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Original article

Income-related health inequalities in France in 2004: Decomposition and explanations

Les inégalités de santé selon le revenu en France en 2004 : décomposition et explications

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Abstract

Background. – This analysis supplements existing work on social health inequalities at two levels: the measurement of health and the measurement of inequalities. Firstly, individual health status was measured using a subjective health indicator corrected within a promising cardinalisation method which had not yet been carried out on French data. Secondly, this study used an innovative methodology to measure income-related health inequalities, to understand the relationships between income, income inequality, various social determinants, and health.

Methods. – The analysis was based on a sample of working-age adults from the 2004 Health and Health Insurance Survey. The methodology used in the study measures the total income-related health inequality using the concentration index. This index is based on a linear model explaining health according to several individual characteristics, such as age, sex, and various socioeconomic characteristics. The method thus takes into account both the causal relationships between the various explicative factors introduced in the model and their relationship with health. Furthermore, it concretely measures the contribution of the social determinants to income-related health inequalities.

Results. – The results show an income-related health inequality favouring individuals with a higher income. Moreover, income level, supplementary private health insurance, education level, and social class account for the main contributions to inequality. Therefore, the decomposition method highlights population groups that policies should target.

Conclusion. – The study suggests that reducing income inequality is not sufficient to lower income-related health inequalities in France in 2004 and needs to be supplemented with the reduction of the relationship between income and health and the reduction of income inequality over socioeconomic status.

Keywords: Inequality; Self-reported health; France; Concentration index

Résumé

Position du problème. – Cette analyse complète les travaux sur les inégalités sociales de santé à deux niveaux : la mesure de la santé et la mesure des inégalités. D'une part, l'état de santé individuel est appréhendé par une mesure subjective de santé corrigée par une méthode de cardinalisation innovante, qui n'a pas encore été appliquée à la France. D'autre part, cette étude met en œuvre une méthode originale de mesure des inégalités sociales de santé qui permet de comprendre les liens existants entre le revenu, les inégalités de revenu, plusieurs déterminants sociaux et la santé.

Méthodes. – L'analyse est conduite sur un échantillon d'adultes en âge de travailler issu de l'Enquête Santé Protection sociale (ESPS) 2004. La méthodologie, sur laquelle les travaux s'appuient, calcule l'inégalité sociale de santé totale à l'aide d'un indice de concentration. Le calcul de l'indice s'appuie sur un modèle linéaire qui explique la santé par plusieurs caractéristiques individuelles, comme l'âge, le sexe, et différentes variables socioéconomiques. La méthode tient compte à la fois des relations causales entre les différents facteurs explicatifs introduits dans l'analyse et de leurs liens avec la santé. De plus, elle mesure concrètement la contribution des déterminants sociaux à la formation des inégalités de santé.

Résultats. – Les résultats mettent en évidence qu'il existe des inégalités de santé selon le revenu à l'avantage des revenus les plus élevés. De plus, les plus fortes contributions aux inégalités proviennent du niveau de revenu, de l'accès à la couverture complémentaire santé, du niveau

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d'éducation et de la classe sociale. Ainsi, la méthode de décomposition permet d'éclairer les groupes spécifiques sur lesquels les politiques doivent concentrer leurs efforts.

Conclusion. – Cette étude suggère que la réduction des inégalités de revenu n'est pas suffisante pour éliminer les inégalités sociales de santé en France en 2004 et qu'elle doit s'accompagner d'une réduction de l'association entre le revenu et la santé et d'une réduction des inégalités de revenu selon les catégories sociales.

Mots clés : Inégalité ; Santé auto-évaluée ; France ; Indice de concentration

1. Introduction

Beyond simply observing that health inequalities exist, the mechanisms causing these health inequalities have been explored in explicative analyses. In addition to social class, which has already been implicated to explain the differences in mortality in demographic studies [1], new health determinants, highly diverse in terms of source and type, have been defined and qualified by epidemiologists under the term ''social determinants of health'' [2,3].

