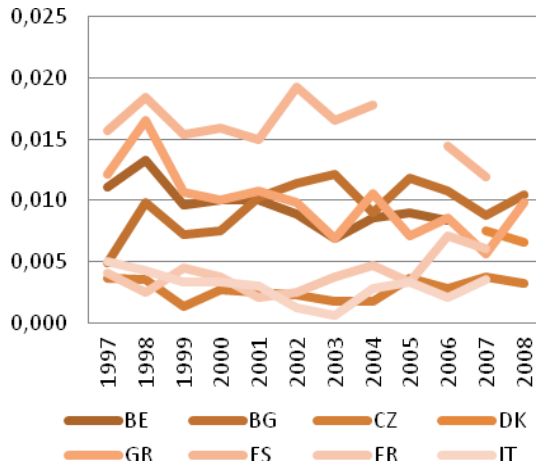
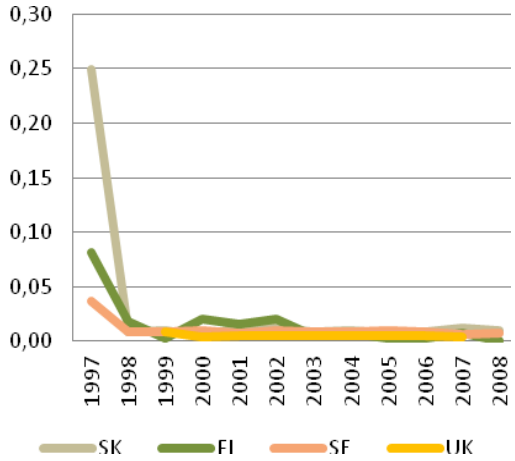


Figure A 2: Trends of Health Inequalities in terms of differences in Standardized Death Rates (3-year averages) for selected EU countries measured by the p90/p10 and the p75/p25 inter quintile ratios. Data from NUTS II regions of the EU and the period 1996-2006 for Life Expectancy and 1997-2008 for the SDRs (Data Source: Eurostat)





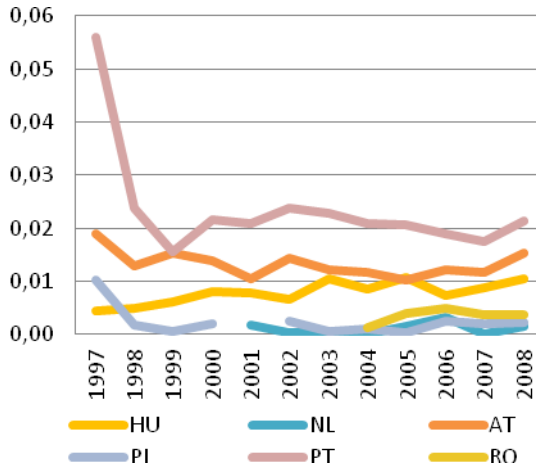
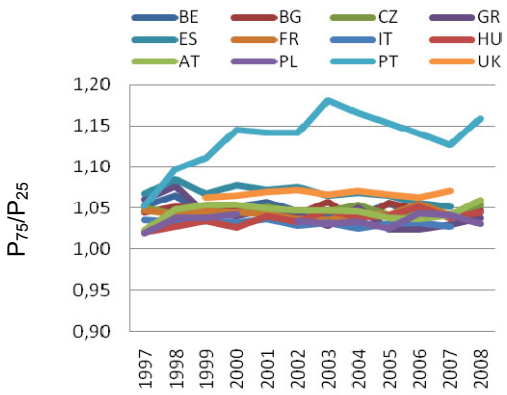


Figure A 3: Health inequalities based measured by the Gini coefficient on the Life Expectancy at birth data of the NUTS II regions of 19 EU members and the period 1997-2008

(Data Source Eurostat)



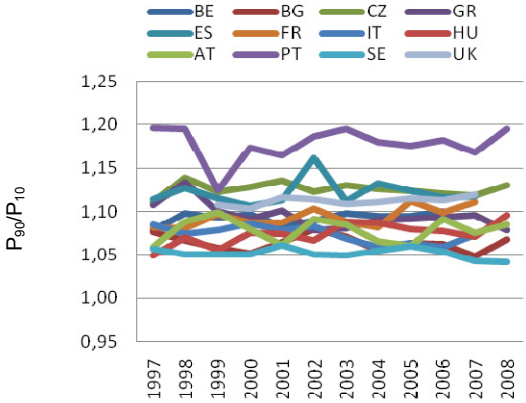


Figure A 4: Trends of Health Inequalities in terms of differences in Life Expectancy at the age of 65 for selected EU countries measured by the p90/p10 and the p75/p25 inter quintile ratios. Data from NUTS II regions of the EU and the period 1996-2006 for Life Expectancy and 1997-2008 for the SDRs (Data Source: Eurostat)

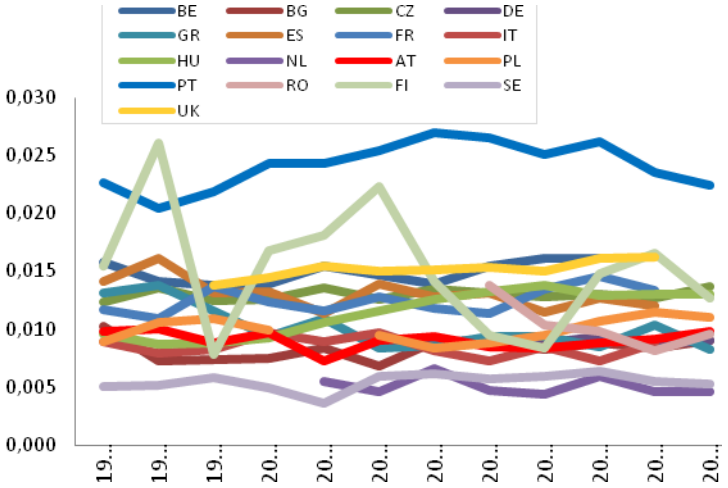
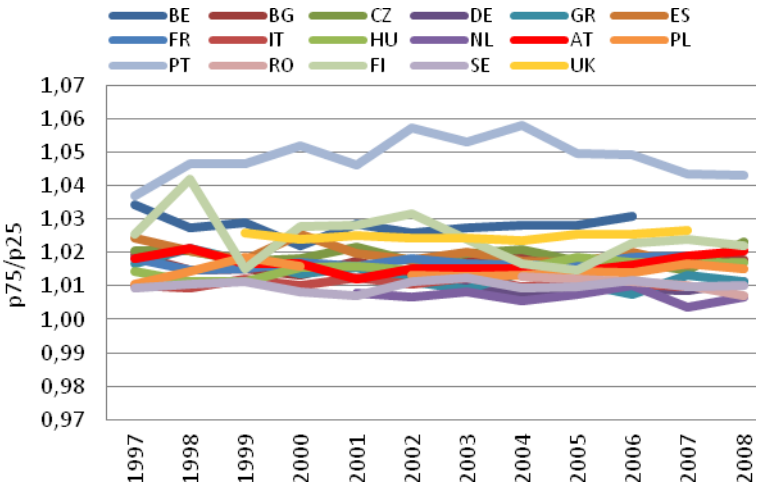


Figure A5: Trends of Health Inequalities measured by the CV on Life Expectancy at birth for the NUTS II Regions of 17 EU members and the period 1996-2007.

(Data Source: Eurostat)



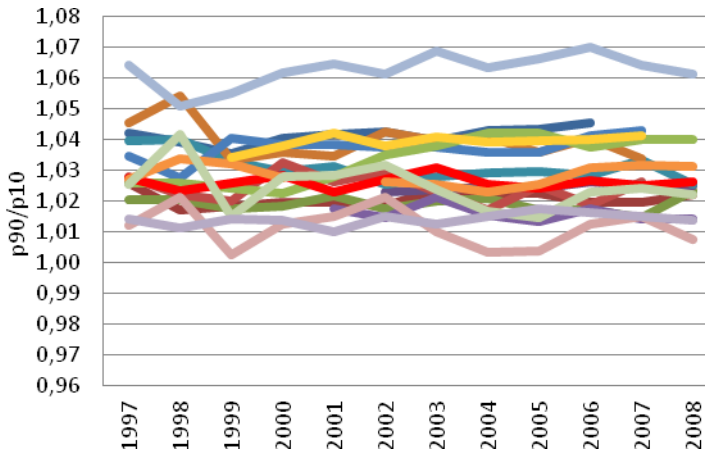
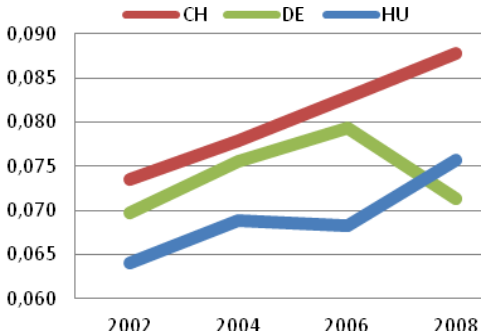
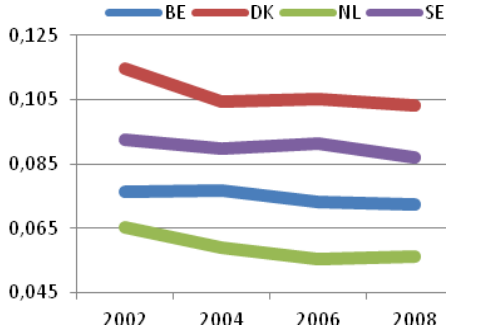


Figure A 6: Trends of Health Inequalities of 17 EU countries in terms of differences in Life Expectancy at birth (age 0) and measured by the p90/p10 and the p75/p25 inter quintile ratios.. Data from NUTS II regions of the EU and the period 1997-2008

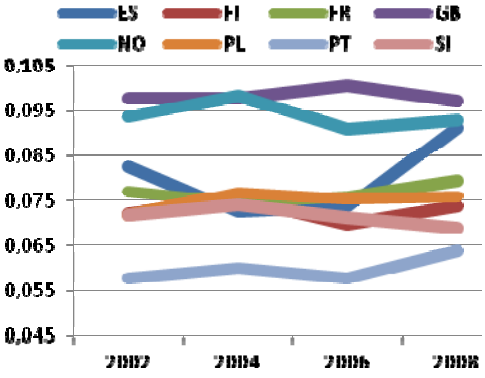
(Data Source: Eurostat)



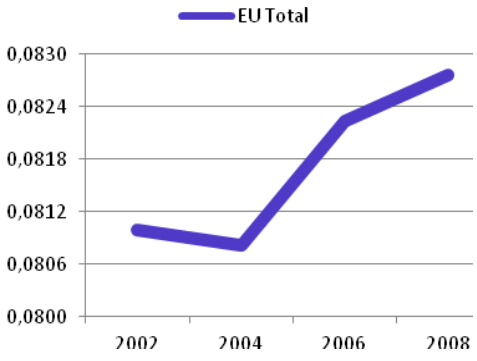
(a): Countries with upward trend of health inequalities



(b): Countries with downward trend of health inequalities

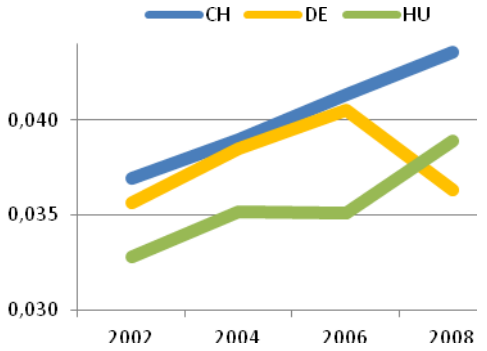


(c): Countries without any significant trend or variation of health inequalities

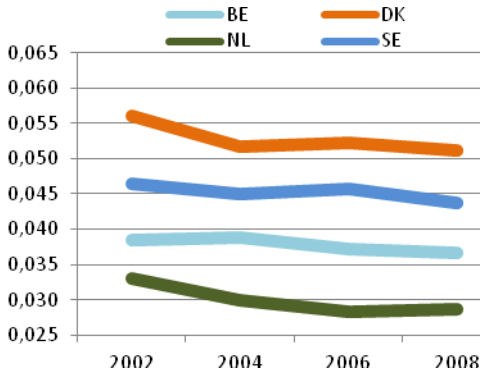


(d): Trend of EU Total's health inequalities

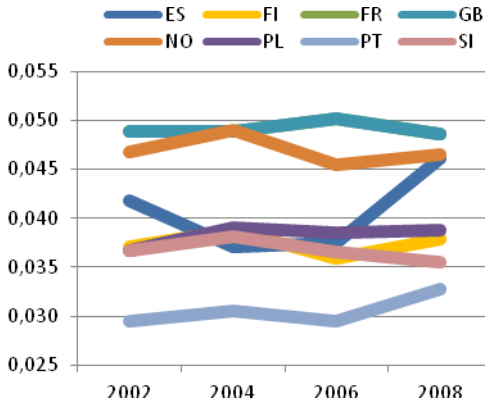
Figure A 7: Trends of Self Perceived Health Inequalities based on the Theil's index (1) for the EU as a whole and selected Member States and the period of 2002-2008 (Data Source: ESS 2002-2008)



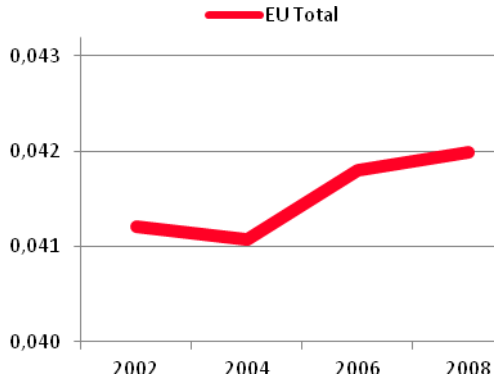
(a): Countries with upward trend of health inequalities



(b): Countries with downward trend of health inequalities

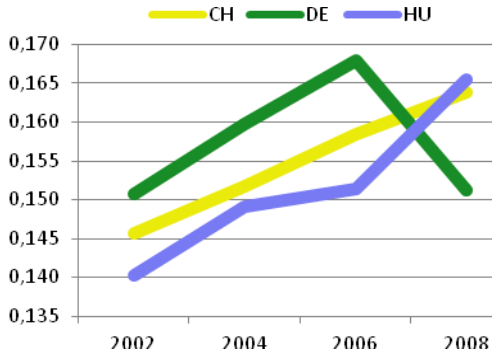


(c): Countries without any significant trend or variation of health inequalities

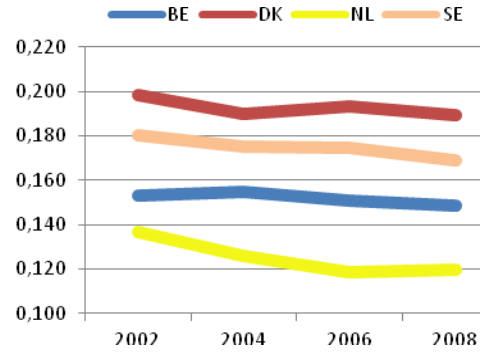


(d): Trend of EU Total's health inequalities

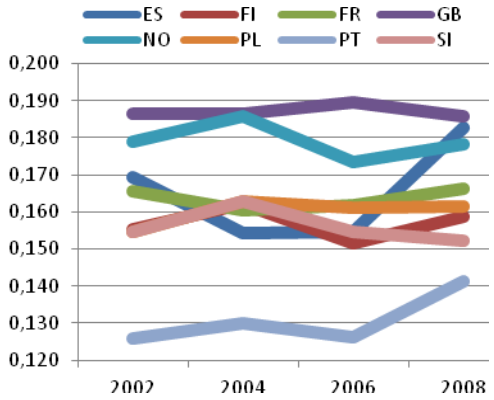
Figure A 8: Trends of Self Perceived Health Inequalities based on the Atkinson index (0,5) for the EU as a whole and several member states and the period of 2002-2008 (Data Source: ESS 2002-2008)



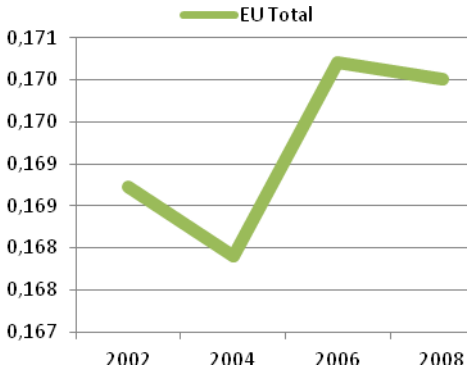
(a) : Countries with upward trend of health inequalities



(b) : Countries with downward trend of health inequalities



(b) : Countries without any significant trend or variation of health inequalities



(d) : Trend of EU Total's health inequalities

Figure A 9: Trends of Self Perceived Health Inequalities based on the Atkinson index (2) for the EU as a whole and several member states and the period of 2002-2008 (Data Source: ESS of 2002-2008)

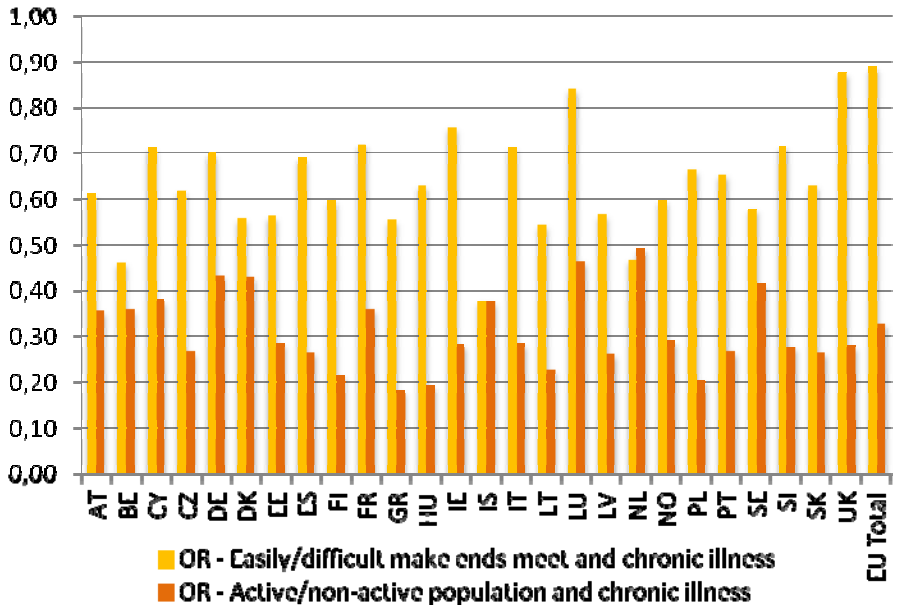


Figure A 10: Odds Ratio for Chronic Illness by SES group, for the EU 27 (Data Source: EUSILC 2007)

