**Income-Related Health Inequalities in France**

**between 1998 and 2002:**

**Comparing Trends with Alternative Health Indicators**

by

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**Abstract :**

The objective of this paper is to characterize the evolution of income-related health inequalities (IRHI) in France between 1998 and 2002, computing concentration indexes and decomposing them in explanatory factors. Two complementary approaches are offered here. The first follows other European IRHI analyses, where self-assessed health is re-scaled and made continuous, using the 1994 Canadian HUI distribution. The second uses an indicator which has been constructed specifically for this study and which is based on additional health data from the same source as the SAH measure. This global health indicator (GHI) uses, beyond SAH, a set of semi-continuous variables measuring the number of diseases at individual level together with the minimal vital risk and the disability that they generate. Changes induced in income-related health inequalities over time will be analysed using both indicators. The data comes from the 1998 and 2002 IRDES Health and Health Insurance Survey (HHIS) and is representative of French households (about 20,000 individuals in 7,338 households). The decomposition method proposed by Wagstaff *et al.* (2001) is first used to measure the respective contribution of each IRHI explanatory factor on French data. The main contribution of this paper, however, is a sensitivity analysis performed by comparing the results under two alternative health indicators. The 2002 results show that, irrespective of the health indicator used, health is unequally distributed. Yet the contribution of each IRHI determinant varies with the indicator. This is particularly marked for activity status and CMU-benefit. As for the evolution between 1998 and 2002, irrespective of the year or of the health indicator used, health is unequally distributed, favouring the richest individuals, with a stability of the gradient over time. This analysis leads to the conclusion that the use of that or that other health indicator is of consequence on the underlying income-related health inequality. Furthermore, this analysis concludes that income is by far the most important factor explaining changes in IRHI, but the nature of its contribution also differs according to the health indicator used. For the HUI-scaled indicator, it is related to its own distribution within the population and not to the strong relationship that exists between health and income, whereas the opposite result holds with the second indicator. In the same way, the contribution of factors (other than income) to the changes in IHRI varies according to the health indicator used.

**Keywords:** Self-assessed health – Diseases' severity index – Inequality – Concentration index Decomposition

# 1. Introduction

The French health care system is based on the principle of horizontal equity, according to which individuals with equal need should have identical access to care regardless of their socio-economic status. But lower socioeconomic groups are known to have higher rates of morbidity and mortality than higher socioeconomic groups. Moreover, health inequalities between groups seem to increase over time. For instance, in France, while over the period 1976-1984, the mortality of blue collar men aged 35-80 was 1.8 higher than that of their white collar counterparts, the ratio increased to 1.9 between 1983 and 1991, to reach 2.1 between 1991 and 1999 (Monteil & Robert-Bobée 2005).

A series of changes in the French health care system over the last ten years has given rise to a new concern for health inequality. Although the great majority -98% of the French population- is covered by insurance, individuals out of the labour market (unemployed with no benefits, homeless…) were excluded from medical insurance cover until 2000. Furthermore, the compulsory national health insurance fund only covers between 70% and 80% of total health care cost. The remaining part is covered by a supplementary medical health insurance taken out voluntarily by individuals or in most cases by their employers. Thus, 10% of the French population, most prominently the poorest-off, was still uncovered by a supplementary health insurance in 2000. Consequently, one of the most striking policy changes in that year has been the extension by Law of free access to medical care to a larger number of individuals with low income, through a universal healthcare coverage, called the *'Couverture Maladie Universelle' (CMU).* Besides granting access to compulsory medical insurance, this reform provides the poorest 4.5 million individuals with a free supplementary health insurance and exempts them from out-of-pocket payments and *'Avance de frais'*[1] for their health care consumption (Boisguérin, 2005). Prior to the implementation of CMU, a limited cover was granted to the poorest and sickest-off through AMG (*Aide Médicale Gratuite*) but it varied substantially across French *départements*. Its extent was, however, fairly limited, mainly exempting individuals from having to pay the *ticket modérateur*[2] while offering no cover for balance-billing by providers or for optical or dental care.

This reform has reduced differences in health care consumption. For an equivalent state of health, CMU beneficiaries' use of healthcare is comparable in level to the population with a supplementary health insurance, even though some differences remain in the actual mix of care (Raynaud, 2003 ; Grignon & Perronnin, 2003). However, the efficacy of this program in reducing social inequalities in health has not yet been fully assessed. The only outcome measure is that by the end of 2000, CMU beneficiaries declared more frequently than non-beneficiaries that their health status had improved during that year (Raynaud, 2003).

By concentrating on the period before and after CMU implementation (1998-2002), one of the objectives of this paper is to analyse the evolution in income-related health inequalities (IRHI) in

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[1] In France, doctors' consultations and drugs must be paid in full (with exceptions) at the time of use and reclaimed afterwards (the so-called *'Avance de frais'*)

[2] The *ticket modérateur* is the copayment, after refunding by the French National Health Insurance fund. It is a minimum participation of the person insured to his/her health expenses. It can however, be partly or fully refunded by a supplementary individual health insurance. See Rochaix L. and Hartmann L. for a presentation of recent changes in the French health care system.

France over that period, computing concentration indexes and decomposing them in explanatory factors. Although assessing the impact of this reform on health inequalities would require a longer time horizon than just two years, the present analysis also provides a useful step in the evaluation of this reform, inasmuch as CMU benefits in 2002 are likely to be important determinants of changes in income-related health inequality.