In economics, at the international level, the possible explanations for the social inequalities in health were investigated using a method decomposing inequality into determinant factors introduced by Wagstaff et al. [4]. These studies demonstrated not only a close relation between income and health, but also the influence of social status (generally captured by the socioprofessional category and level of education) and social protection on healthcare use and the health status itself [5].

In France, substantial disparities in mortality have been observed from one social class to another and from one education level to another [6–9]. These inequalities are among the highest in Western Europe, notably in terms of premature mortality in certain social classes [10]. Moreover, the risk of death is strongly correlated with income level and this relation is verified throughout the income distribution, independently of the effect of socioprofessional categories [11]. The income-related inequalities related to the frequency of health problems has been observed for highly varied diseases [12], such as respiratory and cardiovascular diseases, long-term illnesses, etc., as well as disabilities [13]. However, the analysis of social inequalities in health in France requires new research. The persistence of social inequalities in health [14,15], even though France has shown its willingness to reduce health inequalities by creating the *Couverture Maladie Universelle* (CMU) in 2000, demonstrates that this subject is not closed. In addition, it must be recognised that much of the French research on social inequalities in health uses mortality data. Even though these data allow one to follow the progression in inequalities over long retrospective periods, they only establish the result of social inequalities and do not shed light on the social processes that have led to these mortality disparities. As has been recently highlighted in this journal [16], health surveys do indeed provide health indicators that are less reliable than mortality, but they also make a number of other sociodemographic variables available that significantly broaden the perspectives of the explicative analyses of health inequalities.

This article sheds an economic light on the social inequalities in health derived from the French data. It completes the existing work from two points of view: the measurement of health and the measurement of social inequalities in health.

In measuring health, the individual health status is evaluated by self-reported health, thus describing a continuum of health statuses. Problems arise in the calculation of health inequalities based on self-reported health, which collects data on the individual objective health status but can be disturbed by interindividual variability in the responses, independent of this objective health status. Consequently, income-related health inequalities measured from this single indicator may tend to be poorly estimated. However, it is possible to correct this variability and improve the data on health status by applying an innovative cardinalisation method that we will illustrate in this article on the French data. This method is part of an attempt to provide a finer analysis of inequalities and therefore a more accurate assessment. It provides a more appropriate evaluation of health status and needs for health that better highlights policies aiming to reduce inequalities [17].

From the point of view of inequality measurements, this study implements an original method to measure inequalities that has not yet been applied to France. This methodology provides insight into the relations that exist between income, a variety of social determinants, and health. It is based on an explicative health model and concretely measures the contribution of each explicative variable to the formation of health inequalities using a decomposed concentration index. Decomposition is particularly advantageous because it empirically assesses the main hypotheses formulated to explain social inequalities in health. Do they stem from the strength of the dependent relation between income and health? From the size of income inequalities? From the influence of other socioeconomic determinants on health as well as their correlation with health? This methodology can therefore explain the more or less egalitarian distribution of health within a given population with regard to a previously defined health indicator and suggests public policy orientations.

2. Method

2.1. Measuring health

This study is based on a measurement of health that takes into account an enlarged definition of health. The perception that an individual has of his or her health remains an unavoidable variable of health surveys, which if necessary

encompasses all the physical and psychological dimensions of health. In France, few studies appreciate the analysis of income-related health inequalities based on this variable: the epidemiological, sociological, and demographic approaches prefer using mortality data or data from specific diseases that they deem to be less subjective. The heart of the debate seems to be knowing whether self-reported health is an adequate indicator of "true health," whereas, by definition, it is a subjective indicator of health. However, as underscored by Quesnel-Vallée [18], rather than attempting to define "true health," which remains an unobservable parameter, it is preferable to pursue using reported health indicators and to encourage methodological efforts to improve the comparability of individual responses.