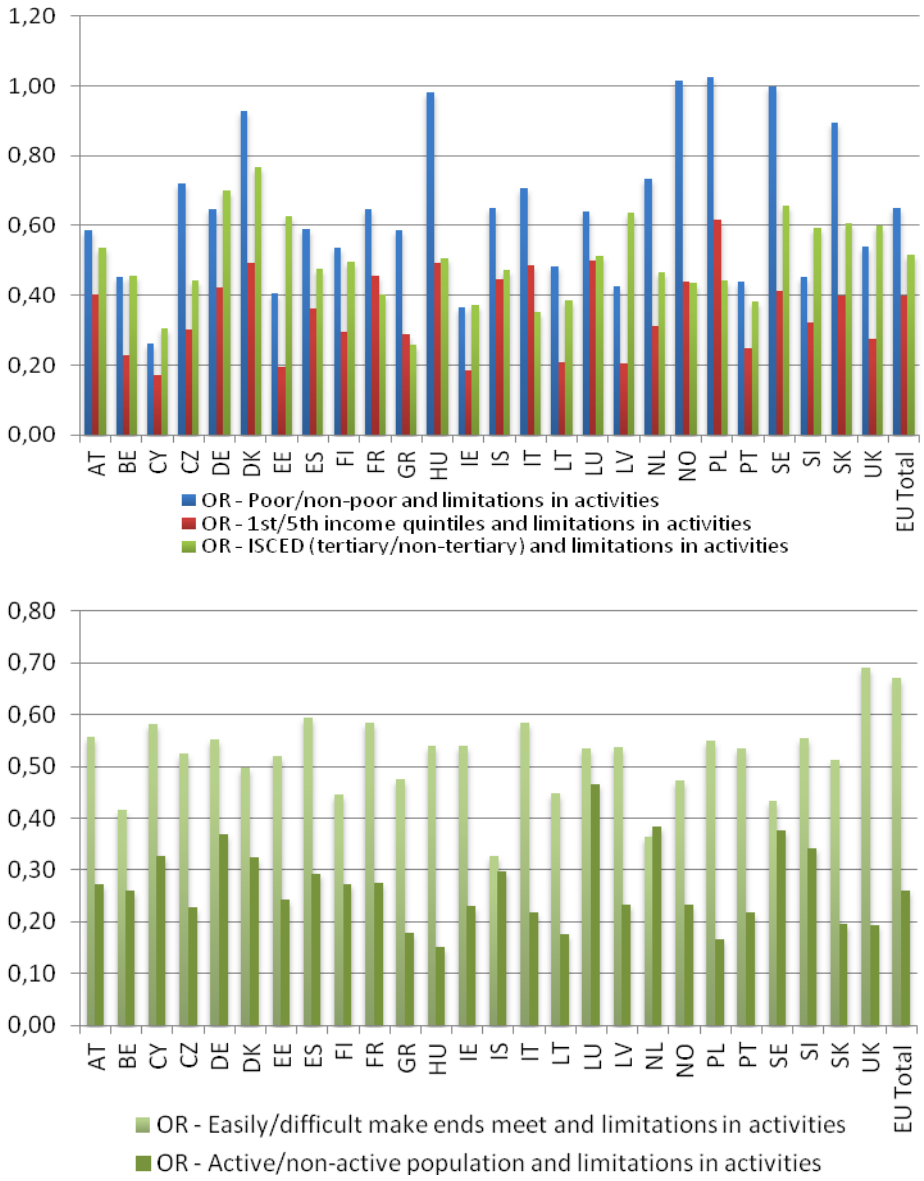
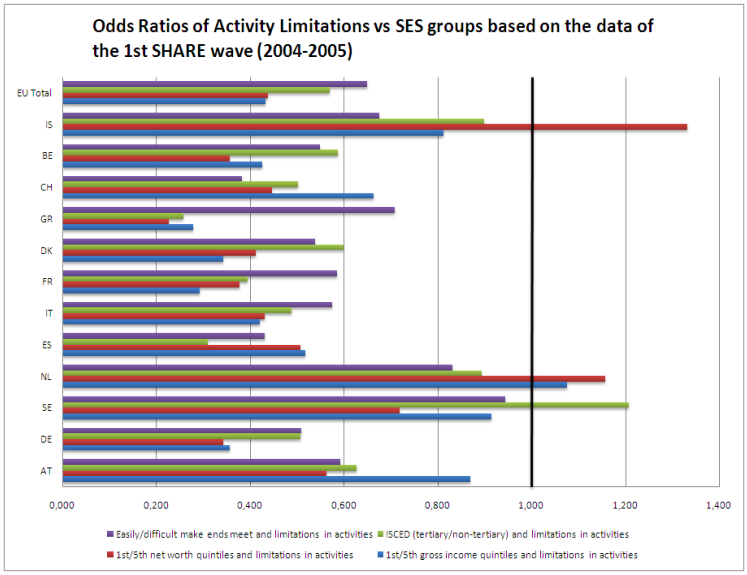


Figure A11: Odds Ratio for Limitations in activities (AL) due to health problems by SES group, for the EU 27. (Data Source: EUSILC 2007)



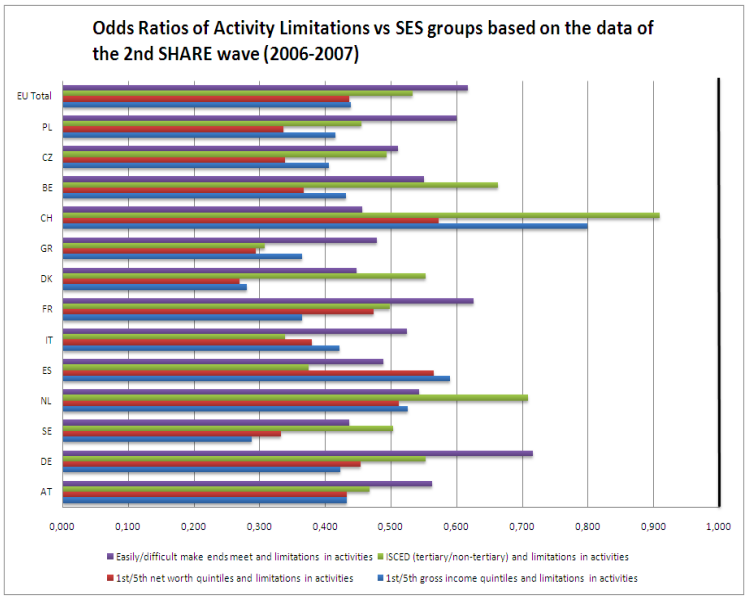


Figure A 12: Odds ratios values for Activity Limitations by SES groups based on the 1st two waves of SAHRE, for the 12 EU member states

(Data Source: SHARE 2004-2005, 2006-2007)

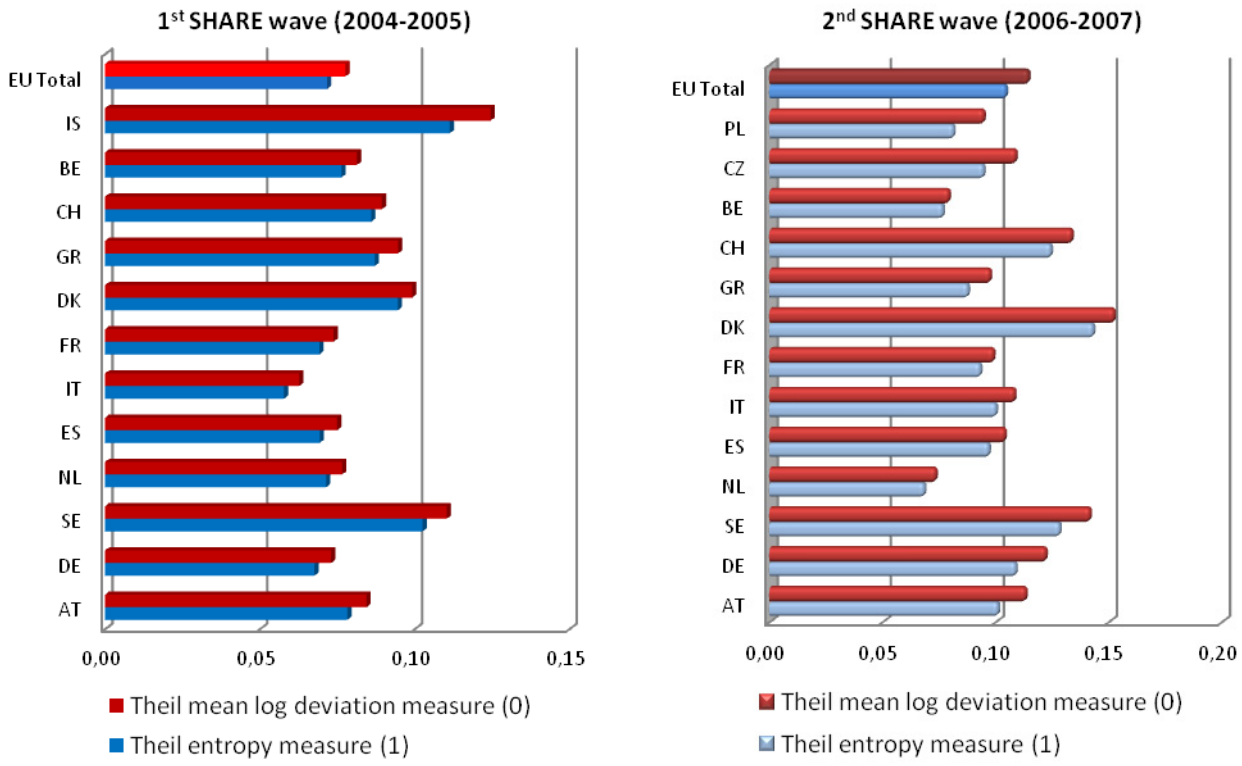


Figure A 13: Theil's index values for SPH for every SHARE wave, 2004-2005, 2006-2007.

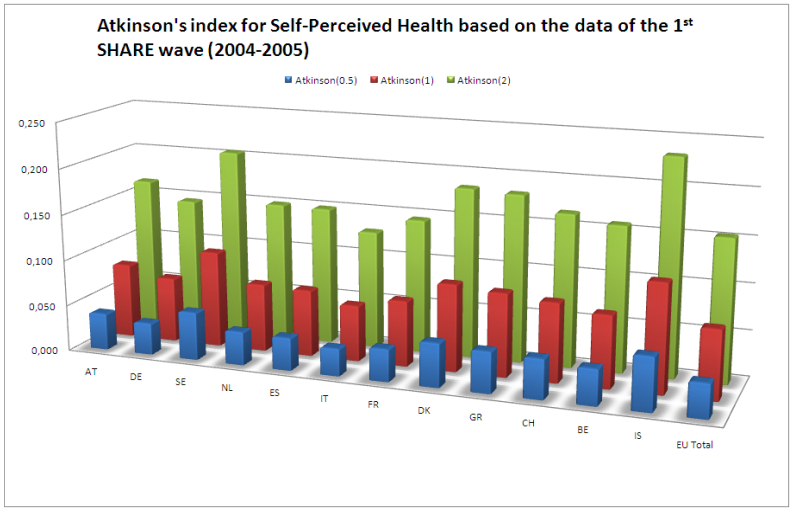


Figure A 14: Atkinson's index for selected index parameter values for SPH based on every SHARE wave.

(Data Source: SHARE 2004-2005, 2006-2007)

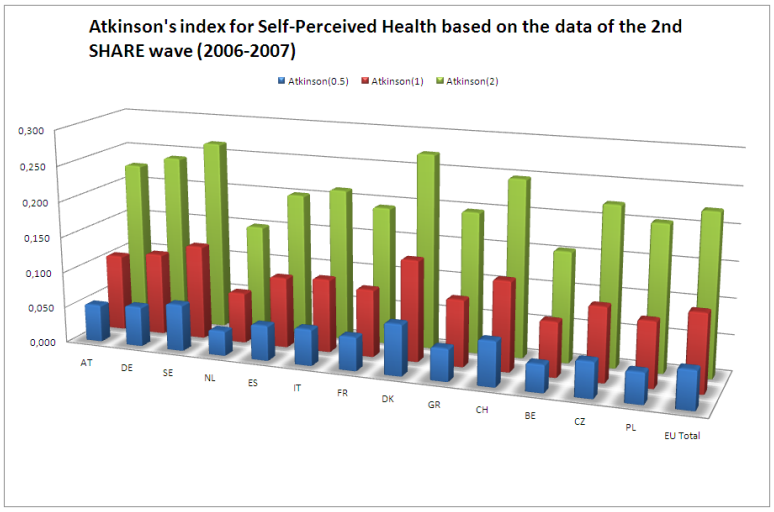


Figure A 15: Atkinson's index for selected index parameter values for SPH based on every SHARE wave

(Data Source: SHARE 2004-2005, 2006-2007)

ANNEX IV: Conceptual Framework to Measurement and Monitoring Health Inequalities

These material is mostly based on the project's report "Review and Analysis of Existing Measurement Approaches, SANCO2008C404Lot 1_SI2.530184"

Introduction

The measurement and monitoring of health inequalities is an important public health issue that comes very high on the European political agenda[23] This is driven by the fact that European and national epidemiological studies highlight a widening gap between socio-economic groups in most Western European Countries (Mackenbach *et al.*, 1997; Dalstra *et al.*, 2002). Monitoring of health inequalities should be incorporated within the general framework of health and social policies. In December 2001 the European Council established a set of indicators to monitor progress towards the Lisbon targets. Among the proposed indicators (see Table 1) two are particularly relevant to the measurement of health status i.e.: i) Life expectancy at birth and ii) self defined health status. Eurostat the OECD, the WHO and other International Organizations have been involved in developing rigorous methodologies to select comparable statistics on life expectancy and to conduct health interview surveys in order to obtain estimates on perceived health.

Several European Countries have also been involved in developing nationwide monitoring systems containing valid and comparable information on the health status of the population, the determinants of health and the utilization of health services. As Houweling *et al.*, (2007) argue:

"Reducing health inequalities between social groups within countries is an important public health objective. Monitoring of such health inequalities, therefore, is an important public health task. Comparisons are an integral part of monitoring. The aims of such comparisons are to assess whether health inequalities are smaller or larger compared to other countries, whether inequalities have increased over time, or whether inequalities develop in the direction of predefined goals. Such monitoring is important, both for high-income countries, and for low and middle-income countries."(Houweling et al., 2007)

The purpose of this chapter is to provide a conceptual framework by distinguishing between different concepts of health inequity and examining several aspects of health inequality related to unit of analysis, the time span, and the measurement strategies.

[23] Decision No 1786/2002/EC European Parliament and the Council (23 September, 2002): Programme of Community Action in the Field of Public Health, 2003-2008).

Laaken Indicators	
Indicator 1a : At-risk-of-poverty rate by age and gender	**Indicator 8 : Early school leavers not in education or training**
Indicator 1b : At-risk-of-poverty rate by most frequent activity and gender	***Indicator 9 : Life expectancy at birth***
Indicator 1c : At-risk-of-poverty rate by household type	***Indicator 10 : Self defined health status by income level***
Indicator 1d : At-risk-of-poverty rate by tenure status	**Indicator 11 : Dispersion around the at-risk-of-poverty threshold**
Indicator 1e : At-risk-of-poverty threshold (illustrative values)	**Indicator 12 : At-risk-of-poverty rate anchored at a moment in time**
Indicator 2 : Inequality of income distribution S80/S20 quintile share ratio	**Indicator 13 : At-risk-of-poverty rate before social transfers by gender**
Indicator 3 : At-persistent-risk-of-poverty rate by gender (60% median)	**Indicator 14 : Inequality of income distribution Gini coefficient**
Indicator 4 : Relative at-risk-of-poverty gap	**Indicator 15 : At-persistent-risk-of-poverty rate by gender (50% median)**
Indicator 5 : Regional cohesion (dispersion of regional employment rates)	**Indicator 16 : Long term unemployment share**
Indicator 6 : Long term unemployment rate	**Indicator 17 : Very long term unemployment rate**
Indicator 7 : Persons living in jobless households	**Indicator 18 : Persons with low educational attainment**

Table: Laaken Indicators

Conceptual Framework

A conceptual framework for a system for monitoring health inequalities is presented in the following Figure.

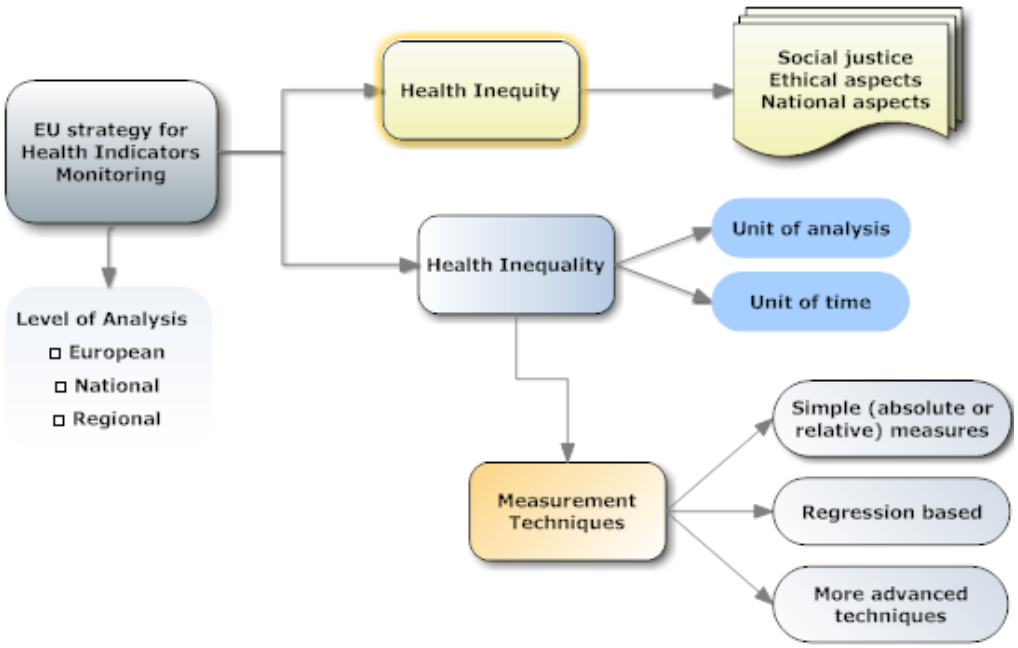


Figure: A conceptual framework for measuring health inequalities.

A framework which links social determinants to health and hence describes where the various measurement techniques may apply it may be presented by the WHO Equity Team social determinants framework (see the following Figure). Supplementary to that is also the framework described by the Determinants of Health-Dahlgren & Whitehead's model (see, Dahlgren G and Whitehead M, 1998).

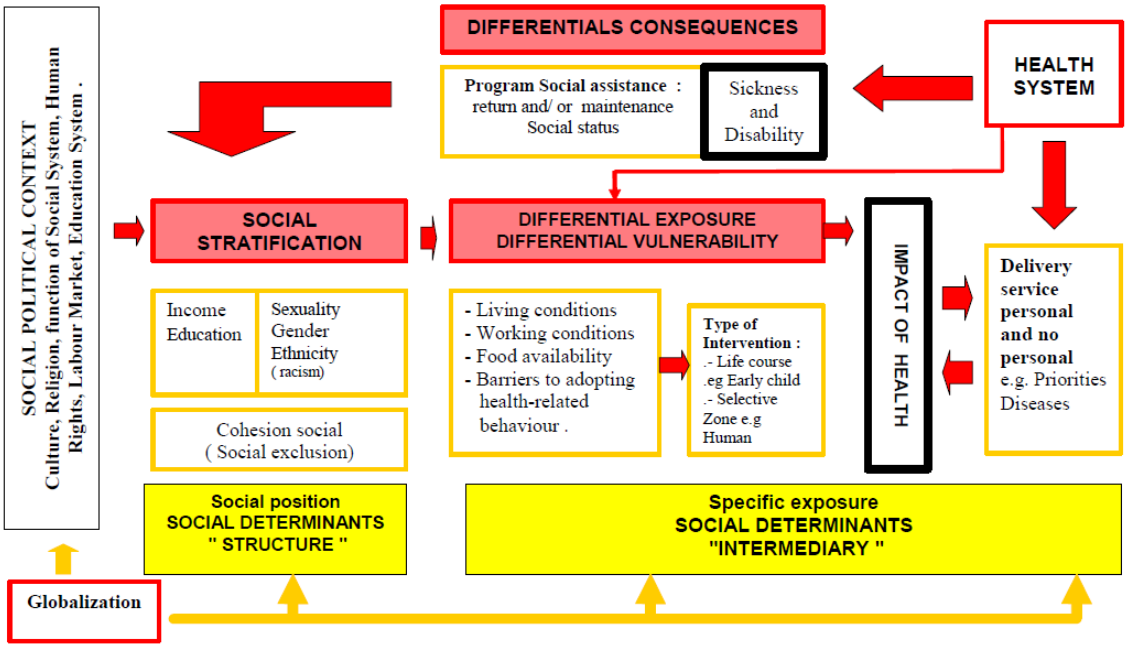


Figure: A conceptual framework that links social determinants to health.
(Source: Commission On Social Determinants Of Health (CSDH), 2005)

Within the framework of our analysis we focus on the investigation of the following research and public health policy questions:

1) Distinction between **Objective** and **Subjective** measures. Objective measures include life expectancy, infant mortality, and standardized mortality and morbidity indicators calculated at an aggregate national or regional level. Death registries and vital statistics are used to calculate these indicators. Subjective measures include scales measuring self-perceived health. (See the following three Tables for a detailed presentation of the data sources with reference to objective and subjective criteria).
2) Distinction between measures that use as an input the "**upstream**" determinants of health (such as education, employment, income, living and working conditions), the "**midstream**" determinants (health behaviors and psychosocial factors) and the "**downstream**" ones (physiological and biological factors).
3) The notions of **Equity** and **Equality**. Equity is a normative term and implies societal value judgements. Should we have a just society? Is it ethical to accept differences in health among social groups, occupational classes, regions, etc? Equality, on the other hand, is a quantitative value–free concept that refers to the distribution of health. According to the WHO, every society that is making an attempt to monitor inequalities in health should obtain a consensus on the concepts of Equality and Equity and provide answers to the questions:
    - **Equality of what?** (health, access to health care, or use of health care?)
    - **Equity among whom?** (socioeconomic class, gender, race, geography?)
4) The **unit of analysis.** The WHO has recently challenged the method of aggregate indicators and proposed individual analysis instead of groups (Murray *et al.*, 1999; WHO, 2000). The WHO researchers posed the question: "Why should you not measure health inequality across individuals?" irrespective of individuals' group affiliations, in much the same way as aggregate measures. Our response to this question is to develop a framework of analysis for measuring health inequalities both at the individual and the aggregate level, provided that the indicators and the methodologies explored are sensitive to relevant moral, ethical and quantitative aspects of analysis.
5) T**he time** of analysis by distinguishing between current, cohort and lifetime data
6) Decide on **measurement strategies** by making reference to simple absolute or relative measures versus more sophisticated techniques.