Considering that the level of income-related health inequality evidenced in empirical studies may depend on the health indicator used (Couffinhal *et al.*, 2004), the second contribution of this paper is to carry out a sensitivity analysis, by comparing results from two alternative health indicators. The first is the widespread cardinalised self-assessed health (SAH). The second uses an indicator which has been constructed specifically for this study and which is based on additional health data from the same source as the SAH measure. This global health indicator (GHI) uses, beyond SAH, a set of semi-continuous variables measuring the number of diseases at individual level together with the minimal vital risk and the disability that they generate.

The first section focuses on methodology, and presents the two alternative IRHI indicators. The second presents the data and variables definition. The empirical results are analysed in the third section. Differences in IRHI in 2002 according to the health indicator used are first analysed before turning to changes in IRHI between 1998 and 2002 and comparing trends with alternative health indicators. The last section concludes with a discussion of these results.

## 2. Methods

### 2.1. Measuring health

Most of the recent international health inequality studies rely on the notion of self-assessed health (SAH) or indicators constructed on SAH information as a measure of health (Van Doorslaer & Koolman, 2005). This widespread use of SAH can be partly attributed to the ease with which such information can be collected. The two health indicators that will be used in the following analysis are also derived from SAH information.

In the IRDES 1998 and 2002 HHIS, self-assessed health is collected using the following question: ”Could you grade your health status from 0 to 10? (with 0 being the lowest health status)”. This analogical scale is slightly different from the more widespread SAH question promoted by the European Office of WHO, which consists in categories ranging from “very good” to “very poor”[3]. The SAH distribution in the HHIS surveys is highly skewed as a great majority report a level of health higher than 7. The skewness is also manifest in the inter-category distances, much smaller between levels 7 to 10 than between 0 and 6. This health measure variable being ordinal and categorical, it must be changed into one of two polar cases to measure inequalities adequately: either a dichotomous or a cardinal variable. A continuous health indicator is generally preferred to a dichotomous one, in order to avoid both information losses and cut-off point dependency (Van Doorslaer & Jones, 2003). The method used to cardinalise SAH consists in assuming that the

[3] In the IRDES 2002 HHSI, this 5-point scale is included for one half of the sample, along with the original 10-point scale. A comparison of the two scales has been performed and shows that a score between 8 and 10 appears to be equivalent to categories ”good” and ”very good” grouped together ( Jusot et al., 2005a).

categorical ordinal variable reflects a continuous latent variable, which describes the population's health status, and then choosing either an arbitrary or a known health distribution on which to scale the different categories of the variable.

#### 2.1.1. Cardinalisation of SAH with an arbitrary distribution

In the literature two arbitrary distributions for the latent health variable are used: the lognormal distribution (Wagstaff & Van Doorslaer, 1994) and the normal one consisting in an ordered Probit regression (Cutler & Richardson, 1997). The former is often encountered in the income-related health inequalities literature and relies on the assumption that a continuous health variable underlies the ordinal categorical health variable. This latent variable is distributed according to the opposite of a lognormal distribution. In the same way, in the second case, it is assumed that there exists an underlying continuous health variable to the categorical variable but it is estimated using an ordered Probit and then rescaled onto the [0,1] interval, using the highest and the lowest prediction. These two methods have been criticised for the arbitrariness of the choice of distribution (Van Doorslaer & Jones, 2003). Indeed, in the same way that concentration indices, for example, depend on the shape of the distribution, the health inequality measure will also be arbitrary. Moreover, the self-assessed health variable is assumed to be continuous but the underlying information is still categorical. Also, an ordinary least square regression cannot be used and intra-categorical differences are not considered.

#### 2.1.2. Cardinalisation of SAH with a health distribution

In view of these limitations, Van Doorslaer & Jones (2003) have advocated rescaling SAH by a health distribution. A first application of the interval regression method was defined on Canada, using a health distribution derived from the Canadian National Population Health Survey (CNPHS), namely the Health Utility Index (HUI), to rescale the Canadian SAH (Van Doorslaer & Jones, 2003). In this context, the cumulative distribution function of the HUI was used as the benchmark, from which the thresholds defining the HUI intervals corresponding to each SAH level are derived. The same thresholds were then used for all European countries (Van Doorslaer & Koolman, 2005), assuming that distributions of health were comparable to the Canadian one. The authors conclude that this is the best procedure in terms of ability to represent both the distribution of generic health from SAH categories and the set of covariates used in the interval regression model. In the end, a prediction of each individual's level of health utility is computed from the observed SAH level.
We will first apply this method to our data and use the empirical distribution of the HUI in the 1994 CNPHS to cardinalise the French SAH variable in both surveys. In so doing, we assume that there is a stable mapping from this HUI distribution to the latent health variable that determines SAH and that it can be applied to the French population. As noted before, there are also eleven thresholds to consider since SAH is collected on a 10-point scale in France: 0 (the worse possible status), 0.293, 0.335, 0.35, 0.394, 0.428, 0.696, 0.756, 0.852, 0.926, 0.947, and 1 (the best possible status).

### *2.1.3. The Global Health Indicator (GHI)*

We propose an alternative method to derive a continuous health indicator. Rather than using a continuous health distribution with which to rescale the SAH indicator, we use additional information available at individual level in order to estimate a latent variable of "true health" (Perronnin, Rochaix & Tubeuf, 2005).

Indeed, even if SAH is now recognized as a good indicator of "true health" (Idler & Benyamini, 1997), it still suffers from various reporting biases related, among other factors, to age, gender and socioeconomic characteristics. Therefore, in order to better capture "true health", it seems important to correct SAH from these reporting biases by using available information in the survey beyond SAH. In particular, we consider the total number of self-reported diseases, each one weighted by a severity index based both on the disability level and on the vital risk it generates.