Health Outcome Indicator	Data Source	Feasibility and Frequency	Indicator		Level of Analysis		
			Objective	*Subjective*	*European*	*National*	*Regional*
Life Expectancy	Death Registries	Feasible / Regular	✓		Eurostat	NSIs	NSIs
Infant Mortality	Death Registries	Feasible / Regular	✓		Eurostat	NSIs	NSIs
Standardized Mortality Rate	Death Registries	Feasible / Regular	✓		Eurostat	NSIs	NSIs
Specific Mortality Rate	Death Registries	Feasible / Regular	✓				
Health Adjusted Life Expectancy HALE	Death Registries	Less Feasible / Periodic	✓		Eurostat		
Disability Adjusted Life Years DALY	Death Registries Survey of Health	Less Feasible / Periodic	✓		Eurostat		

Table: HEALTH OUTCOME INEQUALITIES I

Health Outcome Indicator	**Data Source**	**Feasibility and Frequency**	**Indicator**		**Level of Analysis**		
			Objective	***Subjective***	***European***	***National***	***Regional***
Self Perceived Health	EU. SILC. H.I.S. National H.I.S.	Feasible / Regular		✓	Eurostat	National H.I.S.	
Self rated Disability	Survey of Health and disability L.F.S.	Feasible Non Regular		✓	Eurostat	Selected National H.I.S.	
Self rated oral health	•	•		✓	Eurostat	Selected National H.I.S.	

Table: HEALTH OUTCOME INEQUALITIES II

Access Indicator	Data Source	Feasibility and Frequency	Indicator		Level of Analysis		
			Objective	*Subjective*	*European*	*National*	*Regional*
Doctors Visits	EU. S.I.LC. H.I.S.	Feasible /Regular	✓		Eurostat	NSIs	
Hospitals Visits	EU. S.I.LC. H.I.S.	Feasible /Regular	✓		Eurostat	NSIs	
Screening touch	EU. S.I.LC. H.I.S.	Feasible /Regular	✓		Eurostat	NSIs	
Dental Care	EU. S.I.LC. H.I.S.	Feasible /Regular	✓				
Insurance Curves	Administrator Data	Non Regular	✓		Different public/private	Different public/private	
Out of pocket Expenditures	H.B.S.	Regular	✓		Eurostat	NSIs	Some Regions
Unmet Medical Need	EU. S.I.LC. H.I.S.	Feasible Non Regular		✓	Eurostat	NSIs	Some Regions

Table: HEALTH INEQUALITIES IN ACCESS III

Objective indicators of health inequalities

Life Expectancy

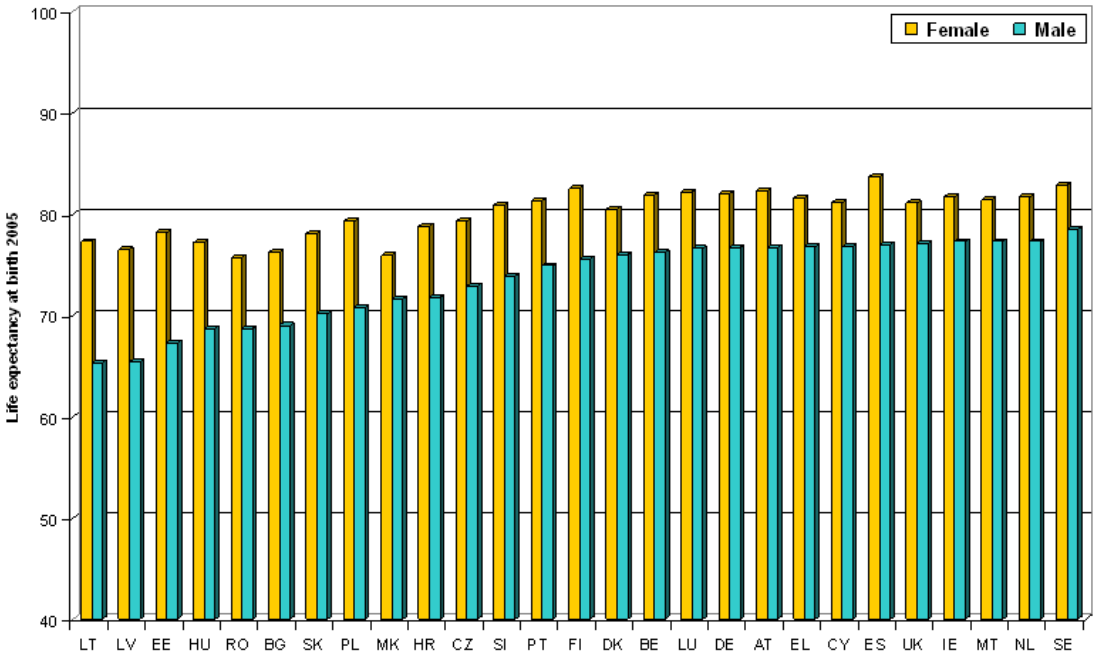
Life expectancy is commonly used as an indicator of health. It measures the average longevity of a population on the basis of a set of given age-specific death rates. Over the last four decades death rates have been falling and life expectancy at birth has shown impressive gains. Increased longevity can be attributed to a large number of factors, such as rising living standards, healthier lifestyles, better education, higher income, better nutrition, improved housing and sanitation, and greater access to quality health services.

The British Programme on Tackling Health Inequalities (Department of Health, 2003) has presented widening inequalities in mortality and life expectancy. Since the 1930's the gap in mortality between professional men (social class I) and unskilled men (social class V) has increased almost two and a half times. Using life expectancy as another objective indicator of health has also identified a health gap between social classes and gender (see Figures 1 ,2). Life expectancy was wider in the early 1990's followed by some signs of narrowing in the early 2000's. It is argued in the Report:

"There is a social gradient in health. Despite overall improvements in health, those from manual groups continue to suffer the worst health. This gradient is also evident across a whole range of wider determinants of health, such as educational attainment and poor housing."(page 15)

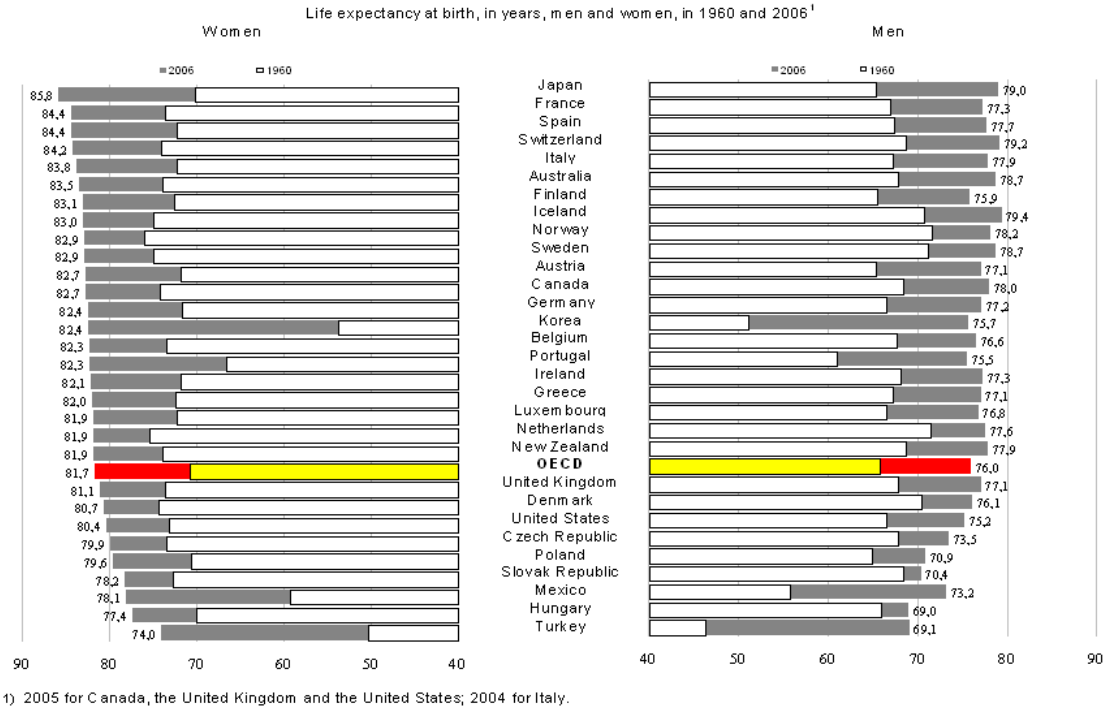
At a European level, recent evidence from the E.U. Social Situation Report has indicated large inequalities in life expectancy among the EU Member states

Figure 1: Life expectancy at birth in the EU of 2005, by gender



Source: Own Estimates based on Social Situation Report 2008, Eurostat-European Commission

Figure 2: Life expectancy at birth in the EU in 1960 and 2006, by gender

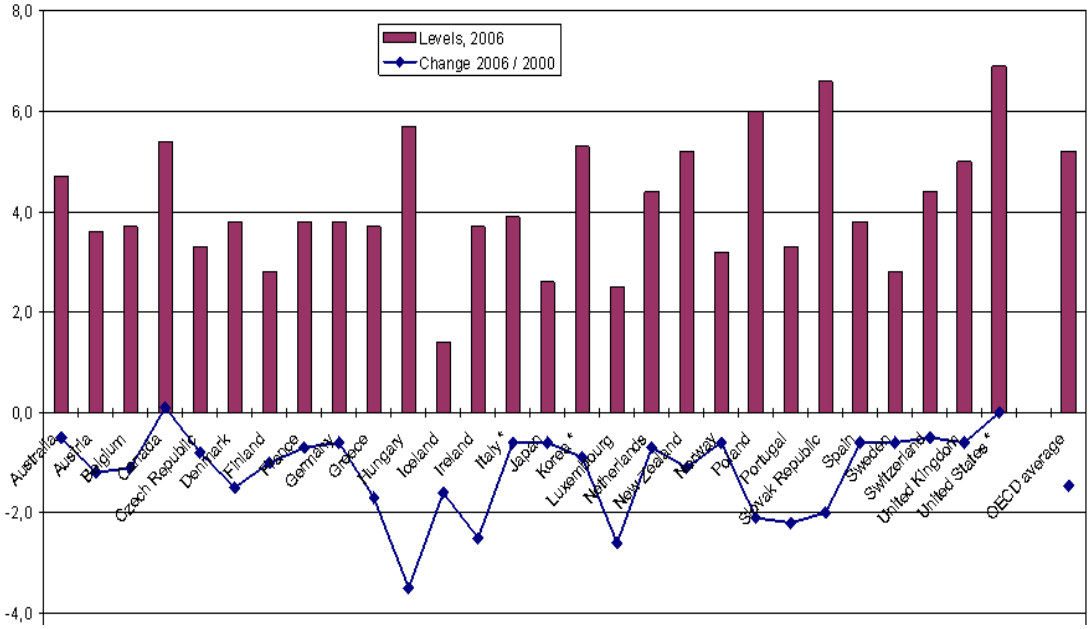


Source: OECD 2009

Infant Mortality

Infant mortality is a sensitive indicator of a country's economic growth and socio-economic conditions and for this reason it has been used extensively in the empirical literature. Infant mortality is defined as the number of deaths of children under one year, expressed as a rate per 1000 live births. As with any measure, it may be subject to measurement problems. Thus some of the international variation in infant deaths may be due to variations among countries' practices with respect to registering and reporting infant deaths. In Figure 3 we present the infant mortality rates for the year 2006 in EU and the changes occurring over the period 2000 to 2006.

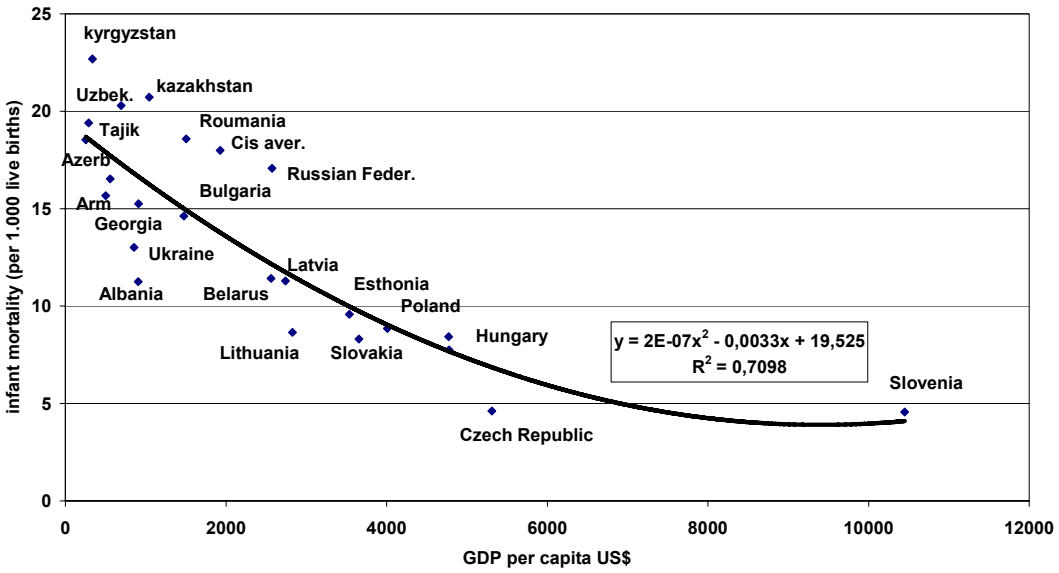
Figure 3: Infant mortality: deaths of children under 1 year of age /1000 live births



Source: Own Estimates based on OECD 2009

A large number of studies have taken infant mortality rates as a health outcome in order to examine the effect of a variety of socio-economic determinants of health. Most analyses portray an overall negative relationship between infant mortality and GDP per capita. (see Figure 4 for selected Eastern European Countries). Moreover, a negative relationship is found between infant mortality and health spending. However, the fact that some countries with high levels of health expenditures do not necessarily exhibit low levels of infant mortality, has led some researchers to conclude that "more health spending is not necessarily required to obtain better results" (Retzlaff-Roberts *et al.*, 2004).

Figure 4: Infant mortality and GDP per capita



Source: Own estimates

Mortality Indicators

Data on mortality are available routinely across the European Countries. A large number of studies have reached the conclusion that the gaps in standardised mortality rates between the socio-economic groups have widened over the last three decades. The overall impression is that mortality rates are much higher in the lower socio-economic groups. One mortality indicator of major importance is infant mortality, discussed further below.

A recent study by Mackenbach *et al.* (2003) presented data from the Nordic, the West, the South and the Eastern European countries on mortality trends for the periods 1981-1985 and 1991-1995 and reached the following conclusions

- premature mortality rates are higher among those with lower levels of income, education and occupational class
- gender inequalities exist in all age profiles
- disease-specific inequalities exist for several diseases including cardiovascular, cancer and injury.

Subjective Indicators of Health Inequalities

Self-perceived health

Self-reported health is an ordinal ranking of an individual's health status, provided by the individual's own subjective estimation. It is an important indicator for specifying demand models for health care as well as utilization models. In the majority of the European states there are Health Interview Surveys which provide estimates of self-perceived health. It is usually measured on an ordinal Likert scale by asking the individual to respond to a question

along the lines: “In general how would you describe your health at present?” The classification of health in response is into five levels labelled, for example: “excellent”, “very good”, “good”, “fair”, and “poor”. For analytical purposes we might combine the categories “excellent”, “very good” and “good” to yield a measure of self-reported health of “good or better than good” and the categories “fair” and “poor” to yield a measure of “less than good”. Various empirical findings have justified the use of the above question to obtain an adequate measure of self-reported health on an ordinal scale.

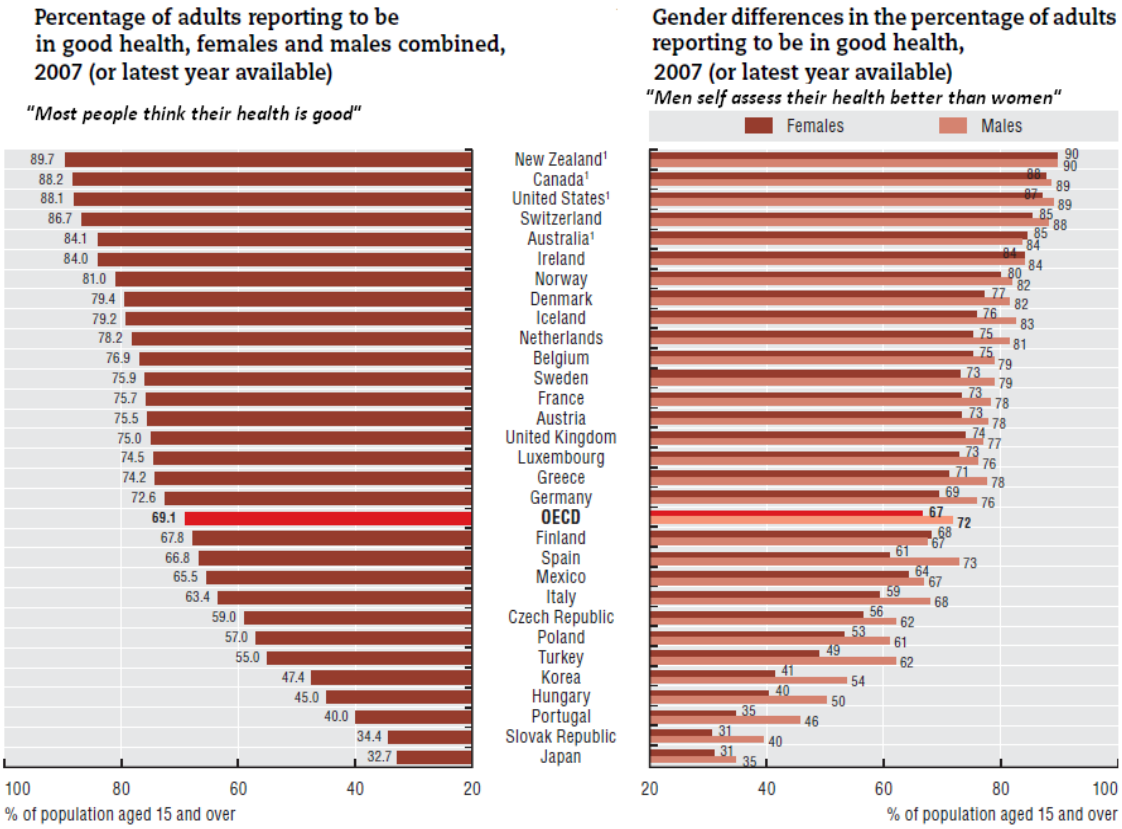
The question and response categories may vary slightly between surveys. The WHO recommended for European Health Surveys a five-category response scale ranging from “very good” to “very bad”. In some cases the five-point ordinal scale has been replaced by a dichotomous variable comparing individuals’ good-very good health status with bad-very bad health. In Table 1 we present a summary of the questions used in various health interview surveys to assess subjective health.