The vital risk indicator captures the disutility from life expectancy loss whereas, the disability indicator evaluates the disutility due to the presence of a disability and the associated loss of life quality For years, researchers from the IRDES have developed successive tests' methods, in close cooperation with doctors and statisticians to generate minima levels of vital risk and disability for each disease. Their work consists in assigning a vital risk and a disability level for each reported disease in reference to the International Classification of the Diseases and in the absence of other information. It is assumed that other diseases from which the individual could suffer, could only increase the vital risk and the disability level, but in no case reduce them. Each disease is thus positioned on a minimum vital risk scale of six points and a minimum disability level scale of seven points. These two scores provide an indication of a disease's severity.

Beyond, since individuals living in the same household are likely to assess their health status in comparable ways, taking into account potential clusters effects seems relevant. Thus, a random effect model is used to estimate health determinants with equivalent health statuses.

Formally, the procedure to generate this global health indicator consists in defining $h_i^{subj}$, namely SAH and a latent variable of true health $h_i^*$ as

$$h_i^{subj} = f(h_i^*, X_i, u_i, u_{HH}; \alpha, \beta) \tag{1}$$

$$h_i^* = g(D_{ij}; \alpha) \tag{1bis}$$

where

*j=1,…,J* is the degree of severity, defined on the basis of the scores on both disability and vital risk indices,

$D_{ij}$**,** is the number of diseases of severity *j* that the individual *i* has reported in the survey,

$X_i$ is a vector of individual characteristics that may induce reporting biases, namely age, gender and socioeconomic characteristics,

$u_i$ is an individual idiosyncratic error term and $u_{HH}$ is a household idiosyncratic error term

The model generates an estimate of the "true health" and the parameter estimates $\hat{\alpha}_j$ are also used as weights to obtain robust SAH indicators, as proposed in Lindeboom & Van Doorslaer (2004). In the end, the cardinal health indicator is constructed for each individual by multiplying the number of declared diseases (weighted by the severity-induced level of diseases) by the estimated parameters. Thus, the GHI is given by

$$GHI_i = \sum_{j=1}^{j} \hat{\alpha}_j D_{ij} \tag{2}$$

This new indicator is continuous[4].

We considered two definitions of GHI: in the first version, we only correct for age and gender while in the second we further correct for socioeconomic characteristics. Indeed, while the literature on SAH unambiguously shows the existence of reporting biases due to gender and age (Baron-Epel & Kaplan, 2001; Van Doorslaer & Gerdtham, 2003), the existence of a potential reporting bias induced by socioeconomic characteristics is still debated (Kerkhofs & Lindeboom, 1995; Shmueli, 2003; Van Doorslaer et Gerdtham, 2003). As a result, we compare the changes in the evolution of IRHI between 1998 and 2002, using HUI and  version 1 of GHI.

### 2.2. Explaining health inequality

Some of the work on inequalities in health is concerned with 'pure inequalities' in health -i.e. defined on a single dimension- (Gakidou *et al.* 2000), but the present research focuses on multidimensional inequalities in health, in particular, the variation in health which is systematically related to socioeconomic status. In the income-related health inequality literature, concentration indices and curves were first introduced by Wagstaff *et al.* (1989) and have since been successfully used to describe and measure the degree of inequality in various measures of health, health care or in health care payments. The concentration index provides a measure of socioeconomic inequality in health, intuitively comparable to the Gini index which is commonly used in pure health inequality measurement. The two measures differ in the ranking variable used: in the two-dimensional case, income is used rather than health in the Gini of health (Le Grand, 1987). The concentration index compares the cumulative proportion of the population ranked by increasing income on the X-axis with the cumulative proportion of health on the Y-axis. It ranges between –1 and 1. The CI is –1 (resp. +1) when all health is concentrated in the poorest (resp. the richest) person. A value of 0 is interpreted as an equal distribution of health over income, i.e. for any *p*, a *p* proportion of individuals ranked according to their income receives a *p* proportion of health.

[4] For practical reasons, GHI is re-scaled to be used on a [0;1] interval. Thus, $GHI_i^{'} = \frac{GHI_i - \min(GHI_i)}{\min(GHI_i)}$

More formally, let us define $y_i$ as the measure of health of individual *i*, with $R_i$ the cumulative proportion of the population ranked by increased income. The concentration index of income-related health inequality is given by:

$$C = \frac{2}{\bar{y}} \operatorname{cov}(y_i, R_i) \tag{3}$$

where $\bar{y} = E(y_i)$.

#### *2.2.1. The decomposition method*

Concern has been expressed with respect to the economic intuition behind concentration indices. As a result, research has focused on the decomposition of the concentration index into its various determinants. A decomposition method was then introduced to observe inequality and to identify its sources (Wagstaff *et al*., 2003).

Let us assume that the following linear regression model defines the measure of health of individual *i* according to the *k* regressors:

$$y_i = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i \tag{4}$$

where $\varepsilon_i$ is a random error term assumed to have expected mean value equal to zero and constant variance and *K*, the number of regressors. The $\beta_k$ are assumed constant for every individual *i*.

By substituting in the previous concentration index equation, we obtain:

$$C = \sum_{k=1}^{K} \left( \beta_k \frac{\bar{x}_k}{\bar{y}} \right) C_k + \frac{2}{\bar{y}} \operatorname{cov}\left(\varepsilon_i, R_i\right) \tag{5}$$

The concentration index is also assumed to be made up of two components: an explained one, equal to a weighted sum of the concentration indices of the *k* regressors and a residual component. The weight represents the estimated health elasticity with respect to regressor *k*, as:

$$\eta_k = \beta_k \frac{\bar{x}_k}{\bar{y}} \tag{6}$$

The estimated health inequality is also expressed as a sum of inequality in each of its determinants, each weighted by his own health elasticity.