Table 1: The measurement of self-perceived health in various surveys

Self-rated health
European Union Statistics on Income and Living Conditions (EU-SILC) How is your health in general? Is it: *Very good/Good/Fair/Bad/Very bad*
European Health Interview Survey (EHIS) How is your health in general? Is it: *Very good/Good/Fair/Bad/Very bad*
Survey of Health, Ageing and Retirement in Europe (SHARE) Would you say your health is: *Excellent/Very good/Good/Fair/Poor*
Commonwealth Fund International Health Policy Survey In general, how would you describe your own health? *Excellent/Very good/Good/Fair/Poor*

At the EU level, around 9% of adults (aged 16 and over) perceive their health to be 'bad' or 'very bad', 65% feel that their health is 'good' or 'very good', while the remaining 26% describe it as 'fair’. The proportion of persons in the category 'bad’ or ‘very bad' increases with respect to age: almost one in four elderly people described their health as such. For all ages, women are more likely than men to perceive their health as 'bad/very bad'. This pattern can be observed in every Member State with one or two minor exceptions. The following Figures 5 and 6 present indicative results from surveys investigating self-rated health.

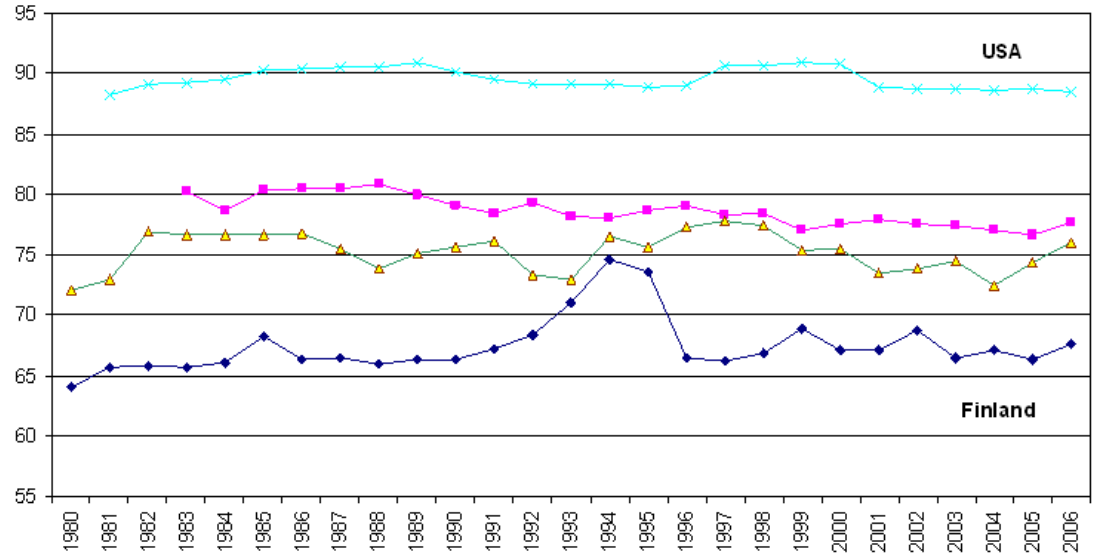
Figure 5: Self-perceived health in OECD countries



1. Results for these countries are not directly comparable with those for other countries, due to methodological differences in the survey questionnaire resulting in an upward bias.

Source: OECD, "Health at a Glance" (2009)

Figure 6: Trends in the percentage of adults (population aged 15 and over) reporting that they are in good health (OECD, 2009)



Source: Own estimates based on OECD data (2009)

Socio-economic inequalities in self-perceived health

Throughout the European Union, persons with a high level of income or high level of education tend to report better health than persons with a low level of income or low level of education. On average, only 4% of people with tertiary education described their health as bad or very bad, compared to 13% of those with no more than compulsory education.

Indicators by socio-economic status

Health inequalities are most frequently investigated in association with socio-economic classes. Socio-economic categorisation is another large issue. Several attempts have been made by the OECD, Eurostat and other international organizations to harmonise the indicators used for its measurement. The variables most commonly used in the empirical literature include educational level, occupational class and income group. In the early studies, these variables were not harmonised and the problems of comparisons among different national studies were substantial. Eurostat's efforts towards harmonizing the classification of socio-economic status have contributed to more valid and reliable comparisons among the EURO Member States.

- **Educational level** is often measured by a hierarchical variable taking different values for educational attainment. The International Standard Classification of Education (ISCED) distinguishes among four basic categories corresponding to: i) elementary, ii) lower secondary, iii) upper secondary and iv) tertiary level.
- **Occupational class** is measured on the basis of the International Standard Classification of Occupations (ISCO) which distinguishes between: i) farmers, ii) unskilled and skilled

manual groups, iii) self-employed, iv) lower non- manual and v) upper non-manual groups.

- I**ncome** is a useful classifier of individual or household economic well being. Equivalence scales are used to standardise income according to the size of the household and its composition in terms of young, adults and elderly members. The entire economic population can be divided according to income into five major groups (quintiles) or ten groups (deciles).

International Studies

Health inequalities are not restricted to one country. The problem is common to all. The size of the problem varies but there seems to be no country where it could be said to be insignificant. Moreover, there appears to be little sign of success in reducing these inequalities. This background shows the importance of the international dimension in confronting the problem. In this section we look at a sample of EU-sponsored studies of socioeconomically related health inequalities

The ECuity project

Many findings from the project "Equity in the Finance and Delivery of Health Care" in Europe" (known as ECuity) are presented by van Doorslaer et al. (1997). This international review differs from earlier ones, firstly, in that it stratifies by income rather than education or occupation, and secondly in concentrating on self-assessed health. One advantage of the latter is claimed to be that the questions used vary only marginally across surveys, although one imagines that the instigators of more recent international comparative surveys such as the European Social Survey might feel that the issue of comparability deserved much more consideration that that.

Based on data from large-scale surveys in eight Western European countries and the USA, income-related inequalities in health, favouring the higher income groups, were found everywhere. The highest degree of inequality was in the USA followed by the UK; the lowest in East Germany (treated separately from West Germany, although these 1992 data follow reunification) and Sweden. An econometric analysis was carried out as a tentative investigation of the factors associated with health inequality. Per capita health care spending, the share of public finance in health expenditure and per capita national income were positively associated with health equality, but their coefficients were not statistically significant in such a small sample of countries. The one item that was strongly associated with health inequality was income inequality; countries with a greater degree of income inequality tended to have also more health inequality.

Mackenbach's report to the EU Presidency, 2006

J.P. Mackenbach's 2006 report commissioned by the UK Presidency of the EU reviews evidence on the existence of socioeconomic inequalities in health in the EU and some

neighbouring countries. It presents data on inequalities in mortality and in self-assessed health.

It notes that inequalities in health have been found between people with higher and lower educational level, occupational class and income level in all European countries. These inequalities declined in absolute terms in the 20th century, but the relative risks remained very stable and, unexpectedly, even increased in the last few decades in many places in Western Europe. Thus it appears that improvements, such as those noted in health-related behaviours and in health care interventions, have tended to benefit the higher socioeconomic groups more. At the same time, with rising education levels, fewer people are found in the lower groups so the mortality disadvantage applies to a smaller section of the population than formerly.

In Eastern Europe, data are not generally available before the political transition of the last 20 years, but Mackenbach suggests that mortality inequalities at that time were at least as big as those in Western Europe and subsequently have changed dramatically, generally for the worse, although this is not true of all the countries that passed through this political and economic upheaval.

Socioeconomic inequalities in morbidity, assessed by self-reports, are available only for recent years and to a lesser extent in Eastern than Western Europe. Where available, they show the same large socioeconomic inequalities as mortality, although without much evidence of a widening gap. Acting together with the inequalities in mortality which lead to substantial inequalities in life expectancy at birth (of the order of 4-6 years among men, although less among women), the inequalities in morbidity contribute to large inequalities in healthy life expectancy (the number of years that a person can expect to live in good health) that can reach 10 years among men and 5 years among women.

These results obtained from self-assessment can be supplemented by objective findings for specific diseases, although not all conform to the same pattern and explanations of relative prevalence between socioeconomic groups may be complex in some cases. The prevalence of limitations in functioning and other forms of disability is also higher in the lower socioeconomic groups.

Considering the case of mental illness, which has long been hypothesised to lead to downward social mobility, it can be seen that a health-related selection effect potentially offers at least a partial explanation of socioeconomic inequalities in health. But as far as is known, this appears to make only a small contribution. The major explanation is the “causal” effect of socioeconomic status. This is of course indirect, a consequence of more specific health determinants which have uneven distributions across socioeconomic groups. Mackenbach recognises

- material factors including financial disadvantage, affecting health in various ways, and occupational health risks
- psychosocial factors with biological and behavioural impacts on health

- health-related behaviours, notably smoking, alcohol consumption and poor diet, all of which may tend to be more prevalent in the lower socioeconomic groups.

Of these factors, large-scale data are generally available only for the health-related behaviours, most of all for smoking.

The Eurothine project

The project on "Tackling Health Inequalities in Europe" (Eurothine), consists of a large number of separate studies on inequalities. The general aim of this international collaboration is to increase substantially understanding of health inequalities in the EU and the possibilities of reducing these inequalities, as the focus research shifts from description to explanation.

One main strand of the project aimed to describe health inequalities, including several studies of mortality (overall and disease-specific) in a variety of countries, and analyses of self-reported health. Its main results and conclusions include the following.

- As is well known, socioeconomic inequalities in health are substantial throughout Europe, but
- variations between countries strongly suggest that reducing health inequalities is feasible, even though the persistence of health inequalities even in the countries with the best-developed social and health care systems indicates the difficulty of the challenge.
- Countries differ strongly in which diseases contribute most to the overall inequality in health and in which health determinants play the greatest role.

The second major strand aimed to evaluate the effectiveness of interventions and policies.

- Sustained powerful interventions are required.
- These policies need to address not only the so-called "upstream" determinants of health inequalities (such as education and income) but also the "midstream" and "downstream" ones.
- Health-related behaviours (notably smoking and heavy alcohol consumption) are important entry-points for policies and interventions to reduce health inequalities.
- Another important entry-point in some countries, especially in Eastern Europe, is access to good-quality health care.
- Quantitative target setting is recommended as an instrument to guide policy making and to support the evaluation of strategies.

The project's recommendations for further work call for improved monitoring of health inequalities in many countries, including the suggestion that the EU should incorporate the socioeconomic dimension in its guidelines for collecting health data.

The separate studies employ a variety of health indicators. Some of these are novel, such as health care utilization. The experience of the project is that the measurement of health inequalities is highly variable, because the choice of indicators depends on the health outcome under study, the available data and the socioeconomic classification (Kunst, 2008).

The two data sources that are strongly recommended are nationally representative, individual-level data from mortality registries, and national (or international) health interview and similar surveys. Regional or local data of the same type and quality are usable, but only if the geographical restriction is recognised. Other data sources are not recommended. In particular, “ecological” analyses based on aggregated data for small areas should not be used because of the difficulty in obtaining estimates at the individual level and their lack of international comparability.

Education, occupation and income are described as the three core indicators of socioeconomic status. None can be regarded as superior to the others, although for a particular purpose one may be clearly be preferable. For example, the public health impact of financial measures will usually be examined in relation to a population classification by income (usually, household equivalent income taking into account the household composition).

ANNEX V: Classification of Health Inequalities Measurement Techniques

These material is a part of the project's report "Review and Analysis of Existing Measurement Approaches, SANCO2008C404Lot 1_SI2.530184"

Introduction

As already noted, for all its apparent simplicity the concept of inequality is actually rather complex and has long provided a topic of research for scientists from different disciplines. A large variety of income, health and social inequality indicators has been developed for its measurement. Those which have often been analyzed and critically evaluated in the economics and sociological literatures have been reviewed by Atkinson (1970), Sen (1973), Cowell (1977), Wagstaff et al. (1991) and Mackenbach and Kunst (1997).
In this chapter, we will briefly mention some of the available indicators and use them to demonstrate the empirical findings of some selected European comparative studies.

Simple Inequality Measures

The simplest presentation of inequalities in health is based on absolute or relative comparisons of the mortality rates (or other rate, as required) between two socio-economic classes. **Relative** measures are expressed as a ratio of different rates. In empirical analysis the most common presentation of health inequalities is in relative terms, such as the ratio of mortality (or morbidity) between the lowest and highest socioeconomic groups. For this purpose the mortality or morbidity indicators are standardized and are often expressed as rates per 1,000 or 100,000 population. For example, a rate of 30 deaths per 100,000 in the lowest socioeconomic group compared to 10 per 100,000 in the highest is a ratio of 3:1; the experience of the lowest group is three times as bad as that of the highest. In the early studies of the British Black Report and the subsequent analysis, the standardized mortality rates of Social Classes I and II were compared to Social Classes IV and V. Although these simple comparisons are still used by many researchers we have to take into consideration the fact that important information about the distribution of health among the members of the population is missing.

Absolute measures are also used widely to portray the difference in mortality/morbidity among social groups, regions or countries. The absolute measure is the simple numerical difference; in the example in the previous paragraph, it is 20 deaths per 100,000. Absolute measures are important for health policy and planning purposes because of their simplicity and their ability to describe a certain goal to be attained by health administrators and professionals. They have been often used to assess the magnitude of success of a public

health programme. It is much more direct and more widely understood to refer to how many deaths have been avoided than to by what factor the rate has been reduced.

Both relative and absolute measures are useful for the appraisal of health inequalities because sometimes the relative position of two indicators may remain unchanged yet the absolute gap indicates narrowing trends between the worse and the better off. In Acheson's report reference is made to both absolute and relative measures:

"Both relative and absolute measures have important implications. However, it may be argued that absolute measures are the most critical, particularly with respect to identifying the major problems which need to be addressed. This is because an absolute measure is determined not only by how much more common the health problem is in one group than another, but also how common the underlying problem – for example the death rate in a particular population – actually is. A doubling in social class V of the rate of occurrence of a rare disease is not as significant as a doubling in the rate of occurrence of a common disease. Major gains in attacking health inequalities are most likely to derive from addressing those health problems which occur reasonably frequently, even if less common diseases may in relative terms demonstrate a steep gradient, occurring, say, ten or twenty times more often in social class V than I. Relative measures are particularly useful for assessing the relative importance of different causal factors, and are important tools in aetiological enquiry." (Department of Health, 1998)

In Box 1 we present a summary of Absolute and relative indicators that have been used in the literature to assess the gap in health inequality.

Box 1 Absolute and Relative Gap Indexes

Absolute measures are used widely to portray the **absolute gap.** This is defined as the difference between two indexes of mortality /morbidity:

Absolute Gap (AG) = HI_A- HI_B

Where HI_A = Health Index for disadvantaged group (group A)

HI_B = Health Index for reference population (group B)

The larger the difference (positive or negative) the larger the inequality

If AG =0 there is no inequality because $HI_A - HI_B = 0$ then $HI_A = HI_B$

AG > 0 then $HI_A - HI_B > 0$ which means $HI_A > HI_B$

AG < 0 then $HI_A - HI_B < 0$ which means $HI_A < HI_B$

The Relative Gap is defined as the ratio between the disadvantaged group HI_A to the reference group HI_B.

Relative Gap (RG) = HI_A / HI_B

Inequality is expressed in proportional terms

If RG =1 there is no inequality because $HI_A / HI_B = 1$ then $HI_A = HI_B$

RG >1 then $HI_A / HI_B > 1$ which means $HI_A > HI_B$

RG < 1 then $HI_A / HI_B < 1$ which means $HI_A < HI_B$

The relative gap can be also presented as a proportion of (%) measured in percentages.

$$RG\ (\%) = \{(HI_A - HI_B) / HI_B\} \times 100$$

The greater the percentage the greater the inequality.

The above indicators have been used widely to indicate absolute or relative differences between socio-economic groups. Absolute measures have often been used for health policy and planning purposes because of their simplicity and their ability to describe a certain goal to be attained by health administrators and professionals.

Many of the simple indicators are not unique to the study of health inequalities but are well known epidemiological indicators. Kunst and Mackenbach (1995) presented a battery of several health inequality measures of this type, along with simple numerical examples for illustration. The following are the most important to mention.

Rate ratio. This is the simple ratio of two rates in order to compare them between two categories, as in the illustration of relative measures at the beginning of the previous section. It may also be called relative risk. Unless there are only two categories (as in a gender comparison), it is usually calculated between the two extreme categories. In this sense, it does not present a full picture across the entire population.

Rate difference. This is the numerical difference between two rates, again as described in the previous section. The restriction to two categories, as with the rate ratio, is a limitation on its usefulness.

(Population) attributable risk (PAR). The attributable risk is a simple function of the rate ratio. In the earlier example where rates of 30 and 10 per 100,000 were compared, the attributable risk is just (30-10)/30 = 2/3 or 67%. Thus it is no more than another expression of how much bigger the risk in the one group is than in the other; it can be written as (RR – 1)/RR where RR is the rate ratio. But it can also be seen as an expression of how much of the mortality in this group is “due to” the individuals being in this group and not the other. If we were talking about groups of people exposed or not exposed to a harmful substance, instead of socioeconomic groups, then it expresses by how much the mortality would be reduced if exposure could be prevented. Obviously, the causal terminology is easier to justify in an example like that than in the case of socioeconomic groups. *Population* attributable risk differs from attributable risk only in comparing the whole population to the low group instead of the high group to the low group. It says what proportion of mortality in the whole population is “due to” the inequality between groups, and this may well be the more meaningful concept in most cases. In our example, we would have to know the relative sizes of the groups as well as their rates in order to compute the population attributable risk.

Odds ratio. This indicator is not mentioned by Kunst and Mackenbach, but is so widely known and used in other contexts that it should always be considered alongside other simple comparisons of rates between categories. We take an extremely simple numerical example to give the idea. Suppose that 50 out of 200 people in group A say that they have poor health (a rate of 0.25) compared to 10 out of 100 in group B (a rate of 0.1). The rate ratio is 2.5. The

odds ratio makes a slightly different comparison. In group A, 50 people have poor health and 150 do not, so there is 50-to-150 (or 1-to-3) chance that a person picked at random out of this group has poor health. This chance is the “odds” on poor health in group A. it is just another way of stating a probability. Similarly, in group B, the odds on poor health are 10:90 or 1:9. The odds ratio (OR) takes the ratio of the two odds, just as the rate ratio takes the ratio of the two rates. It is OR = (1/3)/(1/9) = 3.0. In general, as in this example, the OR is different from the RR. But if we were talking about diseases that affect only a small proportion of people, the OR and RR will take very similar values.

An important point about the OR is that it is a measure that fits naturally into certain well established statistical models, notably logistic regression.

The Range

The Range constitutes one of the most frequently encountered measures of inequality to show the two extreme values (the highest and the lowest) of a particular variable of interest or distribution. The main advantage is its simplicity and interpretability of the results. It has often been used in economic and sociological studies, as well as in many other epidemiological studies describing the top and bottom values of mortality or morbidity rates for various occupational classes. The range is usually expressed in absolute terms or as a ratio of the average income:

Absolute Terms: $$R = \frac{MaxY_i}{MinY_i}$$

Relative Terms: $$R = \frac{\frac{MaxY_i}{MinY_i}}{\overline{Y}}$$

In a pure “egalitarian” society where income is equally distributed among the n members of society the Range takes the value of R= 0. At the other end of the scale, extreme case, where one person receives the total income of the Society the range takes the value of R= n.

The defects of the Range as a representative measure of inequality are obvious, i.e.

1. It does not take into account the intermediate values of distribution.

2. It does not reflect possible redistributions between income or other groups.

3. It is not standardized for different sizes of income or other groups.

Hence, the use of the Range without taking into account the above limitations may lead to bias in income distributions between countries or across time.

Range Ratios

The range ratio provides a relative measure of inequality by comparing the highest decile of a distribution with the lowest one. In order to estimate the range ratio we divide the value of

certain higher percentiles (usually above the median) by the value of the lower percentiles (usually below the median). Often in the inequality literature we use the inter decile ratio where the highest decile is divided by the lowest one. Other popular range ratios often explored in the literature is the inter-quartile range ratio. Range ratios have been used in the income distribution literature as well as in the areas of education and health

The main advantages of the range ratios are the following:

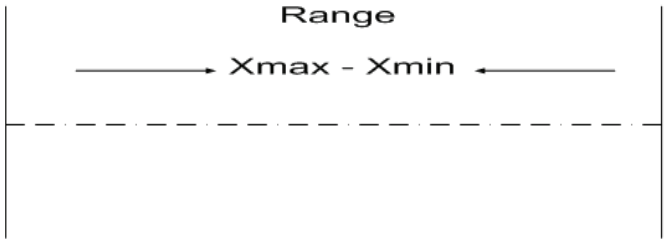
- Simplicity in the estimation process
- Easy to understand
- Clear distinction between the privileged group “those who have: and the disadvantaged “those who have not”

The main disadvantage of the range ratio is that:

- we consider only the upper and lower values (deciles, quintiles, percentiles) of a variable and
- we ignore the intermediate values of the distribution.