This decomposition method emphasizes the contribution of each regressor to the explanation of IRHI and gives each regressor's respective impact on health and also the degree of inequality of its own distribution with respect to income.

### 2.2.2. Decomposition of inequality over time

The decomposition of the changes over time between the two concentration indices relies on the Oaxaca decomposition methodology (Oaxaca, 1973) and on the approach proposed by Wagstaff *et al*. (2001). It consists in writing the difference between the concentration indices of the population at the two time periods:

$$\Delta CI = CI_{2002} - CI_{1998} = \sum_k \eta_{k_{2002}} (CI_{k_{2002}} - CI_{k_{1998}}) + \sum_k CI_{k_{1998}} (\eta_{k_{2002}} - \eta_{k_{1998}}) \quad (7)$$

Not only can the difference in measurement of the income-related health inequality be decomposed but the contribution of each regressor to these changes may also be evaluated, thus:

$$\Delta CI_k = \eta_{k_{2002}} (CI_{2002} - CI_{1998}) + CI_{k_{1998}} (\eta_{k_{2002}} - \eta_{k_{1998}}) \quad (8)$$

As the decomposition of the changes is also expressed in elasticity parameters, the difference between the two periods is explained by two terms: the inequality in the distribution of the regressor (differences between the two CI) and the inequality related to the regressor's specific link with health (differences between elasticities). Moreover, the relative importance of the inequality compared to the health elasticity component in the contribution of each variable can be assessed by computing both the relative excess elasticity and the relative excess inequality over time.

## 3. Data and variable definition

The data comes from the 1998 and 2002 IRDES Health and Health Insurance Survey. The IRDES-HHIS is representative of French households, covers about 20,000 individuals (about 7,338 households) and is carried out every two years. Although half of the sample is re-interviewed every four years, we treat each wave separately to carry out cross-section analyses.

Surveys were conducted with some degree of variation in the questionnaire wording and scope, but the sample selected compares populations with similar characteristics over time. It provides information on socio-economic and demographic characteristics, as well as on health status and health insurance coverage. Each household fills a medical consumption record during a month. All pharmaceutical expenditures, hospital and ambulatory consultations are also reported.

The analysis is restricted to the working-age population i.e. individuals aged 16 to 60. The lower bound is also justified by the fact that individuals under 16 do not assess their own health. Finally, individuals with incomplete health questionnaires and those who did not answer some of the socio-demographic questions were also excluded. In the end, the sample contains 8,699 individuals in 1998 and 6,837 individuals in 2002. Samples are corrected to account for the under-representation of the severely ill and the elderly in the surveys.

The ranking variable is the equivalent household income, using the OECD scale. In the IRDES-HHIS, individuals are asked for a detailed set of questions on income including an income bracket and a continuous value. When this value is unknown, the median of the bracket is used to compute the equivalent household income.

Detailed social, health and demographic variables are also available at individual level. Ten age-gender categories are created for men and women aged 16-25, 26-35, 36-45, 46-55, and lastly, 56-60. Three levels of education are considered (low, medium, high). Employment status has six modalities: employed, unemployed, inactive, looking after family/home, retired and student. Health insurance variables are also recorded, indicating whether the individual is covered by private health insurance beyond compulsory insurance or by the AMG in 1998 or the CMU complementary insurance in 2002. The omitted reference individual is a young man, less educated, with no private insurance and in employment.

# 4. Results: Differences in income-related health inequality in 2002 according to the health indicator

We first present the estimated coefficients of the regression. Second, the various concentration indices for both dependent and independent variables are computed and discussed. Third, health inequality contributions are analysed for each year using both indicators to test for sensitivity.

## 4.1. What are the relationships between the determinants of health and the health variables?

The estimated parameters explain the relationships between socioeconomic characteristics and the measurement of the health variable. These relationships are comparable in terms of signs -when significant- for both health indicators and for the two years (Table 1). Besides, the estimated parameters of the two GHI versions (version1 when correcting for age and gender only and version 2 when correcting for age, gender and socioeconomic conditions) are similar in the same year. Thus, we do not distinguish between them in the following paragraph.

As individuals become older, their health status deteriorates. This relationship is slightly stronger for women for both HUI and GHI. Both indicators increase with equivalent income. As for the relationship between health and education, we find that both primary/secondary and high school levels have a significant and positive influence on health status.

There is an inverse relationship between voluntary health insurance and health (although it is insignificant for 1998, using HUI). The sicker appear to take out supplementary health insurance more readily, a finding which could tentatively be interpreted in terms of adverse selection. There is also a negative relationship between health and being a CMU beneficiary over time but it is only significant for GHI. Intuition on the sign of these estimated parameters can be found in the CMU eligibility conditions, i.e. very low incomes often implying low health statuses too. A similar conclusion is found in a recent analysis (Boisguérin, 2005), which showed that individuals tend to apply for CMU-benefit if they anticipate health care needs. Lastly, parameters on the activity status variable provide us with information on the relationship between health and social characteristics.

Unsurprisingly, the effect of being a student is the only factor with a positive relationship with health, students' health status being better than other employed because of an age effect. Compared to the employed, inactivity, unemployment and retirement statuses have a negative and significant correlation with health, irrespective of the health indicator. Compared to the general 16-60 population, unemployment or inactivity is associated with an excess mortality for both men and women. This result is in line with recent findings which show that in the five years following unemployment, the annual risk of death for an unemployed is, at comparable age, approximately three times higher than that of the general 16-60 population (Mesrine, 2000). Moreover, before the age of 60, a bad health status has been found a good predictor of inactivitiy, retirement and unemployment, four years later (Jusot et al., 2005b).