It is obvious that the range ratio is influenced by the outliers and the extreme values See Figure 7 below:

Figure 7: The Range



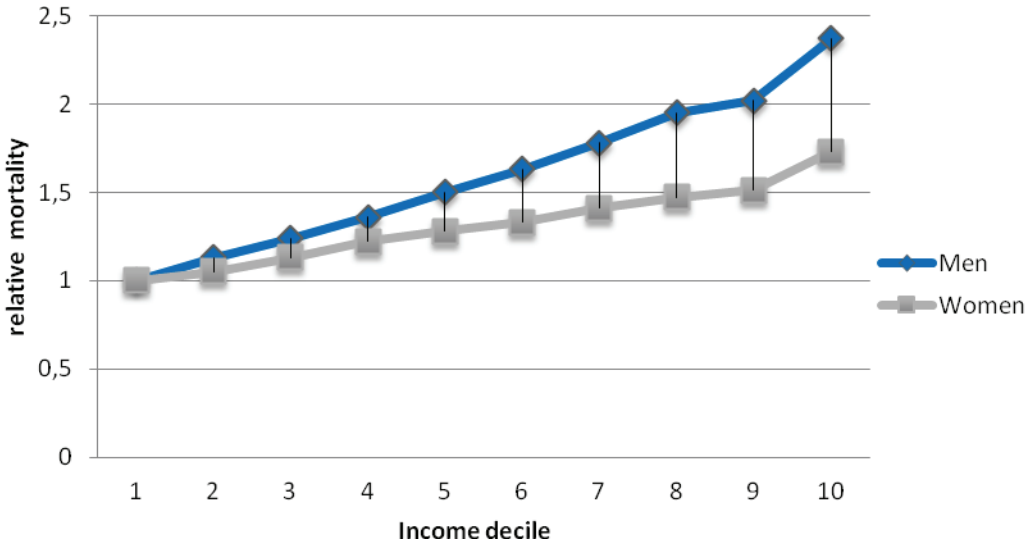
Because of its limitations, researchers tend to use range ratios with other more sophisticated inequality indexes.

Index of dissimilarity. Another index listed by Kunst and Mackenbach is an index of dissimilarity that has some similarity to the population attributable risk. Take the population rate and apply it to each group: this gives, for each group the “expected” number of deaths that there would be if mortality did not differ between groups. This will differ from the observed number. Now add up over all the groups the absolute differences between observed and expected. Half of this number can be interpreted as the number of deaths that must be transferred between groups in order to achieve equality of mortality rates. Finally this is expressed as a ratio to the total number of deaths to give the index of dissimilarity. Both the population attributable risk and the index of dissimilarity are based on the idea of what would happen if all the population shared the same mortality rate, in the case of the population attributable risk this is the extreme group’s rate whereas for the index of dissimilarity it is the population rate.

The simplest of the measures that have been mentioned above make comparisons between two groups. In practice, there will usually be more than two socioeconomic groups. Figure 8 gives an example of an analysis, taken from Martikainen et al. (2001) study of mortality rates in relation to income for three million people aged 30 years above in Finland in the period 1990-1996. In this case, the groups are the deciles of the income distribution: that is, the population is sorted by income and then divided into ten equal groups. Thus the lowest decile contains the 10% of the population with the lowest incomes and the upper decile contains the 10% with the highest incomes. A striking widening of the gender gap can be seen as income increases (always compared to the lowest income category).

The simplest measures can obviously be applied here to the gender comparison (overall or within any income group), but can only be applied to the income comparison by selecting the extreme groups, in preference to the less useful solution of comparing all the groups - two at a time. (Note, however, the index of dissimilarity and the population attributable risk can both be applied when there are more than two groups.)

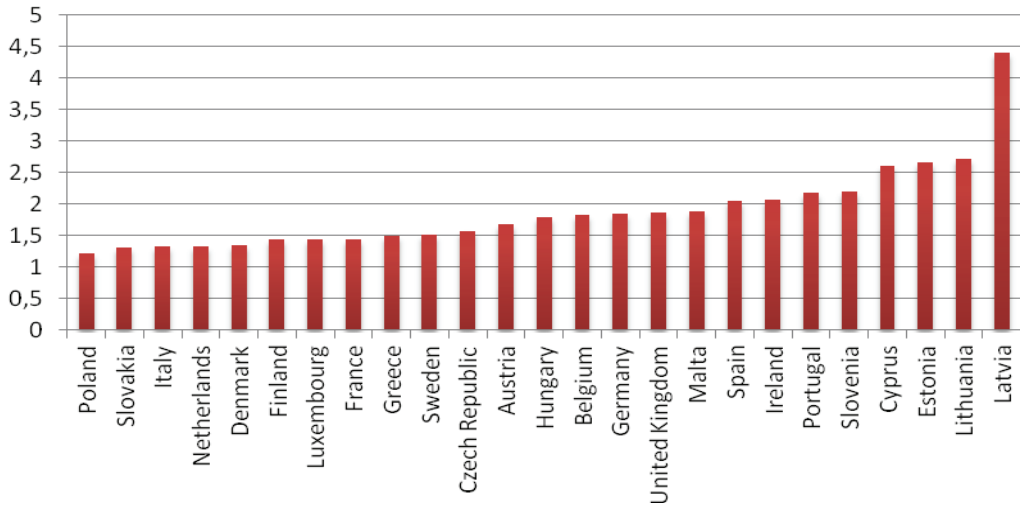
Figure 8: Age adjusted relative mortality rates (all causes of death) between the lowest and the highest income by gender (men & women aged ≥ 30)



Source: Martikainen et al (2001)

Figure 9 shows the inter-quintiles ratios for "very good health" between the two extreme income quintiles.

Figure 9: Inter-quintiles ratio between the 5th and the 1st quintiles (2005)



Source: Own estimates based on EU-SILC, 2006

Regression-based inequality measures

The intention behind the construction of a regression-based inequality measure is to provide a method of analysing the relationship between health status (dependent variable) and socioeconomic level (independent variable) across the whole range of levels, in the situation displayed earlier in Figure 5.3, for example. The strict applicability of a method of this kind requires that socioeconomic status should be measured on an interval scale.

Any increase or decrease in the socioeconomic level is associated with a corresponding increase or decrease in average health status. The direction and magnitude of change is indicated by the sign and size of the estimated regression coefficient ***b*** in the fitted linear regression equation:

$$H = a + b \cdot SES$$

where H denotes health status and SES the socioeconomic status. Although H could be a numerical level of health or the frequency of a health index, its nature may determine the choice of best method for fitting the regression equation. Least squares methods are appropriate for a continuous quantitative health measure but Poisson regression or logistic regression is preferable when data represent counts of number of events. We will now discuss different approaches used in the literature for measuring absolute and relative regression-based inequality indexes.

The slope index of inequality (SII) is defined as the slope of a regression line showing the relationship between the health variable and the hierarchical ranking on a social scale of each socioeconomic category. Hence the slope index of inequality is the coefficient ***b*** estimated in the following regression:

$H = a + b \cdot \text{Rank}SES$

where in order to estimate the above regression, we first calculate the mean value of the health status for each socioeconomic group and then create a hierarchical ordering of different classes on the base of their socioeconomic status. For example if we consider educational inequalities then the socioeconomic variable of educational ranking is created as follows:

i) If the highest educational class includes 10% of the population then the range of values is from 0 to 0.10 and the estimated mean is 0.05
ii) The next educational class includes 20% of the population. The range is from 10% to 30% i.e: from 0.10 to 0.30 and the mean is 0.20
iii) We continue the process of ranking for the rest of educational classes

On the base of this approach the highest educational class has a value of 0 and the lowest the value of 1. The SII can be interpreted as the change in health status as we move from the one extreme of the social hierarchy to the other.

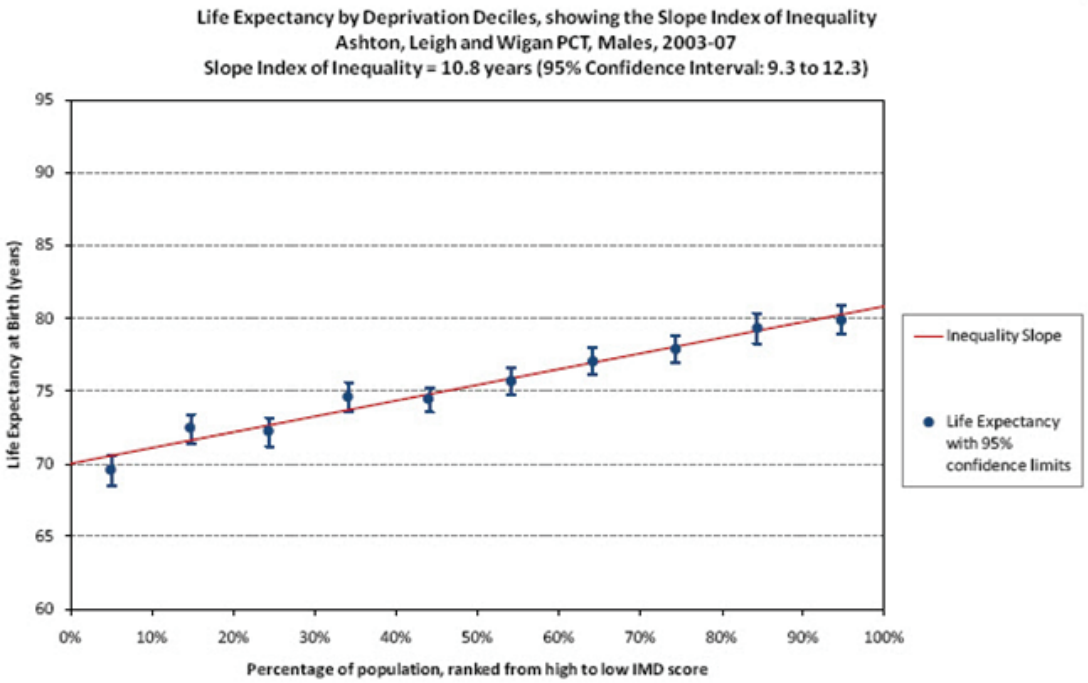
The Relative Index of Inequality (RII).

Pamuk's relative index of inequality is defined as the ratio of the estimated slope ***b*** to the mean value of Y in the same analysis as above.

Figure 11 illustrates an application of the slope index of inequality to the analysis of life expectancy at birth in relation to a measure of deprivation. On the horizontal axis we present the ranking of deciles starting from the most deprived and moving up to the richest.

The vertical axis represents the life expectancy at birth (Y) in each income decile (X). We fit the regression $Y = \beta_0+\beta_1 X$; then the estimate of β_1 is the slope indicator.

Figure 10: Illustration of a slope index of inequality



Source: Fryers, P., et..al. (2009) - World Class Commissioning Assurance Framework - Health Inequalities Indicator

The red slope line in Figure 10 represents the gradient of the relationship between life expectancy and deprivation by decile.

Life expectancy for males in these three towns from 70 years in the lowest decile to 81 years in the highest decile. A range of 10.8 years is indicated by the slope index of inequality which has been widely researched and validated in the literature

More Advanced Measures of Inequality

Basic axioms

It is possible to approach the issue of selecting an inequality index by stating various conditions that an index should logically satisfy. These axioms are stated below. Consider a population of N_i individuals that has been classified in ascending order according to an objective or subjective individual measurement of level of health, from the sickest person with the worst health H_1 up to the healthiest person with level of health H_{Ni}:

$$H_1 \leq H_2 \leq H_3 \leq \ldots\ldots\ldots\ldots \leq H_{Ni}$$

The main objective is to obtain a single measure which adequately describes the extent of health inequality within the society of N_i individuals.

The **first axiom** is that a valid index should take the value of zero in an egalitarian society where all individuals have identical health and a positive value as soon as one or two individuals have a slightly greater level of health. Any differences in the levels of health status

should be reflected in the values of index. This axiom is satisfied by all measures of inequality, including the crudest ones.

The second axiom requires scale invariance in the inequality index. It implies that the degree of inequality is unaffected if all levels of a health index are multiplied by a constant value. The majority of indices used in the literature can be transformed into invariant measures by normalizing them and dividing them by the mean value or some other function of the mean. For example, the simple coefficient of variation of the values of H is an invariant measure of health distribution.

The third axiom deals with the pooling of two identical populations with similar characteristics. It states that if a population or sample of N_i households is pooled with another similar population of N_j households (where N_i may be different from N_j), the value of the inequality index should not change.

The fourth axiom is called the principle of transfer, and it was initially formulated by Dalton in 1920. Dalton emphasized the normative notion of value judgements within a social welfare framework. Under this principle, he assumes that an inequality index is valid if it always increases when a transfer takes place from a person with poor health to a person with better level of health, regardless of the amount of health transferred.

Another important dimension to this axiom is its sensitivity to transfers. For example, among the indicators to be presented below, the Gini index is more sensitive to transfers in the middle levels of the health distribution and the Theil coefficient is more responsive to transfers at the higher levels of the health distribution. Hence, the choice of inequality measurements becomes a difficult task. However, in the empirical literature, in order to avoid the above constraints, several indices have been used to investigate different aspects of health distribution between individuals, socioeconomic groups, regions or countries.

The Relative Mean Deviation and the Variance

The Relative Mean Deviation and the Variance are better measures since both take into account all the values of a distribution. The Relative Mean deviation which is known as Schutz's (1951) indicator is described as:

$$M = \frac{1/n \sum_{i=1}^{n} |Xi - \mu|}{2\mu} \text{ or alternatively } M = \frac{\sum_{i=1} |Xi - \mu|}{\eta\mu}$$

Where, n=population's size, μ=average of the population's health, and X_i = the health status of the *i-th* individual.

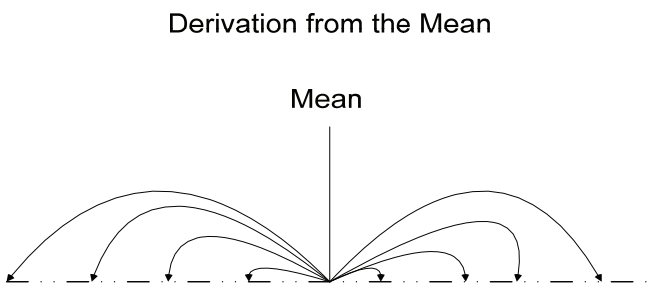
Instead of taking the sum of the absolute values, we can consider the sum of the square of the difference. This is the *Variance*, which is expressed as:

$Var = \frac{1}{n}\Sigma\left[X_i - \mu\right]^2$ or the square root of the expression which is the

Standard Deviation $\sigma = \sqrt{1/n \sum_{i=1}^{n} (X_i - \mu)^2}$

Graphically, the deviation from the mean is presented below in Figure 11.

Figure 11: Deviations from the Mean



The significant restrictions imposed on the above measures are that, they do not satisfy the principle of transfer expressed by Pigou and Dalton since even a small transfer from a poor person to a richer (changes within the distribution) would increase the value of variance.

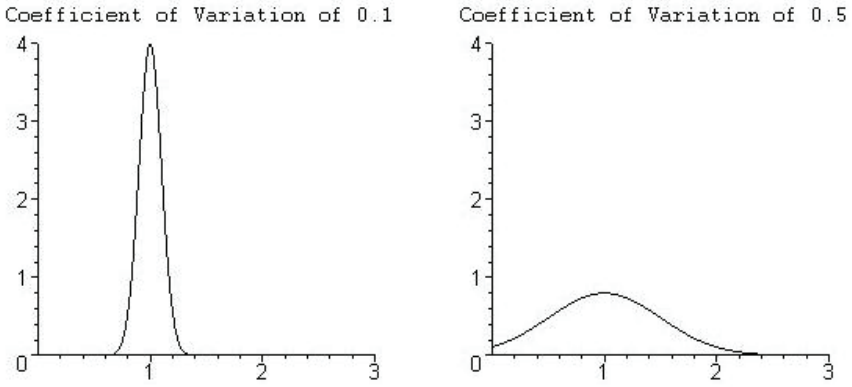
Coefficient of Variation

The above defects could be overcome if we take into account the Coefficient of Variation CV which is expressed as the ratio of the square root of the variance divided by the mean value of the distribution:

CV=Standard Deviation/Mean $= \frac{\sigma}{\mu} = \frac{\sqrt{\frac{1}{n}\Sigma (X_i - \mu)^2}}{\mu}$

Graphically the coefficient of variation presents the peakedness of a unimodal frequency distribution. (see Figure 12). Low values of CV are associated with small deviation around the mean and a peak in the distribution. More dispersed data around the mean are associated with a shorter peak and a higher estimate of CV. The smaller the CV the greater the equality in the distribution

Figure 12: Distributions of Coefficient of Variation.



The properties of this simple measure of dispersion are multiple since:

- It is simple to estimate
- It reflects adequately the extent of inequality.
- It is an invariant measure of dispersion being independent of the income unit of measurement
- It satisfies the principle of transfer.

Standard Deviation of Logarithms

A normalization of an income distribution, done by taking the logarithmic values of health and calculating the standard deviation of logarithms, provides an interesting measure of dispersion this has often been used in the economic literature. The Logarithmic variance is defined as:

Log(Var) = $\frac{1}{n}\Sigma\left[\log\left(\frac{X_i}{\mu}\right)\right]^2$ or, $L = \frac{1}{n}\sum_{i=1}^{n}\left[\log\left(x_i - \mu\right)\right]^2$ and finally as,

$$L = \frac{1}{n}\left[\sum\left(\log x_i - \log\mu\right)^2\right]$$

The square root of the above formula provides the standard deviation of the Logarithms.

$$L = \left[\frac{\sum_{i=1}^{n}\left(\log x_i - \log\mu\right)^2}{n}\right]^{1/2}$$

The computed variance and standard deviation of transformed values of health provides some useful properties, i.e.:

1) It reduces the extreme variation and the out layers by eliminating the arbitrariness of the units of measurement
2) It satisfies the principle of transfer
3) By expressing the unit values in logarithmic terms, the final logarithmic variance is an invariant measure of the units of income

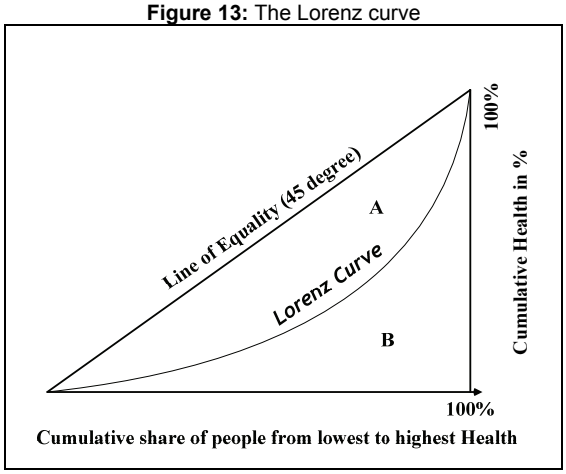
The standard deviation of logarithms is a dispersion measure which is particularly sensitive to transfers in the lower end of distribution. This property makes the standard Deviation of Logarithms a particularly interesting indicator for studies focusing on poor households.

The Lorenz curve and the Gini coefficient

Lorenz Curve

The Lorenz curve is used to provide a graphical representation of inequality within a population, such as a country. It is very widely used for examining income inequality but is equally applicable to any other measurable quantity such as health. The population is stated on a percentage scale, starting from lowest possible health and moving up to highest possible level of health. On the horizontal axis of Figure 13 the population of a country is arranged in health levels hierarchical order. On the vertical axis the different levels of health are portrayed from the very lowest level of health belonging to the sickest population and moving up to higher levels of health represented by the healthiest people in the society. Hence, the horizontal axis presents the cumulative proportions of population with a certain level of health and the vertical axis, the cumulative health.