### 4.2. How unequal is each dependent or independent variable distribution compared to that of income?

The first step of the decomposition method allows to analyse the concentration indices of each dependent and independent variables over the income distribution (Table 2). The two first lines show the distribution of the two health indicators over income. Irrespective of the year or of the health indicator used, health is unequally distributed, favouring the richest individuals, with a stability of the gradient over time. The concentration indices for the determinants of health are identical for both HUI and the two versions of GHI as the inequality is measured over the same ranking variable, which is independent of the health dimension. The target variable here, namely the equivalent income, induces an inequality obviously in favour of the rich, which decreases over time. The concentration index obtained for income is in fact a Gini index. As expected, income inequality and income-related health inequality have the same sign, the income one being larger.

With respect to the age-gender categories, it is clear that the youngest and the middle-aged women are concentrated in lower income groups, although inequality generally decreases over time. Older women are concentrated in the higher income groups, although inequality decreases over time. The same pattern is observed for both oldest men and others age groups with a stronger decrease in the two middle-aged groups. Besides, an income inequality favoring men is observed but decreases over time.

The most-educated individuals are highly concentrated in the richest income groups, and the income inequality induced slightly decreases over time. The primary/secondary school level is concentrated in the richest in 1998, but its impact decreases over time and is concentrated in the poorest in 2002.

Unemployed, individuals undertaking family/home care and the inactive are highly concentrated in the lower income groups. Unlike those in inactivity for whom concentration indices are stable, the concentration index in unemployment slightly decreases over time. Concerning retired people, an inequality favouring the richest-off is observed. As the sample only includes individuals between 16 and 60, most of those who have retired before 60 have either done so for their bad health (which would explain at least partly the positive concentration index) or for general economic reasons.

Finally, concentration indices concerning health insurance accord with primary intuition. The supplementary health insurance implies a pro-rich income inequality, which is stable over time. The CMU highly favours the poorest-off since it is means-tested. The concentration of CMU beneficiaries in the lowest income groups decreases over the time period.

### 4.3. How does each regressor contribute to the yearly health inequality and how does this vary according to the health indicator used?

Irrespective of the health indicator used, each regressor contributes in the same way to the health inequality (the contributions' values have identical signs). For both years however, CMU-beneficiary, inactivity, retirement and gender show important differences according to the health indicator used. Indeed, the positive contribution of being a CMU-beneficiary is more marked using GHI in 2002, whether under version 1 or 2. Clearly new CMU beneficiaries have a better access to health care so that their diseases are better diagnosed and therefore better declared.

As for gender it appears that both for 1998 and 2002, contributions to health inequality are higher for men under HUI and for women under GHI. An explanation is that GHI is based on the number of reported diseases and there is some evidence of a higher tendency for women to report diseases more (Auvray *et al.*, 2003). Because of their higher number of doctors' consultations, women are more likely to know exactly the diseases they suffer from (Auvray *et al.*, 2003). Differences in the contribution of inactivity status are significant in 1998 and are more marked using HUI. This difference may be due to the fact that because GHI corrects for reporting bias due to age, it reduces the contribution of inactivity to health inequality.

Differences in the contribution of retirement are also of interest and it appears to be more marked in 2002, with higher values under both versions of GHI compared to HUI. One interpretation of this effect may be that it is those in poor health and diagnosed diseases who tend to leave the labour market earlier. Alternatively, this result could be explained considering Bound's (1990) point of view according to which workers are in fact encouraged to take earlier retirement and they justify their behaviour by declaring health limitations or diseases.

Income implies very slight differences in 1998 as in 2002 and its contribution to health inequality is higher with HUI. The contribution of education remains unchanged whichever health indicator used.

## 5. Results: *Income-related health inequalities in France between 1998 and 2002: comparing trends using HUI and GHI*

Changes between variables over time in terms of means in the two surveys are first reported. We then turn to changes in income-related health inequalities over time. Results concerning differences between health indicators are systematically reported.

### 5.1. What are the changes in the determinants of health between 1998 and 2002?

The mean value of the health measure, whether in HUI or GHI terms, slightly decreases between 1998 and 2002 (table 4). An explanation for this health status deterioration is the higher number of older individuals in the 2002 survey.

The mean value of equivalent income increases over the same period. If we compare to overall French statistics, we find that the mean value of equivalent income for the 18-59 income class in 1998 was about 16,208 euros per year and 17,879 euros per year in 2002. The value of equivalent income is therefore underestimated in the two surveys: in 1998, its value is 1,167 euros per month and 1,382 in 2002.

The proportion of highly educated individuals between the two surveys increases.

Concerning supplementary health insurance, the proportion of individuals without supplementary health insurance reduces from 10% in 1998 to 6.4% in 2002. Regarding employment status, the data shows that the modality 'being in employment' is that which changes most (64.5% in 1998 and almost 70% in 2002). The number of unemployed slightly decreases over time while unemployment rates have fallen more markedly in France over that period (from 11,3% in December 1998 to 9.1% in December 2002 -respectively from 13.84% to 10.10% for women, and from 10.20% to 7.80% for men). The proportion of individuals looking after family/home as well as that of retired and inactives are the same over time. As for students, the proportion reduces by 4 points in 2002, which is consistent with the ageing of the population in 2002 previously mentioned.

### 5.2. How do the changes in the determinants of health explain the change in income-related health inequality over time?

The decomposition method previously presented gives the contribution of each determinant of health to the changes in income-related health inequality between 1998 and 2002. The last line in table 5 gives the value of the total change in the income-related health inequality over time both with HUI or with GHI (version 1).This total change is positive both with HUI and GHI, so that IRHI slightly increases from 1998 to 2002.