Figure 13: The Lorenz curve



In an ideal, egalitarian society, the Lorenz curve coincides with the diagonal (45 degree curve 0) and is depicts the absolute level of equality. This implies that, for example, 30% of the population enjoys 30% of this population's total health. However, no society has ever achieved this absolute level of equality. What happens in reality is that the Lorenz curve falls beneath the diagonal line. Hence in Figure 13, the first 30% of the population receives less than 10% of the total health. The greater the inequality, the further the Lorenz curve is from the diagonal.

Gini Coefficient

The Gini Coefficient is named after Gini (1912) who devised an indicator based on the diagrammatic representation of the Lorenz curve. It is a relative measure of the area A in Figure 4.5 and mathematically is expressed as the *area between the Lorenz curve and the diagonal line as a proportion of the total area under the diagonal.* Hence the Gini coefficient is defined as the ratio,

$$G = \frac{A}{(A+B)}$$

This is always expressed as a decimal fraction. At its lower extreme, the value zero denotes the ideal of perfect equality (when the Lorenz curve coincides with the diagonal line). At the upper extreme, the value one denotes absolute inequality (when all the health is possessed by one person). Values between zero and one, e.g. 0.400, represent the general level of measured inequality for a population. Thus, a country with a Gini coefficient of 0.3 appears to have a smaller degree of inequality than one with a Gini coefficient of 0.55. Mathematically the Gini index can be calculated as:

$$G = \frac{\sum_{i=1}^{n}(2i - n - 1)X_i}{n^2\mu}$$

where G is the Gini index, n is the number of observations, X_i is the number of persons with ranked level i of health and μ is the mean population health .

Alternatively G is obtained as the sum of all pairwise differences between the health status X_i and X_j of two individuals:

$$G = \frac{1/n^2 \sum_{i=1}^{n} \sum_{j=1}^{n} |X_i - X_j|}{2\mu}$$

Alternative forms of the Gini coefficient include:

Author	Formula
Dasgupta	$G = \frac{2}{\mu n^2}\sum_{i=1}^{n} i x_i - \frac{n+1}{n}$
Mehran	$G_{Mehran} = \frac{3}{n^3\mu}\sum_{i=1}^{n} i(2n+1-i)(x_i - \mu)$
Bonferroni	$G_{Bonferroni} = \frac{1}{n\mu}\sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{j}(x_i - \mu)$
Piesch	$G_{Piesch} = \frac{3}{2n^3\mu}\sum_{i=1}^{n} i(i-1)(x_i - \mu)$

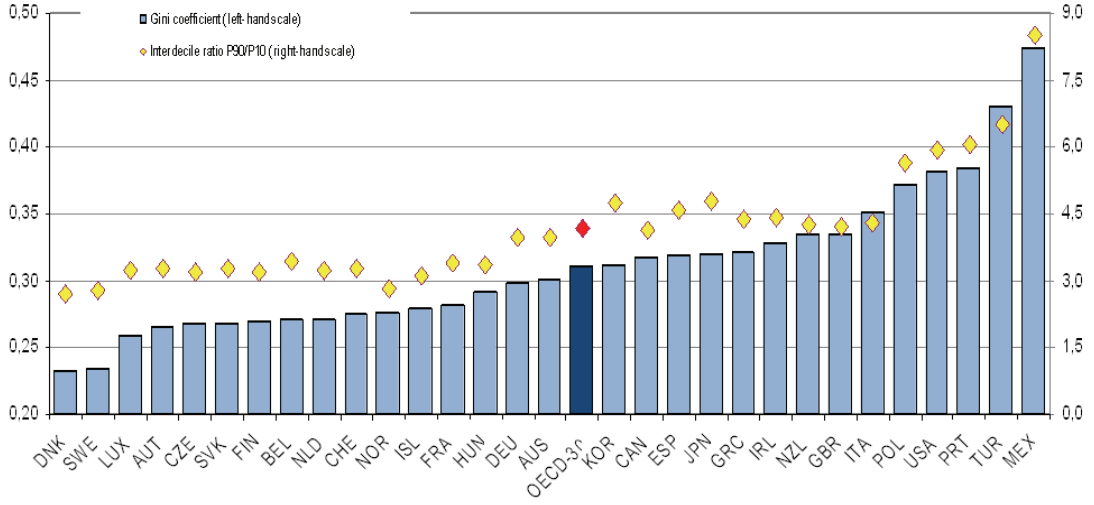
De Vergottim	$G_{Vergottim} = \frac{1}{n\mu}\sum_{i=1}^{n}\sum_{j=1}^{n-1}\left(\frac{1}{n-j}\right)(\mu - X_i)$

The following properties have been claimed for the Gini Index:

1. It provides a measure which satisfies the principles of invariance and transfer
2. It provides a visual impression of degree of income inequality among several socio-economic groups
3. It reflects inequality based on absolute differences among all levels of income

Figure 14 presents income inequality in the mid-2000's measured with Gini and rate ratios (P90/P10). Both measures highlight a high degree of income inequality among OECD countries.

Figure 14: Income inequality varies considerably across OECD countries



Source: OECD 2009

Empirical studies using the Gini coefficient

One of the first attempts to use Gini coefficients to measure health inequalities was undertaken by Le Grand and Rabin. They measured "inequality in age of death" in England and Wales in 1933 and 1983. Later Leclerc et. al. used the same index to make international comparisons among England-Wales, Finland, and France. Table 7 portrays some of the findings from an attempt by Le Grand to investigate trends in inequality over time using mortality indicators to estimate Gini coefficients for men and women over the period 1921 to 1983.

Table 2 Health Inequalities in U.K in Male and Female Standardised Death Ratios

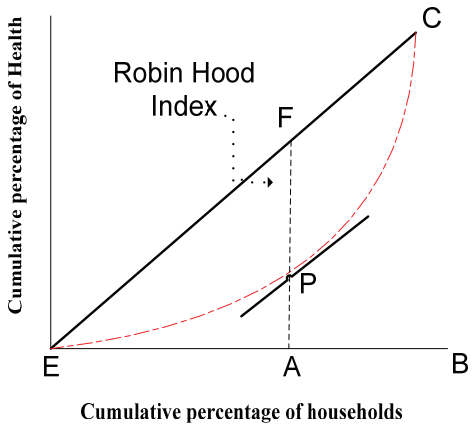
	Males: all ages			Females: all ages		
Year	**Mean**	**Variance**	**Gini**	**Mean**	**Variance**	**Gini**
1921	59.98	712.11	0.237	68.87	624.27	0.185
1931	62.64	638.56	0.212	70.63	552.15	0.167
1941	61.79	628.66	0.216	70.31	562.66	0.170
1951	68.40	393.58	0.147	75.59	351.88	0.122
1961	69.11	354.96	0.137	76.19	323.19	0.116
1971	69.49	331.18	0.132	76.25	314.17	0.115
1981	70.26	306.59	0.127	76.84	285.26	0.110
1983	70.40	296.40	0.125	76.84	280.19	0.109

Source: Le Grant, Julian (1989)

Robin Hood Index

The Robin Hood Index is defined as the maximum vertical distance between the Lorenz curve (EPC in Figure 20) and the diagonal line portraying a perfectly equal distribution. The value of the Robin Hood index indicates how much health has to be taken away from the healthier individuals above the mean and transferred to the less healthy ones below the mean in order to achieve perfect equality in the distribution of health. (This is a notion similar to the index of dissimilarity discussed earlier.) Kennedy *et al*. (1996) are amongst the researchers who have used the Robin Hood index to examine health inequalities.

Figure 15: Illustration of the Robin Hood index



Inequality and Social Welfare

The preceding measures of inequality provide a general impression of existing distributions within a society. However, the notion of distribution also incorporates some ethical values concerning a society's perception of the degree of inequality. While some countries may demand a relatively low degree of inequality, other societies may pursue higher rates of

economic growth at the cost of inequality; therefore, every country has certain political and socio-economic objectives which could be described by the use of a welfare function.

Dalton (1920), following the ideas of Pigou and with income distributions in mind, argued that as some implicit hypotheses are always made concerning the normative aspects of the distribution, it would be better to devise some inequality measures which incorporate several explicit criteria regarding this distribution. If we have a society of *N* households and a given total health H_{tot}, we assume the existence of a welfare function which takes into account all levels of household's health:

$$W = W\{ H_1, H_2, H_3, H_4, ...H_N\} = W[H_{tot}]$$

The empirical problem is the choice of mathematical form for this welfare function. It is usually assumed that the function should satisfy the criteria of a) additivity, b) separability and c) concavity.

Atkinson's index

Atkinson (1970) introduced the concept of welfare economics into inequality literature. He demonstrated the strong relationship between the social welfare function and the Lorenz Curve. He began by assuming an additive social welfare function defined as the sum of n individual utility functions.

$$W = \sum U_i X_i$$

where (Xi) represents the utility of income X for the ith individual.

He further assumed homotheticity, i.e. that all individuals have the same utility function (the same rate of substitution between different goods), and concavity, i.e as income increases the marginal utility diminishes

For these types of Welfare Functions, Atkinson (1970) devised an inequality measure which is sensitive to normative judgements concerning the societal sensitivity to inequality. The major contribution by Atkinson was his proof that, on the basis of the above assumptions an ordering of the Lorenz curves implies a similar ordering of social welfare functions.

The Atkinson Index has been used in the economic literature as a measure of income inequality. Its main advantage is its sensitivity to movements in different levels of income distribution. The mathematical form of the index is the following:

$$A = \begin{cases} 1 - \frac{1}{\mu}\left(\frac{1}{N}\sum_{i=1}^{N} y_i^{1-\varepsilon}\right)^{1/(1-\varepsilon)} & \text{for } \varepsilon \in [0,1) \\ 1 - \frac{1}{\mu}\left(\prod_{i=1}^{N} y_i\right)^{1/N} & \text{for } \varepsilon = 1, \end{cases}$$

The normative aspects of a health distribution can be investigated by imposing different values in the Atkinson coefficient ε which expresses the "social inequality judgements". We may distinguish between two extreme cases:

1) As ε approaches 1 the index becomes more sensitive to changes in the lower part of the health distribution.
2) As ε moves towards 0 it becomes more sensitive to changes in the upper part of health distribution

The advantages of the Atkinson measure can be summarized as:

1. It is a scale invariant measure
2. It satisfies the principle of transfer
3. It can be more or less sensitive to transfers towards the higher/ lower income classes
4. It is a more flexible indicator of inequality in comparison to the other Gini indices.
5. It provides a more theoretically sound approach

Theil coefficient

Theil (1967) developed an index derived from Shannon's measure of information entropy. His measure is more sensitive to changes of income and is also widely used by many researchers. The mathematical formula is based on the degree of relevant available information concerning each level of health and is expressed as:

$$\frac{1}{n\mu}\Sigma \mathrm{X}_i \log\left(\frac{X_i}{\mu}\right)$$

where n = number of classes, μ = overall average health, X_i = average health in each class. Alternative mathematical expressions to Theil's index are defined below:

$$T_1 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{x_i}{\overline{x}} \cdot \ln\frac{x_i}{\overline{x}}\right)$$

$$T_0 = \frac{1}{N}\sum_{i=1}^{N}\left(\ln\frac{\overline{x}}{x_i}\right)$$

where x_i is the health of the *i-th* person, $\overline{x}$ is the average health and *N* is the number of people. If everyone has the same health then the index is 0. If one person has all the health, then the index is ln *N*.

Theil's measure is invariant and satisfies the principle of transfer. In Table 8 we bring together the above health inequality indicators and we present a summary of their mathematical expressions and the range of values

Table 3: Range Values and Mathematical Expression of Selected Inequality Indexes

Inequality Index	RANGE OF VALUES			
	Minimum	Maximum	Discrete Variables	Continuous Variables
Range	**0**	∞	$X_{j\max} - X_{j\min}$	-
Mean Deviation	**0**	$2\left[1-\frac{1}{n}\right]$	$M = \frac{1}{n}\Sigma\left\|\frac{X_i}{\mu - 1}\right\|$	$\int\left\|\frac{X_i}{\mu - 1}\right\|dF$
Variance	**0**	$X[n-1]$	$\frac{1}{n}\Sigma[X_i - \mu]^2$	$\int (X_i - \mu)^2 dF$
Coefficient of Variation	**0**	$\sqrt{(x-1)}$	$\frac{\sqrt{\frac{1}{n}\Sigma (X_i - \mu)^2}}{\mu}$	
Logarithmic Variance	**0**	∞	$\frac{1}{n}\Sigma\left[\log\left(\frac{X_i}{\mu}\right)\right]^2$	$\int\left[\log\left(\frac{X_i}{\mu}\right)\right]^2 dF$
Gini	**0**	**1**	$\frac{1}{n^2\mu}\Sigma_i\Sigma_j\left\|X_i - X_j\right\|$	$(1-2)\int_0^1 \Phi dF$
Theil	**0**	**Log n**	$\frac{1}{n\mu}\Sigma X_i \log\left(\frac{X_i}{\mu}\right)$	$\int\left(\frac{X}{\mu}\right)\log\left(\frac{X}{\mu}\right)dF$
Atkinson	**0**	$(1-n)^{\frac{-n}{1-n}}$	$1-\frac{1}{\mu}\left[\Sigma\frac{1}{n}X_i\right]^{\frac{1}{1-}}$	$1-\frac{1}{\mu\left[\int X^{1-}dF\right]}^{\frac{1}{1-}}$

Source: Own selection of indicators

Kawachi and Kennedy (1997) examined the pairwise relationship between various health inequality indicators. They used data from the USA to estimate the matrix of correlations between the values of the Gini, Robin Hood, Theil, Atkinson (for different values of ε) and other coefficients. Hardly any coefficients were below 0.95 (in absolute value) and many were 0.99. Thus overall the various coefficients were giving similar values. Naturally, this does not mean that their properties are identical.

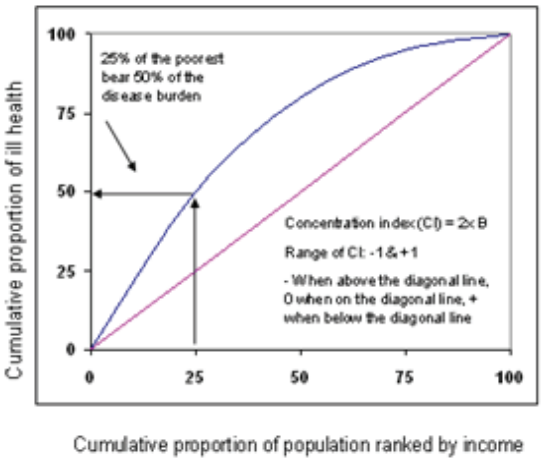
In economics and sociological research, several methods have been developed for measuring inequality. The current literature reveals a wide range of indicators varying from the objective to normative methodologies. The choice of the appropriate technique depends on the objectives of the study as well as on the conditions concerning the fulfilment of the scale invariance and transfer axioms The Gini index, the coefficient of variation and Theil's coefficient seem to satisfy these principles. Although the Gini index is the most popular index used in the majority of these studies, it does not hold any major advantages over the other measures of inequality.

In the economics literature it has been argued that we should not make any income comparisons without adopting certain value judgements. This implies that we should first specify a welfare function and then derive a measure for inequality. Atkinson's index seems to comply with such a philosophy. However, there is little consensus among economists on the mathematical form of the social welfare function.

Concentration Curve and Index

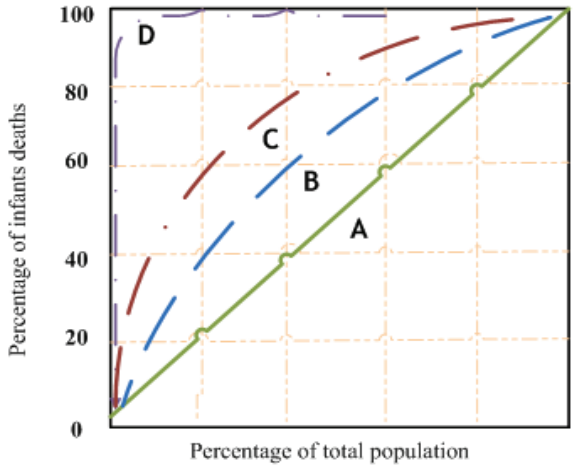
The Concentration curve is plotted in a similar way to the Lorenz curve. However, it brings in the socioeconomic dimension whereas the Lorenz curve is considering only one variable at a time. On the horizontal axis we plot the cumulative proportion of population ranked by their income or other similar indicator, from the poorest to the richest. On the vertical axis we plot the cumulative proportion of ill health starting from the sickest and ending up with the healthiest. In other words the concentration curve presents the shares of the health variable against the shares (quintiles or deciles) of living standards or income. The data could be either at an individual level (e.g. health interview survey) or grouped at a regional or national level. In Figure 21 we present a concentration curve where 25% of the poorest population bears 50% of the burden of disease.

Figure 16: Illustration of a concentration curve



Concentration curves could be used to explore inequalities for the same variable in different countries or the same country over time. In Figure 22 we plot different concentration curves for countries A, B, C and D with different levels of health inequalities.

Figure 17: Comparative concentration curves - A, B, C and D show increasing degrees of inequality



Concentration Index

The similarity in appearance of the concentration curve to the Lorenz curve suggests that a similar method to the Gini coefficient could be used for expressing the shape of the curve as an index. This concentration index has been used widely in the literature as an indicator of income- related health inequalities. It is calculated in a similar way as the Gini Coefficient but its values differs ranging from -1 to +1, because the concentration curve can be either above or below the diagonal line.

Negative values of the Concentration Index arise when the curve is above the diagonal, positive values when it is below the diagonal. Thus if lower levels of health status are concentrated in the lower socioeconomic strata then the concentration curve is above the diagonal and takes negative values.

The mathematical expression of concentration C index is defined as:

a) For group data

$$C = (p_1L_2 - p_2L_1) + (p_2L_3 - p_3L_2) + \ldots + (p_{T-1}L_T - p_TL_{T-1}),$$

Where p is the cumulative percent of the sample ranked by economic status, $L(p)$ is the estimated concentration curve, and T is the number of socioeconomic groups.

b) For micro-survey data

The concentration index (C) for micro data is estimated by making use to "convenient covariance" model:

$$C = \frac{2cov\left(\frac{Y_i}{R_i}\right)}{\mu}$$

where Y_i is a health variable, μ is the mean, R_i is the *i*th individual fractional rank in the socioeconomic distribution, and cov(.,.) is the covariance.

Recent empirical analysis using the concentration index has found significant income-related inequalities in health in a number of European and other developed countries (Kakwani *et al*., 1997; van Doorslaer *et al*., 1997). The UK and the USA were identified as countries with high levels of inequality, with concentration index values of −0.115 and −0.136, respectively, suggesting that income- related inequalities in health affected mainly the poorest members of each country (van Doorslaer *et al*., 1997).

The application of Gini and Concentration indexes in a recent European comparative study is illustrated by the results of Table 9 taken from the SHARE programme.

Table 4: Gini and Concentration indexes in selected countries

Pure health inequality		Education-related inequality in health		Income related inequality in health		Wealth related inequality in health	
Country	**Gini**	**Country**	**C.I.**	**Country**	**C.I.**	**Country**	**C.I.**
Switzerland	0,0703	Switzerland	0,0105	Switzerland	-0,0038	Austria	0,0074
Sweeden	0,0791	Germany	0,0118	Austria	0,0034	Switzerland	0,0124
Netherlands	0,0838	Greece	0,0118	Italy	0,006	Greece	0,0154
Denmark	0,0937	Austria	0,0124	Greece	0,0071	Spain	0,0157
Germany	0,0948	Sweeden	0,013	Spain	0,0075	Sweeden	0,0177
Austria	0,0974	Netherlands	0,0131	Netherlands	0,0117	Italy	0,0214
France	0,0991	Denmark	0,0149	England	0,0121	Germany	0,0236
Greece	0,1034	Spain	0,0184	Denmark	0,0124	Netherlands	0,0245
Italy	0,1037	England	0,0197	Sweeden	0,0133	Denmark	0,0265
United States	0,1105	Italy	0,0212	Germany	0,0142	France	0,0298
Spain	0,1117	France	0,0218	France	0,0181	England	0,0315
England	0,1133	United States	0,0237	United States	0,0347	United States	0,0361

Source: Jürges, H. (2010)

ANNEX VI: Preliminary Evaluation of health Inequality Indicators & Desirable Properties

These material is part of the project's report "Review and Analysis of Existing Measurement Approaches, SANCO2008C404Lot 1_SI2.530184"

Evaluation of Key health Inequality Indicators.