By far, the two regressors which explain most of the changes in IRHI over time are income and inactivity. Concerning the former, its strong contribution is explained both by a decrease in the concentration index of inequality in income over time and by a change in the elasticity of health which is different according to the health indicator. With HUI, its contribution is also due to an increase in the elasticity of health with respect to income, whereas for GHI, its stronger effect is rather driven by a reduction in the elasticity of health with respect to income. These results are hardly surprising. Intuitively, the impact of CMU may increase the poorest's health satisfaction by increasing access to care. As HUI contains a more subjective dimension than GHI, we therefore expect a higher income elasticity of health measured on a sole subjective assessment (HUI) than on GHI which adds a more objective dimension: the number of diseases. As to the contribution of inactivity, irrespective of the health indicator, it is by far much more explained by an increase in the elasticity of health with respect to inequality than changes in its income-related inequality. A similar result is found in Monteil & Robert-

Bobée (2005). Again, increases in elasticity are different under the two health indicators, with that of GHI being more sizeable.

Irrespective of the health indicator, the other activity status categories, except retirement, contribute to a reduction of IRHI. Although the contribution of looking after family/home is almost the same for both health indicators, others activity statuses differ from one to another. Unemployment decreases the income-related health inequality especially when health is measured with HUI. Its impact is explained more by an increase in the elasticity of health with respect to unemployment than by a change in inequality over the distribution of income. The contribution of retirement is also important with HUI health variable and due to changes in elasticity. As a matter of fact, when health is measured by the HUI, activity strongly contributes toward explaining the increase in the IRHI.

On the other hand, contributions of the health insurance to the changes in inequality over time are also of interest. Concerning supplementary health insurance, its contribution to changes is relevant with both HUI and GHI but higher with the former. In both cases, the reduction of IRHI is exclusively explained by changes in the elasticity of health with respect to having a private insurance coverage. Whereas the changes in the elasticity of health under HUI are driven by a reduction (the relative change in the elasticity of health is negative), those of the other health indicator concern an increase(the relative change in the elasticity of health is positive). As for the CMU-coverage, its impact on the changes differs from one indicator to the other. In the HUI case, access to a universal cover contributes to reducing the changes (a negative contribution). This reduction is driven by the change in the CMU-beneficiaries inequality over the distribution of income. In the GHI case, the CMU regressor contributes positively to the changes in the IRHI over time, displaying a marked positive partial association with health.

The level of education has a lower impact, though appreciable, on changes in IRHI, compared to the variables previously analysed. Irrespective of the health indicator, education contributes to a reduction in IRHI. This reduction is more marked, whatever the level of education, when health is measured by HUI and with higher education level only when health is measured by GHI.

Observing these results, one may note that generally, elasticity differences are more likely to dominate concentration indices differences.

## 6. Summary and conclusions

In this paper, we have analysed inter-individual income-related health differences in France. Yet the originality of the paper lies mainly in the comparison in inequality measurement offered by two alternative health indicators, with evidence of some variations in the results. Activity status, namely inactivity and retirement, contributes differently to health inequality. These results tend to highlight the fact that the choice of the health indicator is not trivial and the comparison also contributes towards testing the robustness of the results to the choice of a health indicator.

With respect to time changes, the results show that there is indeed an income-related health inequality favouring the higher income group in France, with a stability of the gradient over time. The decomposition analysis leads to the conclusion that income and activity status are by far the most important factors explaining these changes in income-related health inequalities. Depending on the health indicator used, we find that it is more related to the strong increasing relationship that exists between health and income in the case of the new global health indicator (GHI) while it is mainly attributable to the own distribution of income within the population under HUI. In the same way, other social factors contribute to the increase in inequality, in particular, inactivity. However, the changes observed in this analysis were not statistically tested. In effect, it could be useful in the future to apply a bootstrap method to assess sampling variability and obtain standard errors for the estimates of both the whole of concentration indices and elasticities.

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## Empirical results

**Table 1: Estimated regression parameters according to the health indicator used.**

| 1998 | Interval Regression Coefficients | Regression Coefficients GHI AgeSex | Regression Coefficients GHI AgeSexSES |
|---|---|---|---|
| Constant | ***0,843*** | 0,921 | ***0,917*** |
| lninc | ***0,012*** | ***0,004*** | ***0,004*** |
| male26_35 | -0,005 | ***0,010*** | ***0,011*** |
| male36_45 | ***-0,028*** | -0,009 | -0,010 |
| male46_55 | ***-0,055*** | ***-0,034*** | ***-0,036*** |
| male56_60 | ***-0,067*** | ***-0,073*** | ***-0,076*** |
| fem16_25 | ***-0,007*** | ***-0,011*** | ***-0,012*** |
| fem26_35 | ***-0,012*** | ***-0,013*** | ***-0,014*** |
| fem36_45 | ***-0,030*** | ***-0,033*** | ***-0,036*** |
| fem46_55 | ***-0,073*** | ***-0,086*** | ***-0,091*** |
| fem56_60 | ***-0,072*** | ***-0,132*** | ***-0,139*** |
| edu_2 | ***0,012*** | ***0,007*** | ***0,007*** |
| edu_3 | ***0,012*** | 0,005 | 0,005 |
| shi_private | 0,004 | ***-0,008*** | ***-0,009*** |
| shi_cmu | -0,013 | -0,008 | -0,008 |
| act_inactive | ***-0,189*** | ***-0,116*** | ***-0,119*** |
| act_housewk | ***-0,014*** | ***-0,004*** | ***-0,004*** |
| act_retired | ***-0,051*** | ***-0,059*** | ***-0,062*** |
| act_unempld | ***-0,027*** | ***-0,015*** | ***-0,016*** |
| act_student | 0,006 | ***0,012*** | ***0,013*** |
| Significativity in bold type, p<0.05 | | | |

| 2002 | Interval Regression Coefficients | Regression Coefficients GHI AgeSex | Regression Coefficients GHI AgeSexSES |
|---|---|---|---|
| Constant | ***0,812*** | ***0,934*** | ***0,931*** |
| lninc | ***0,012*** | 0,002 | 0,002 |
| male26_35 | 0,006 | ***0,020*** | ***0,021*** |
| male36_45 | ***-0,018*** | 0,001 | 0,001 |
| male46_55 | ***-0,056*** | ***-0,039*** | ***-0,040*** |
| male56_60 | ***-0,071*** | ***-0,060*** | ***-0,061*** |
| fem16_25 | 0,000 | 0,000 | 0,000 |
| fem26_35 | -0,010 | ***-0,014*** | ***-0,014*** |
| fem36_45 | ***-0,026*** | ***-0,031*** | ***-0,032*** |
| fem46_55 | ***-0,063*** | ***-0,082*** | ***-0,085*** |
| fem56_60 | ***-0,088*** | ***-0,116*** | ***-0,119*** |
| edu_2 | ***0,017*** | ***0,013*** | ***0,013*** |
| edu_3 | ***0,013*** | 0,003 | 0,004 |
| shi_private | 0,000 | ***-0,016*** | ***-0,016*** |
| shi_cmu | -0,010 | -0,037 | -0,037 |
| act_inactive | ***-0,188*** | ***-0,170*** | ***-0,171*** |
| act_housewk | ***-0,017*** | 0,002 | 0,003 |
| act_retired | -0,020 | ***-0,071*** | ***-0,072*** |
| act_unempld | ***-0,022*** | ***-0,019*** | ***-0,020*** |
| act_student | ***0,019*** | ***0,021*** | ***0,021*** |
| Significativity in bold type, p<0.05 | | | |

**Table 2: Concentration indices of regressors in 1998 an 2002**

**Concentration indices of dependent & independent variables**

| | 1998 | 2002 |
|---|---|---|
| predicted HUI | 0,0061 | 0,0064 |
| predicted GHI AgeSex | 0,0005 | 0,0014 |
| predicted GHI AgeSexSES | 0,0004 | 0,0015 |
| lninc | 0,048 | 0,037 |
| male26_35 | 0,070 | 0,039 |
| male36_45 | 0,017 | -0,041 |
| male46_55 | 0,142 | 0,073 |
| male56_60 | 0,154 | 0,138 |
| fem16_25 | -0,219 | -0,118 |
| fem26_35 | -0,002 | 0,023 |
| fem36_45 | -0,054 | -0,052 |
| fem46_55 | 0,120 | 0,063 |
| fem56_60 | 0,175 | 0,155 |
| edu_2 | 0,003 | -0,021 |
| edu_3 | 0,280 | 0,196 |
| shi_private | 0,066 | 0,054 |
| shi_cmu | -0,762 | -0,619 |
| act_inactive | -0,384 | -0,331 |
| act_housewk | -0,229 | -0,255 |
| act_retired | 0,215 | 0,190 |
| act_unempld | -0,376 | -0,302 |
| act_student | -0,170 | -0,112 |

**Table 3: Health inequality contributions of the regressors in 2002 and 1998 according to the health indicator**

**Health inequality contributions of regressors in 1998 per health indicator**

| | predicted HUI | | predicted GHI AgeSex | | predicted GHI AgeSexSES | |
|---|---|---|---|---|---|---|
| | Contrib | Sum of Contrib | Contrib | Sum of Contrib | Contrib | Sum of Contrib |
| CI pred | 0,0061 | | 0,0005 | | 0,0004 | |
| lninc | 0,0006 | 0,0006 | 0,0002 | 0,0002 | 0,0002 | 0,0002 |
| male26_35 | 0,000 | | 0,001 | | 0,001 | |
| male36_45 | -0,001 | | 0,000 | | 0,000 | |
| male46_55 | -0,009 | | -0,005 | | -0,006 | |
| male56_60 | -0,012 | -0,021 | -0,012 | -0,017 | -0,013 | -0,018 |
| fem16_25 | 0,002 | | 0,003 | | 0,003 | |
| fem26_35 | 0,000 | | 0,000 | | 0,000 | |
| fem36_45 | 0,002 | | 0,002 | | 0,002 | |
| fem46_55 | -0,010 | | -0,011 | | -0,012 | |
| fem56_60 | -0,014 | -0,020 | -0,025 | -0,032 | -0,027 | -0,034 |
| edu_2 | 0,000 | | 0,000 | | 0,000 | |
| edu_3 | 0,004 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| shi_private | 0,000 | 0,000 | -0,001 | -0,001 | -0,001 | -0,001 |
| shi_cmu | 0,011 | 0,011 | 0,006 | 0,006 | 0,006 | 0,006 |
| act_inactive | 0,081 | | 0,049 | | 0,050 | |
| act_housewk | 0,004 | | 0,001 | | 0,001 | |
| act_retired | -0,012 | | -0,014 | | -0,015 | |
| act_unempld | 0,011 | | 0,006 | | 0,007 | |
| act_student | -0,001 | 0,082 | -0,002 | 0,040 | -0,002 | 0,041 |