The main goal of Task 1 is to undertake a literature review and to select a set of appropriate indicators that satisfy a number of criteria- axioms (see table related mainly to i) Simplicity, ii) Applicability, iii) Scale Invariance, iv) Principle of Transfer (Pigou –Dalton) from high risk to low risk socioeconomic groups, (or from rich to poor and vice-versa) v) Decomposition into within groups and between groups.

We first surveyed the literature to find inequality measures previously applied in the disciplines:

- Epidemiology with main emphasis in Social Epidemiology
- Economics with main emphasis to Income distribution and Equity
- Sociology with emphasis to Social Statistics, Social Measurement
- Social Policy with emphasis to Social Cohesion, Poverty Social Inequality and deprivation.

A large number of articles was selected and screened through searches in Medline, Econlit, Social Sciences Citation Index, Science Citation Index Medline, Scopus, Embase. The key words used were: Inequality and health, measurement, measurement health inequalities, equity measures, income distribution and poverty measures.

Our main goal was to cover the relevant areas of health inequality measurement and to device a representative sample of indicators. We avoid the idea of providing an exhaustive list of all possible publications with different techniques and approaches used in the different disciplines under investigation. In the inequality literature we found a large number of sources highlighting the philosophical features and the relevant social judgments associated with each indicator. For the purpose of our analysis we specify a number of axioms that are related to the context and the quantitative principles (see Table 5) and we distinguished three major categories to taxonomize the indicators:

- Simple and widely comprehensive
- Regression based
- More advance by taking into account the whole distribution of health and satisfying the greatest possible number of certain axioms.

Examining different indicators from the literature of inequality we reach the conclusion that the following indexes can be further examined in task 3 by using illustrative example from both aggregate and individual based health surveys.

From the group of simple and comprehensive indicators we think that the philosophy of range is useful to capture the magnitude of inequality and we propose the inter-decile and inter-quintile indexes. The inter-quintile share ratio of S80/S20 has been used extensively in the income distribution literature and it has been adopted by the Committee of Laeken Indicators.

From the second group of Regression Based indicators we would like to adopt the decisions taken by several national committees in Britain and elsewhere in the EU states and further experiment using illustrative examples in Task 3 for the Slope Index of Inequality.

From the third group we may clearly conclude that the Atkinson index is the best indicator satisfying the needs of both health and economic inequality assessment. It fulfils the Pigou-Dalton principle of transfer, it is sensitive in various level of the distribution of health and income, and allows subgroup decomposability. In addition the parameter “e” indicates an “inequality averseness” that allows measurement of inequality to be assessed across a range of societal socio-economic strata.

Theil index is similar to Atkinson and could easily satisfy the previous criteria. The functional forms are similar and present high correlation coefficients as have been recorded in the relevant empirical exercises.

Concentration Index also satisfies the above criteria although it is less sensitive in comparison to Atkinson’s index.

Finally Gini index despite its limitation in decomposability, it is a widely used indicator in inequality literature and has been also proposed for the measurement of income distribution by the Committee of Laken Indicators.

Table 5: Axioms–Criteria for Health Inequality Measurement

Inequality Index	Mathematical Expression	Satisfaction of Axioms of Health Inequality Measurement					
		Egalitarian =0	Scale Invariance	Pooling Poulations	Pigou-Dalton Transfer	Sensitivity to transfers	Decomposition
Absolute Gap	$HI_A - HI_B$	Yes	No	No	No	No	No
Relative Gap	HI_A / HI_B	Yes			No	No	No
% change Relative gap	$\{(HI_A - HI_B) / HI_B\} \times 100$	Yes			No	No	No
Range	*{ Max. Yi - Min Yi }*	Yes			No	No	No
Deciles	$Z_i = Y_i + \frac{\delta}{f_i}\left[\frac{N}{10} - \Phi_i\right]$	Yes			No	No	No
Inter-Decile	S80/S20	Yes			No	No	No
Slope Index of Inequality		Yes					No
Relative Index of Inequality		Yes					No
Index of Dissimilarity		Yes					No
Relative Mean Deviation	$\frac{\sum_{i=1} \lvert Xi - \mu \rvert}{\eta\mu}$	Yes					No
Variance of Log	$\frac{1}{n}\sum_{i=1}^{n}\left(\ln y_i - \ln\mu^*\right)^2$	Yes					No
Mean Log Deviation	$\frac{1}{n}\sum_{i=1}^{n}\ln\left(\frac{\mu}{y_i}\right)$	Yes			Yes		Yes
Coefficient of variation		Yes	Yes				Limited
Gini	$\frac{n+1}{n} - \frac{2}{n^2\mu}\sum_{i=1}^{n}(n+1-i)y_i$	Yes			Yes		Limited
Theil's Entropy	$\frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\mu}\ln\left(\frac{y_i}{\mu}\right)$	Yes			Yes		Yes
Atkinson Index	$1 - \frac{1}{\mu}\left[\frac{1}{n}\sum_{i=1}^{n} y_i^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$	Yes			Yes		Yes
Concentration Index	*2 cov(Yi,Ri) / μ*	Yes			Yes		Yes

Source: Own estimates and calculations

ANNEX VII: Health Inequalities Measurement by Social Groups - Core Social Variables

These material is part of the project's report "Supplementary Report, SANCO2008C404Lot 1_SI2.530184".

In this section we elaborate on the issue of Socio-economic Status measurement with respect to mortality and morbidity analysis. We also discuss the main classifications of socio-economic variables that can be applied to the reviewed data sources.

As described in the previous sections and in the Task 1 and 2 reports, EU Member States and international organisations which are tackling health inequalities use a wide variety of measures to describe the situation and to measure progress. The issue of statistical classifications used in health inequalities measurement is a major one and involves the variations in the definitions of social groups as well as the classifications used in other concepts, such as diseases, causes of deaths etc.

The issue of the definition of "social groups" is important on its own. It is more important for our purposes because it is directly related to the combination of health information with socio-economic information. Many studies based on national health surveys have pointed out that there is a relative lack of socio-economic variables in the national morbidity data sources. Mackenbach in 2006[24] concludes that there is incoherence between the national health surveys in the Member States in the available socioeconomic variables which can be used to assess the trends in morbidity between socio-economic groups.

With regard to the variables that can be used to analyse health inequalities among specific social groups, these are mainly *age, gender, education level, occupation, type of employment and income level*. Using such data, we can analyse mortality or morbidity among men and women, levels of education or income, occupation categories, employment types etc. The applicability of measurement approaches using the so-called Socio-Economic Status (SES) indicators on the appropriate data sources is the main condition for the construction of summary measures to monitor social inequalities in health.

European countries have their own national socio-economic classifications which they use to analyse the social patterns associated with a variety of life statuses, such as health, education, deprivation, poverty and so on[25]. The types of indicators chosen for the description of health inequalities may include particular diseases, particular age groupings and different ways of defining social groups (average income, education categories, type of employment etc). It should be noted that there is no single indicator or set of indicators that can describe a person's socioeconomic status in an unambiguous and undisputable way. Different SES indicators generally affect health and mortality measurements in a different way. Furthermore, various country comparisons show that although the direction of the effect of SES indicators may be the same, the strength of the effect of each of the SES indicators on health and mortality measurements differs depending on the context in which a study takes place[26]. In any case, data availability as a whole, is the crucial factor which allows the analysis of

[24] Mackenbach, J.P (2006). "Health Inequalities: Europe in Profile". Report produced in the framework of the EC project "Tackling Health Inequalities: Governing for Health".

[25] Task force Meeting, "European Socio-economic Classification", Doc. Eurostat/F2/EMPL/04/07

[26] Duncan et al., (2002), Optimal indicators of socioeconomic status for health research, American Journal of Public Health, 92:7, 1151—1157

mortality and morbidity within various social groups. The more difficulties are met in the data derived from *administrative sources*. The problems here are complicated and challenging due to the variations in the national registries organisation. For instance, not the same socio-economic information is kept at the individual level in every Member State. The integration of socio-economic and demographic information in administrative sources would result to less field interviewing and thus increased efficiency, but we are far from reaching this target.

In particular with regard to *mortality*, as it was mentioned in the relevant chapter 2 "*The Measurement of Mortality*", measurements are mainly based on administrative sources (death certificates) and the analysis by social groups meets certain limitations due to the lack of harmonisation and the difficulties in the linkage of mortality data with sources of socio-economic information for the deceased. Differences also exist regarding the kind of socioeconomic status (SES) characteristics that are collected by the EU Member States. The evidence so far suggests that data and data sources differ considerably concerning accessibility, completeness, coverage, quality, and adopted record-linkage methods. Furthermore, the practices of NSIs differ with respect to the compilation of mortality statistics by SES, as these often use different definitions and measures, notably for the SES itself.

To present the extent of the situation, in the following table we illustrate the capacity of each Member State to calculate the life expectancy mortality indicator by Socio-economic Status, according to the data quality and availability of a record-linkage methodology.

Table 13: Feasibility of Life expectancy calculation by SES indicator in MS's

Country 27	Calculation of life expectancy by SES	Country 27	Calculation of life expectancy by SES
Austria	SES calculated	Poland	Feasible calculation
Belgium	Not feasible	Romania	Feasible calculation
Bulgaria	Feasible calculation	Slovenia	Feasible calculation
Czech Republic	SES calculated	Spain	Feasible calculation
Denmark	SES calculated	Sweden	Feasible calculation
Estonia	Feasible calculation	United Kingdom	SES calculated
Finland	Feasible calculation	Latvia	Feasible calculation
France	SES calculated	Portugal	Not feasible
Germany	Feasible calculation	Greece	Not feasible
Hungary	SES calculated	Cyprous	Not feasible
Ireland	Feasible calculation	Luxembourg	Not feasible
Italy	SES calculated	Malta	Not feasible
Lithuania	SES calculated	Slovakia	Feasible calculation
Netherlands	SES calculated		

Concerning *morbidity*, which is mainly based on survey data (due to the weakness of administrative sources to support morbidity measurement) information on education, occupation and income is not always available in the EU countries. Furthermore, not all age groups are included in the surveys. Additionally, in most national (therefore non-harmonised) surveys, there is limited time coverage, from one to ten years. As a result, the magnitude of inequalities in morbidity cannot always directly be compared between countries.

In response to this challenges, Eurostat has proceeded to a systematic effort to harmonise social statistics. In particular, in 2001 the Task Force on Core Social Variables adopted the principles of feasibility, simplicity, relevance, ease of implementation and conformance with the existing international standards and concluded that every survey (i.e. LFS, EU-SILC, EHIS, census etc.) must record the following Core Social Variables[27]:

Table 14: Core Social Variables

Demographic information:	Sex Age in completed years Country of birth Country of citizenship at time of data collection Legal marital status De facto marital status (consensual union) Household composition
Geographic information:	Country of residence Region of residence Degree of urbanisation
Socio-economic information:	Self-declared labour status Status in employment Occupation in employment Economic sector in employment Highest level of education completed Net monthly income of the household

The definitions, classifications and the coding for the Core Social Variables are given in the Annex.

Socio-Economic Status Indicators' Measurement and Usage

In the following we present briefly the most common practices used by countries for the measurement of Socio-economic status. Although each of them has advantages and disadvantages, the use of occupation data is the approach followed more often by scholars and practitioners alike, since these data are universally considered as the more efficient for reasons of classifications, in order to reveal the real position of individuals in the social structure.

*Education***:** To measure education, the most common method is to record the years in the formal education system or the highest level of formal education successfully attained. The main challenge when using education as a SES indicator is in the disparities among the EU national educational systems. These pose certain limitations to the comparisons among countries. In addition, formal education ignores the on-the-job training qualifications which can, in many cases, be equivalent to a level of formal education. Another limitation stems from the possible bias in the age group which has not completed any formal educational level at all.

[27] The "Core Social Variables" project has to be implemented in each EU-household Survey as of 2010

The International Standard Classification of Education (ISCED)[28] is a classification scheme developed to serve as an instrument suitable for assembling, compiling and presenting comparable indicators and statistics in relation to educational level, and is used extensively by the EU countries in the study of inequalities in mortality.

Occupational Status: The majority of existing socio-economic classifications approaches use the occupational position as a key point for many kinds of social inequalities analysis. A literature review shows three main occupation-based measures that have been developed to classify individuals:

- SES classification on the basis of the attributed prestige of the stated occupation.
- SES classification based on occupation-related social classes.
- SES classification based on occupation-related educational requirements and remuneration.

The most relevant classification used for *occupation* is the International Standard Classification of Occupations - ISCO-88 which has been adopted in all EU surveys and censuses[29] and are the following:

- upper non-manual,
- lower non-manual,
- skilled manual,
- unskilled manual,
- self employed,
- farmer/entrepreneur.

Among the three measures mentioned above, the second one used the ISCO-88 occupational classification and resulted to the well-known European Socio-economic Classification (ESeC) which takes into account power relationships and the social class position.

Economic Status: The classification used for the economic activities is the Statistical Classification of Economic Activities (NACE Rev.1, from 2005 NACE Rev.1.1). It is based on the 3 digit level for the main job and 2 digit level for other job descriptions. For more details, please view: NACE Rev.1and NACE Rev.1.1[30].

Core Social Variables – Definition and Coding

Demographic Information
Sex: Sex refers to the biological sex of the person according to WHO,

[28] International Standard Classification of Education, ISCED 1997, UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION, May 2006, Re-edition.
[29] http://www.healthindicators.eu/healthindicators/object_document/o5728n29135.html
[30]http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM&StrGroupCode=CLASSIFIC&StrLanguageCode=EN

Classification used: This variable is a standard one in survey and administrative data.

Coding: 1. Men, 2. Women

Age in completed years: Age in completed years

Classification used: none

Coding: The 3 digits of age in completed years

Country of birth: Country where a person was born, namely the country of usual residence of mother at the time of the birth, determined at the time of data collection.

Classification used: Classification of country of birth should be done on the basis of the UN Statistical Division, Standard Country or Area Codes for Statistical Use, ST/ESA/STAT/ SER.M/49/Rev.4/, the classification developed on the basis of ISO 3166. As proposed by the Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing three-digit alphabetical codes should be used.

Coding: 1Native-born

2 Foreign-born

2.1 Born in another EU Member State

2.2 Born in non-EU country

Country of citizenship: Citizenship is defined as the particular legal bond between an individual and his/her State, acquired by birth or naturalisation, whether by declaration, option, marriage or other means according to the national legislation.

Classification used: Classification will be developed on country of citizenship. Information on country of citizenship should be coded, based on classification issued by UN Statistical Division, Standard Country or Area Codes for Statistical Use, ST/ESA/STAT/SER.M/49/Rev.4/., the classification developed on the basis of ISO 3166. As proposed by the Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing three-digit alphabetical codes should be used.

Coding: 1 Nationals

2 Non-nationals

2.1 Nationals of other EU Member States

2.2 Nationals of non EU countries

Legal marital status: Legal marital status is defined as the (legal) conjugal status of each individual in relation to the marriage laws (or customs) of the country (i.e. *de jure* status)

Classification used: Legal marital status is classified as presented below.

Coding: 1 Unmarried (i.e. never married)
2 Married (including registered partnership)
3 Widowed and not remarried (including widowed from registered partnership)
4 Divorced and not remarried (including legally separated and dissolved registered partnership)

Consensual union (De facto marital status): De facto marital status is defined as the marital status of each individual in terms of his or her actual living arrangements within the household. Consensual union is defined as the union between non-married partners.

Classification used: Classification as presented

Coding: 1. Person living in a consensual union, 2 Person not living in a consensual union

Household Composition: This variable refers to the size and composition of the private household and is derived from the information on the relationship between household members, and the economic activity status.

Classification used: Classification used: Classified as presented below. ombination of size and type of household in case of categories 2.2., 2.3. and 2.4

Coding:

#1 Household size (see the variable "age in completed year" for the definition of age)

1. Number of persons aged less than or equal to 4
2. Number of persons aged from 5 to 13*
3. Number of persons aged from 14 to 15*
4. Number of persons aged from 16 to 24 of which, number of students
5. Number of persons aged from 25 to 64
6. Number of persons aged more than or equal to 65

#2 Transmission codes for household type

1. One-person households
2. 2. Multi-person households

2.1. Lone parent with child(ren) aged less than 25
2.2. Couple without child(ren) aged less than 25
2.3. Couple with child(ren) aged less than 25
2.4. Couple or lone parent with child(ren) aged less than 25 and other persons living in household*
2.5 Other type of household**

* Category "other persons" includes all persons in household who are not children of that couple or lone parent or partner in that couple.
** Category "Other type of household" includes all other households without parent-child relationship.

#3 Economic activity (see the variable “self-declared labour status” for the definition of economic activity)

1. Number of persons aged 16-64 in household who are at work
2. Number of persons aged 16-64 in household who are unemployed or are economically inactive

Geographic information:

Country of residence: The respondent’s country of usual residence.

Classification used: NUTS Nomenclature of territorial units for statistics, at the most aggregate level (level 0 or country level).

Coding: NUTS Nomenclature of territorial units for statistics, at the most aggregate level (level 0 or country level).

Region of residence: This variable indicates the region where the individual/household is living (place of usual residence). The level of detail may need to be different from on survey to another (see below).

Classification used: NUTS Nomenclature of territorial units for statistics, at 2-digit level.

Coding: NUTS Nomenclature of territorial units for statistics, at 2-digit level.

Degree of Urbanisation: The type of locality the individual/household is living in, namely whether an urban or a rural area (or a borderline case).

Classification used: Classification developed by Eurostat

Coding: 1. Densely-populated area
2 Intermediate area
3 Thinly-populated area

Socio-economic information:

Self-declared labour status: Normal or current ‘main’ labour status as perceived by the respondent

Classification used: not applicable

Coding:

10 Carries out a job or profession, including unpaid work for a family business or holding, including an apprenticeship or paid traineeship, etc.

11 Fulltime

12 Part-time

20 Unemployed

31 Pupil, student, further training, unpaid work experience

32 In retirement or early retirement or has given up business

33 Permanently disabled

34 In compulsory military or community service

35 Fulfilling domestic tasks

36 Other inactive person

Status in employment: Professional status of employed persons

Classification used: based on the ILO resolution concerning the International Classification of Status in Employment (15th ICLS, 1993).

Coding: 10 Self-employed

20 Employee
21 with a permanent job or work contract of unlimited duration
22 with temporary job/work contract of limited duration

Occupation in employment - 36 positions according to ISCO 88 (COM)

Classification used: ISCO-COM (88). The ISCO-88 (COM) is the standard occupational classification used at the EU level; It is based on ISCO-88: International Standard Classification of Occupations' published by ILO (Geneva 1990). The classification is available as an internal Eurostat Working Document; See 'ISCO-88 (COM) Definitions and Structure'.

Coding:

10 to 13 Legislators, senior officials and managers (4 positions)

20 to 24 Professionals (5 positions)

30 to 34 Technicians and associate professionals (5 positions)

40 to 42 Clerks (3 positions)

50 to 52 Service workers and shop and market sales workers (3 positions)

60 to 61 Skilled agricultural and fishery workers (2 positions)

70 to 74 Craft and related trades workers (5 positions)

80 to 83 Plant and machine operators and assemblers (4 positions)

90 to 93 Elementary occupations (4 positions)

00 Armed forces (1 position)

Economic sector in employment: Economic activity of the local unit where the respondent is employed (incl. self-employed).

Classification used: NACE Rev.2

1.	Agriculture, hunting and forestry; fishing and operation of fish hatcheries and fish farms	A +B
2.	Industry, including energy	C + D + E

3.	Construction	F
4.	Wholesale and retail trade, repair of motor vehicles and household goods, hotels and restaurants; transport and communications	G + H + I
5.	Financial, real-estate, renting and business activities	J + K
6.	Other service activities	L + M + N + O + P

Coding:

Highest level of education attained: This variable provides information about educational level successfully completed by a person.