**Health inequality contributions of regressors in 2002 per health indicator**

| | predicted HUI | | predicted GHI AgeSex | | predicted GHI AgeSexSES | |
|---|---|---|---|---|---|---|
| | Contrib | Sum of Contrib | Contrib | Sum of Contrib | Contrib | Sum of Contrib |
| CI pred | 0,0064 | | 0,0014 | | 0,0015 | |
| lninc | 0,0005 | 0,0005 | 0,0001 | 0,0001 | 0,0001 | 0,0001 |
| male26_35 | 0,000 | | 0,001 | | 0,001 | |
| male36_45 | 0,001 | | 0,000 | | 0,000 | |
| male46_55 | -0,005 | | -0,003 | | -0,003 | |
| male56_60 | -0,011 | -0,015 | -0,009 | -0,011 | -0,009 | -0,012 |
| fem16_25 | 0,000 | | 0,000 | | 0,000 | |
| fem26_35 | 0,000 | | 0,000 | | 0,000 | |
| fem36_45 | 0,002 | | 0,002 | | 0,002 | |
| fem46_55 | -0,004 | | -0,006 | | -0,006 | |
| fem56_60 | -0,016 | -0,019 | -0,020 | -0,024 | -0,021 | -0,025 |
| edu_2 | 0,000 | | 0,000 | | 0,000 | |
| edu_3 | 0,003 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 |
| shi_private | 0,000 | 0,000 | -0,001 | -0,001 | -0,001 | -0,001 |
| shi_cmu | 0,007 | 0,007 | 0,025 | 0,025 | 0,026 | 0,026 |
| act_inactive | 0,071 | | 0,062 | | 0,063 | |
| act_housewk | 0,005 | | -0,001 | | -0,001 | |
| act_retired | -0,004 | | -0,015 | | -0,015 | |
| act_unempld | 0,008 | | 0,006 | | 0,007 | |
| act_student | -0,002 | 0,077 | -0,003 | 0,050 | -0,003 | 0,051 |

**Table 4: Means and proportions of dependent and independent variables**

**Means of variables**

| | 1998 | 2002 |
|---|---|---|
| predicted HUI | 0,896 | 0,877 |
| predicted GHI AgeSex | 0,921 | 0,909 |
| predicted GHI AgeSexSES | 0,913 | 0,905 |
| income/UC (€/month) | 1166,99 | 1382,35 |
| age | 36,27 | 37,38 |
| male | 49,83 | 49,36 |
| female | 50,17 | 50,64 |
| edu_less | 47,05 | 44,16 |
| edu_2 | 22,74 | 23,09 |
| edu_3 | 30,21 | 32,75 |
| shi_no | 9,81 | 6,36 |
| shi_private | 87,55 | 89,66 |
| shi_cmu | 2,64 | 3,98 |
| act_empl | 64,46 | 69,74 |
| act_housewk | 6,28 | 5,62 |
| act_inactive | 1,89 | 2,46 |
| act_retired | 2,66 | 2,18 |
| act_student | 17,19 | 13,53 |
| act_unempld | 7,51 | 6,48 |

**Table 5: Decomposition over time: contributions of regressors to the changes in the income-related health inequality**

| | | HUI | | | GHI AgeSex | | |
|---|---|---|---|---|---|---|---|
| | Relative change in inequality over the dist. of income | Contribution to total change in IRHI 98-02 | % Contribution | Relative change in the elasticity of health 98-02 | Contribution to total change in IRHI 98-02 | % Contribution | Relative change in the elasticity of health 98-02 |
| Change in IRHI | | 0,0002 | | | 0,0011 | | |
| lninc | -23,7% | -0,0005 | -231,4% | 14,2% | -0,0008 | -67,6% | -38% |
| male26_35 | -45% | 0,0001 | | -228,4% | 0,0000 | | 115,7% |
| male36_45 | -340,3% | 0,0002 | | -40,4% | 0,0000 | | -115,6% |
| male46_55 | -48,7% | 0,0003 | | 19,0% | 0,0002 | | 28,2% |
| male56_60 | -10,3% | -0,0001 | | 44,0% | 0,0000 | | 9,2% |
| fem16_25 | -46,3% | -0,0002 | | -101,3% | -0,0002 | | -82,9% |
| fem26_35 | -1433,9% | 0,0000 | | -27,2% | 0,0000 | | 2,3% |
| fem36_45 | -3,8% | -0,0001 | | -23,6% | 0,0000 | | -14,2% |
| fem46_55 | -48,1% | 0,0004 | | 6,4% | 0,0004 | | 17,9% |
| fem56_60 | -11,3% | -0,0002 | 175,4% | 59,4% | 0,0000 | 21,8% | 14,2% |
| edu_2 | -766,2% | -0,0001 | -41,5% | 42,9% | -0,0001 | -6,1% | 81,5% |
| edu_3 | -29,9% | -0,0001 | -30,2% | 33,6% | -0,0002 | -15,4% | -20,6% |
| shi_private | -18,7% | -0,0002 | -85,1% | -87,1% | -0,0003 | -29,5% | 108,3% |
| shi_cmu | -18,6% | -0,0001 | -27,4% | 3,6% | 0,0010 | 84,7% | 515,2% |
| act_inactive | -13,8% | 0,0011 | 463,8% | 98,1% | 0,0014 | 121,9% | 191,7% |
| act_housewk | 11,5% | 0,0000 | -15,5% | -21,3% | -0,0001 | -11,4% | -137,8% |
| act_retired | -12% | 0,0003 | 107,4% | -67,9% | 0,0000 | 4,3% | -1,4% |
| act_unempld | -19,6% | -0,0004 | -169,3% | -28,2% | 0,0000 | -4,4% | 12,3% |
| act_student | -34,2% | -0,0001 | -48,4% | 152,5% | 0,0000 | 1,8% | 42,4% |

**Indications:**

Relative change in inequality = $C_{2002}$-$C_{1998}$/$C_{1998}$

Relative change in the elasticity of health = $\eta_{2002}$- $\eta_{1998}$/ $\eta_{1998}$