Classification used: ISCED-97

Coding:

0 No formal education or below ISCED1
1 ISCED 1 - primary education
2 ISCED 2 - lower secondary education
3 ISCED 3 - upper secondary education
4 ISCED 4 - post secondary education but not tertiary
5 ISCED 5 - tertiary education , first stage
6 ISCED 6 - tertiary education, second stage

Net monthly income in employment:

Coding: Net monthly income of the household (value in national currency) and Transmission codes #2 – UNEQUIVALISED household total net monthly income

ANNEX VIII: EU Survey Tools & Questions

SURVEY instrument	Period of analysis/ Survey waves	Questions analyzed/Variables	Categories/Responses	SES variables
EU SILC	**2004 to 2008:** 1st wave 2004 - EU 15 2nd wave 2005 - EU 25 3rd wave 2006 - EU 25 4th wave 2007 - EU 27 5th wave 2008 - EU 27	**1.** Self-perceived health (SPH): "How is your health in general?" **2.** Chronic illness: "Do you suffer from long-standing (chronic) illness or condition (health problem)?"	**1.** 5 categories: Very good, good, fair, bad, and very bad. **2.** 3 categories: Yes, strongly limited, yes, limited, and not limited	- Poor (yes, no), - Income (lowest vs highest quintile), - Ability to "make ends meet" (easily, difficult), - Educational level (ISCED coding: tertiary vs non-tertiary education), - Activity status (yes, no).
ESS	**2002 to 2008:** 1st wave 2002 2nd wave 2004 3rd wave 2006 4th wave 2008	**3.** Self-perceived health (SPH): Question C15 "How is your health in general?" **4.** Limitations in activities (AL): Question C16 "Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?"	**3.** 5 categories: Very good, good, fair, bad, and very bad. **4.** 3 categories: Yes a lot, Yes to some extent, No	- Income level (lowest versus highest deciles), - Ability to "make ends meet" (easily, difficult), - Educational level (ISCED coding: tertiary vs non-tertiary), - Activity status (yes, no).
SHARE	**2004-2007:** 1st wave 2004/5 2nd wave 2006/7	**5.** Self-perceived health (SPH): "How is your health in general?" **6.** Limitations with activities (GALI) **7.** Number of limitations with activities of daily living: It describes the number of limitations with activities of daily living (ADL). Six activities are included. **8.** Number of chronic diseases **9.** Number of limitations with instrumental activities of daily living: It describes the number of limitations with instrumental activities of daily living reported by each individual. Seven activities are included. **10.** Depression scale EURO-D **11.** Number of symptoms: This variable presents the number of symptoms	**5.** 5 categories: Very good, good, fair, bad, and very bad. **6.** 3 categories: severely limited, limited, but not severely & not limited.	- Poor (yes, no), - Income level (lowest versus highest quintile), - Wealth (lowest versus highest quintile), - Ability to "make ends meet" (easily, difficult), - Employment status, Activity status.

		reported by each individual. **12.** Other questions on Conditions and Symptoms		

Table A 29: Survey tools used for measuring health inequalities & their basic characteristics

1) Survey on Income and Living Conditions (EU-SILC) 2007, Health section:

Hlth_stus (Health status): How is your health in general?

1. Very good
2. Good
3. Fair
4. Bad
5. Very bad

Chron_ill (Chronic illness): Do you suffer from long-standing (chronic) illness or condition (health problem)?

1. Yes
2. No

Lim_Act (Limited activity): For at least the last 6 months have you been limited in activities people usually do, because of a health problem?

1. Yes, strongly limited
2. Yes, limited
3. Not limited

Chron_ill2 (Type of chronic condition): Which of the following long-standing conditions do you suffer from?

1. Blindness, or a severe vision impairment
2. Deafness, or a severe hearing impairment
3. A condition that substantially limits one or more basic physical activities such as walking, climbing stairs, reaching, lifting or carrying
4. A learning or intellectual disability
5. A psychological or emotional condition
6. Other, including any chronic illness

Chron_ill3 (Difficulty doing following activities due to chronic illness): Do you have any difficulty in doing any of the following activities?

1. Learning, remembering or concentrating
2. Dressing, bathing or getting around inside the home
3. Going outside the home alone to shop or visit a doctor's surgery
4. Working at a job or business or attending school or college
5. Participating in other activities, for example leisure or using transport
6. None of the above

Med_CnsIt (Medical consultation): Was there any time during the last 12 months when you personally, really needed a medical examination or treatment for a health problem but you did not receive it?

1. Yes
2. No

No_m_CnsIt (Reason for not consulting a doctor): What was the main reason for not consulting a medical specialist?

1. Could not afford to (too expensive)
2. Waiting list
3. Could not take time off work (or could not take time off from caring for children or others)
4. Too far to travel or no means of transport
5. Fear of doctor/hospitals/examination/treatment
6. Wanted to wait and see if problem got better on its own
7. Didn't know any good doctor or specialist
8. Other reason

Dent_CnsIt (Dental consultation): Was there any time during the last 12 months when you personally, really needed a dental examination or treatment but you did not receive it?

1. Yes
2. No

No_d_CnsIt (Reason for not consulting a dentist): What was the main reason for not consulting a dentist?

1. Could not afford to (too expensive)
2. Waiting list
3. Could not take time off work (or could not take time off from caring for children or others)
4. Too far to travel or no means of transport
5. Fear of dentist/examination/treatment
6. Wanted to wait and see if problem got better on it's own
7. Didn't know any good dentist
8. Other reason

"Accessibility to primary health care services"

1. With great difficulty
2. With some difficulty
3. Easily
4. Very easily).

2) Labour Force Survey (EU-LFS) 2002 ad-hoc module on employment of disabled people :

EXLHPBDI: Existence of a longstanding health problem or disability

1. Yes

2. No

9. Not applicable (persons aged less than 16 or more than 64)

Blank. No answer

TYPHPBDI: Type of health problem or disability (code main type)

01. Problems with arms or hands (which includes arthritis or rheumatism)

02. Problems with legs or feet (which includes arthritis or rheumatism)

03. Problems with back or neck (which includes arthritis or rheumatism)

04. Difficulty in seeing (with glasses or contact lenses if worn)

05. Difficulties in hearing (with hearing aids or grommets, if used)

06. Speech impediment

07. Skin conditions, including severe disfigurement, allergies

08. Chest or breathing problems, includes asthma and bronchitis

09. Heart, blood pressure or circulation problems

10. Stomach, liver, kidney or digestive problems

11. Diabetes

12. Epilepsy (include fits)

13. Mental, nervous or emotional problems

14. Other progressive illnesses (which include cancers NOS, MS, HIV, Parkinson's disease)

15. Other longstanding health problems

99. Not applicable

Blank. No answer

TIMHPBDI: Time since onset of health problem or disability

1. Less than 6 months

2. At least 6 months but less than 1 year

3. At least 1 year but less than 2 years

4. At least 2 years but less than 3 years

5. At least 3 years but less than 5 years

6. At least 5 years but less than 10 years

7. 10 years or more

8. Don't know

9. Not applicable

Blank. No answer

CAUHPBDI: Cause of health problem or disability

1. Born with it or birth injury

2. Work-related accident or injury including traffic accidents at Work

3. Traffic accident or injury (non-work-related)

4. Household, leisure and sports accident or injury (non-workrelated)

5. Work-related diseases

6. Non-work-related diseases

7. Don't know

9. Not applicable

Blank. No answer

HPBRKIWK: Whether health problem restricts kind of work that can be done

1. Yes, considerably

2. Yes, to some extent

3. No

4. Don’t know

9. Not applicable

Blank. No answer

HPBRAMWK: Whether health problem restricts amount of work that can be done

1. Yes, considerably

2. Yes, to some extent

3. No

4. Don’t know

9. Not applicable

Blank. No answer

HPBRMOBI: Whether health problem restricts mobility to and from work that can be done

1. Yes, considerably

2. Yes, to some extent

3. No

4. Don’t know

9. Not applicable

Blank. No answer

3) Survey of Health, Ageing and Retirement in Europe (SHARE) 2004/05, 2006/07, physical health module:

PH002_HealthGen1 (PH002_) HEALTH IN GENERAL QUESTION 1

Would you say your health is ...

1. Very good

2. Good

3. Fair

4. Bad

5. Very bad

PH003_HealthGen2 (PH003_) HEALTH IN GENERAL QUESTION 2

Would you say your health is ....

1. Excellent

2. Very good

3. Good

4. Fair

5. Poor

PH004_LStIll (PH004_) LONG-TERM ILLNESS

Some people suffer from chronic or long-term health problems. By long-term we ean it has troubled you over a period of time or is likely to affect you over a period of time. Do you have any long-term health problems, illness, disability or infirmity?

1. Yes

5. No

PH005_LimAct (PH005_) LIMITED ACTIVITIES

For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do?

1. Severely limited

2. Limited, but not severely

3. Not limited

PH006_DocCond (PH006_) DOCTOR TOLD YOU HAD CONDITIONS

Please look at card 6. Has a doctor ever told you that you had any of the conditions on this card? Please tell me the number or numbers of the conditions.

1. A heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure

2. High blood pressure or hypertension

3. High blood cholesterol

4. A stroke or cerebral vascular disease

5. Diabetes or high blood sugar

6. Chronic lung disease such as chronic bronchitis or emphysema

7. Asthma

8. Arthritis, including osteoarthritis, or rheumatism

9. Osteoporosis

10. Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers

11. Stomach or duodenal ulcer, peptic ulcer

12. Parkinson disease

13. Cataracts

14. Hip fracture or femoral fracture

96. None

97. Other conditions, not yet mentioned

PH007_OthCond (PH007_) OTHER CONDITIONS

What other conditions have you had?

PH008_OrgCan (PH008_) CANCER IN WHICH ORGANS

In which organ or part of the body have you or have you had cancer?

1. Brain
2. Oral cavity
3. Larynx
4. Other pharynx
5. Thyroid
6. Lung
7. Breast
8. Oesophagus
9. Stomach
10. Liver
11. Pancreas
12. Kidney
13. Prostate
14. Testicle
15. Ovary
16. Cervix
17. Endometrium
18. Colon or rectum
19. Bladder
20. Skin
21. Non-Hodgkin lymphoma
22. Leukemia
97. Other organ

PH010_Symptoms (PH010_) BOTHERED BY SYMPTOMS

Please look at card 7. For the past six months at least, have you been bothered by any of the health conditions on this card? Please tell me the number or numbers.

1. Pain in your back, knees, hips or any other joint
2. Heart trouble or angina, chest pain during exercise
3. Breathlessness, difficulty breathing
4. Persistent cough
5. Swollen legs
6. Sleeping problems
7. Falling down
8. Fear of falling down
9. Dizziness, faints or blackouts
10. Stomach or intestine problems, including constipation, air, diarrhoea
11. Incontinence or involuntary loss of urine
96. None
97. Other symptoms, not yet mentioned

PH011_CurrentDrugs (PH011_) CURRENT DRUGS AT LEAST ONCE A WEEK

Our next question is about the medication you may be taking. Please look at card 8. Do you currently take drugs at least once a week for problems mentioned on this card?

1. Drugs for high blood cholesterol
2. Drugs for high blood pressure
3. Drugs for coronary or cerebrovascular diseases
4. Drugs for other heart diseases
5. Drugs for asthma
6. Drugs for diabetes
7. Drugs for joint pain or for joint inflammation
8. Drugs for other pain (e.g. headache, backpain, etc.)
9. Drugs for sleep problems

10. Drugs for anxiety or depression

11. Drugs for osteoporosis, hormonal

12. Drugs for osteoporosis, other than hormonal

13. Drugs for stomach burns

14. Drugs for chronic bronchitis

96. None

97. Other drugs, not yet mentioned

PH012_Weight (PH012_) WEIGHT OF RESPONDENT

Approximately how much do you weigh?

PH013_HowTall (PH013_) HOW TALL ARE YOU?

How tall are you?

PH041_UseGlasses (PH041_) USE GLASSES

Do you usually wear glasses or contact lenses?

1. Yes

5. No

PH042_EyeSight (PH042_) EYESIGHT

Is your eyesight [using glasses or contact lenses as usual/{empty}]...

1. Excellent

2. Very good

3. Good

4. Fair

5. Poor

6. SPONTANEOUS registered or legally blind

PH043_EyeSightDist (PH043_) EYESIGHT DISTANCE

How good is your eyesight for seeing things at a distance, like recognising a friend across the street using glasses or contact lenses as usual? Would you say it is ...

1. Excellent

2. Very good

3. Good

4. Fair

5. Poor

PH044_EyeSightPap (PH044_) EYESIGHT READING

How good is your eyesight for seeing things up close, like reading ordinary newspaper print using glasses or contact lenses as ? Would you say it is ...

1. Excellent

2. Very good

3. Good

4. Fair

5. Poor

PH045_UseHearingAid (PH045_) USE HEARING AID

Are you usually wearing a hearing aid?

1. Yes

5. No

PH046_Hearing (PH046_) HEARING

Is your hearing [using a hearing aid as usual]...

1. Excellent

2. Very good

3. Good

4. Fair

5. Poor

PH047_HrBackNoise (PH047_) HEARING WITH BACKGROUND NOISE

Do you find it difficult to follow a conversation if there is background noise, such as a TV, a radio or children playing [using a hearing aid as usual]?

1. Yes

5. No

PH055_HrSevPeople (PH055_) HEARING WITH SEVERAL PEOPLE

Can you hear clearly what is said in a conversation with several people [using a hearing aid as usual]?

1. Yes

5. No

PH056_HrOnePers (PH056_) HEARING WITH ONE PERSON

Can you hear clearly what is said in a conversation with one person [using a hearing aid as usual]?

1. Yes

5. No

PH024_UseDent (PH024_) USE DENTURES

Do you use dentures?

1. Yes

5. No

PH025_BiteHrdFoods (PH025_) BITE ON HARD FOODS

[Using your dentures,/{empty}] [can you/Can you] bite and chew on hard foods such as a firm apple without difficulty?

1. Yes

5. No

PH048_HeADLa (PH048_) HEALTH AND ACTIVITIES

Please look at card 9.We need to understand difficulties people may have with various activities because of a health or physical problem. Please tell me whether you have any difficulty doing each of the everyday activities on card 9. Exclude any difficulties that you expect to last less than three months.(Because of a health problem, do you have difficulty doing any of the activities on this card?)

1. Walking 100 metres
2. Sitting for about two hours
3. Getting up from a chair after sitting for long periods
4. Climbing several flights of stairs without resting
5. Climbing one flight of stairs without resting
6. Stooping, kneeling, or crouching
7. Reaching or extending your arms above shoulder level
8. Pulling or pushing large objects like a living room chair
9. Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries
10. Picking up a small coin from a table
96. None of these

PH049_HeADLb (PH049_) MORE HEALTH AND ACTIVITIES

Please look at card 10.Here are a few more everyday activities. Please tell me if you have any difficulty with these because of a physical, mental, emotional or memory problem. Again exclude any difficulties you expect to last less than three months.(Because of a health or memory problem, do you have difficulty doing any of the activities on card 10?)

1. Dressing, including putting on shoes and socks
2. Walking across a room
3. Bathing or showering
4. Eating, such as cutting up your food
5. Getting in or out of bed
6. Using the toilet, including getting up or down
7. Using a map to figure out how to get around in a strange place
8. Preparing a hot meal
9. Shopping for groceries
10. Making telephone calls
11. Taking medications
12. Doing work around the house or garden
13. Managing money, such as paying bills and keeping track of expenses
96. None of these

4) Survey of Health, Ageing and Retirement in Europe (SHARE) 2004/05, 2006/07, mental health module

MH001_Intro (MH001_) INTRO MENTAL HEALTH

Earlier we talked about your physical health. Another measure of health is your emotional health or well being -- that is, how you feel about things that happen around you.

MH002_Depression (MH002_) DEPRESSION

In the last month, have you been sad or depressed?

1. Yes
5. No

MH003_Hopes (MH003_) HOPES FOR THE FUTURE

What are your hopes for the future?

1. Any hopes mentioned

2. No hopes mentioned

MH004_WishDeath (MH004_) FELT WOULD RATHER BE DEAD

In the last month, have you felt that you would rather be dead?

1. Any mention of suicidal feelings or wishing to be dead

2. No such feelings

MH005_Guilt (MH005_) FEELS GUILTY

Do you tend to blame yourself or feel guilty about anything?

1. Obvious excessive guilt or self-blame

2. No such feelings

3. Mentions guilt or self-blame, but it is unclear if these constitute obvious or excessive guilt or self-blame

MH007_Sleep (MH007_) TROUBLE SLEEPING

Have you had trouble sleeping recently?

1. Trouble with sleep or recent change in pattern

2. No trouble sleeping

MH008_Interest (MH008_) LESS OR SAME INTEREST IN THINGS

In the last month, what is your interest in things?

1. Less interest than usual mentioned

2. No mention of loss of interest

3. Non-specific or uncodeable response

MH009_KeepUpInt (MH009_) KEEPS UP INTEREST

So, do you keep up your interests?

1. Yes

5. No

MH010_Irritability (MH010_) IRRITABILITY

Have you been irritable recently?

1. Yes

5. No

MH011_Appetite (MH011_) APPETITE

What has your appetite been like?

1. Diminution in desire for food

2. No diminution in desire for food

3. Non-specific or uncodeable response

MH012_EatMoreLess (MH012_) EATING MORE OR LESS

So, have you been eating more or less than usual?

1. Less

2. More

3. Neither more nor less

MH013_Fatigue (MH013_) FATIGUE

In the last month, have you had too little energy to do the things you wanted to do?

1. Yes

5. No

MH014_ConcEnter (MH014_) CONCENTRATION ON ENTERTAINMENT

How is your concentration? For example, can you concentrate on a television programme, film or radio programme?

1. Difficulty in concentrating on entertainment

2. No such difficulty mentioned

MH015_ConcRead (MH015_) CONCENTRATION ON READING

Can you concentrate on something you read?

1. Difficulty in concentrating on reading

2. No such difficulty mentioned

MH016_Enjoyment (MH016_) ENJOYMENT

What have you enjoyed doing recently?

1. Fails to mention any enjoyable activity

2. Mentions ANY enjoyment from activity

MH017_Tear (MH017_) TEARFULNESS

In the last month, have you cried at all?

1. Yes

5. No

MH018_DepressionEver (MH018_) DEPRESSION EVER

Has there been a time or times in your life when you suffered from symptoms of depression which lasted at least two weeks?

1. Yes

5. No

MH020_EverTreated (MH020_) EVER TREATED BY DOCTOR OR PSYCHIATRIST

Were you ever treated for depression by a family doctor or a psychiatrist?

1. Yes

|5. No

MH021_EverAddHos (MH021_) EVER ADMITTED TO HOSPITAL OR PSYCHIATRIC WARD

Were you ever admitted to a mental hospital or psychiatric ward?

1. Yes

5. No

List Of Abbreviations

EU-SILC	European Union Survey on Income and Living Conditions
ECHP	European Community Health Panel
EU-LFS	European Union Labor Force Survey
ESS	European Social Survey
SHARE	Survey on Health, Ageing and Retirement
MEHM	Minimum European Health Module
EHES	European Health Examination Survey
EHSS	European Health Surveys System
EHIS	European Health Interview Survey
ESHSI	European Survey on Health and Social Integration
ISCO	International Standard Classification of Occupations
ICD	International Classifications of Diseases
ISCED	International Standard Classification of Education
OECD	Organization of Economic Cooperation and Development
WHO	World Health Organization
GDP	Gross Domestic Product
EHEMU	European Health Expectancy Monitoring Unit
HFA-db	Health For All database
EU-MDB	European Mortality Database
EU-DMDB	European Detailed Mortality Database
UNECE	United Nations Economic Commission for Europe
EUPhix	European Public Health Information System
ECHI	European Community Health Indicators
HIS	Health Interview Survey
HES	Health Examination Survey
SWOT	Strengths, Weaknesses, Opportunities, Threats
SES	Socioeconomic Status
SPH	Self Perceived Health
AL or al	Activity Limitations
ADL or adl	Limitations with activities of daily living
IADL or iadl	Limitations with instrumental activities of daily living
SDR	Standardized Death Rate
LE	Life Expectancy
IMR	Infant Mortality Rate
CoD	Cause of Death
HLYs	Healthy Life Years

ORs	Odds Ratios
SII	Slope Index of Inequality
RII	Relative Index of Inequality
LE gap	Life Expectancy Gap
CV	The Coefficient of Variation
CI	Concentration Index