Therefore, we measured health based on self-reported health, the declaration of individual variability of which is corrected by applying a cardinalisation method founded on the distribution of the Canadian Health Utility Index[1] (HUI). This method consists in transforming a self-reported variable initially described as categorical into a continuous variable by creating dispersion in its distribution from the distribution of a cardinal and continuous health variable observed elsewhere. This method presents two major advantages. First of all, using additional information on health can improve the information contained in the subjective health variable. Next, the interval regression model used to implement cardinalisation can make a self-reported explanatory health model including a vector of individual characteristics the basis of analysis. In this way, the individual variations in measuring health can be taken into account.

In addition to these two advantages, cardinalisation based on interval regression provides a more robust estimation than a traditional ordinary least squares model or an ordered probit model.

We therefore applied this model[2] to the French data. The self-reported health variable is a variable in five categories from the question: "How is your health status in general? (i) very good, (ii) good, (iii) fair, (iv) poor, (v) very poor." Table 1 shows that slightly more than 70% of individuals aged 16–60 years report that they are in good or very good health. Following the example of several European studies [5,21,22], we used the HUI estimated thresholds based on Canadian data by van Doorslaer and Jones [23]. These thresholds were obtained in a nonparametric context by matching the cumulated frequency of the five categories of self-reported health in Canada to the cumulated distribution of the Canadian HUI according to the hypothesis that the Canadian HUI distribution accurately describes the latent variable determining self-reported health. In the present study, we assume that this hypothesis is true not only for Canadians, but also for the French. Concretely, within an interval regression model, the six estimated thresholds – 0[3]; 0.428; 0.756; 0.897; 0.947, and 1[4] are matched to the five self-reported health categories.

Table 1
Descriptive statistics (ESPS 2004).

Variable	Mean
Income by consumption unit	1945.33
Age	37.82
Self-reported health	**Proportion**
Very good	20.6
Good	53.18
Fair	14.31
Poor	10.36
Very poor	1.55
Education	**Proportion**
No degree	46.37
With elementary or middle school degree	21.42
With high school degree or higher	32.21
Supplementary private health insurance	**Proportion**
Supplementary coverage	89.02
No supplementary coverage	7.57
UHC	3.41
Working status	**Proportion**
Employed	69.22
Inactive	2.88
Housewife	5.5
Retired	2.15
Unemployed	6.79
Student	13.45
Occupation	**Proportion**
Employee	28.05
Farmer	1.72
Independent	4.61
Executive	13.96
Technician	21.63
Skilled worker	21.47
Unskilled worker	8.56

[1] The Health Utility Index, hereafter designated by the acronym HUI, is a quality-of-life scale related to health. It provides a description of the subject's general health based on eight attributes: vision, hearing, speech, ambulation, dexterity, cognition, emotion, and pain and discomfort. For more information, please consult the internet portal of the Health Utility Group of McMaster University http://fhs.mcmaster.ca/hug/.

[2] An alternative method for correcting biases proposed by Perronnin et al. [19] consists in incorporating several morbidity variables collected in the survey. Their health measurement is built on a model based on a latent variable regression model explaining self-reported health status, while controlling for the number of diseases and their degree of severity, as well as other individual data such as social and demographic characteristics as well as lifestyle characteristics. This indicator was compared to the method proposed by van Doorslaer and Jones in an analysis of health inequalities [20]. The article demonstrates that the most important determining factors are the same for all indicators. On the other hand, the extent of the inequalities varies with the health indicator used: there are greater inequalities when health is assessed using the health indicator proposed by Perronnin et al. Given that the cardinalisation method proposed by Van Doorslaer and Jones has international renown, we have chosen to analyse inequalities based on this method and refer the reader to the comparative analysis in Tubeuf [20].

[3] For the worst health status possible.

[4] For the best health status possible.

The procedure that measures health, y_i, is based on predictions of a latent variable y_i^*, according to the following econometric model:

$$y_i^* = \alpha + \sum_{k=2}^{K} \beta_k x_{ki} + u_i \quad (1)$$

where $y_i = a$ si $c_{a-1} < y_i^* \leq c_a$ with $a = 1, 2, 3, 4$

The variable u_i is the normally distributed random error term, with a null mean and a constant variance. The variable $a = 1, 2, 3, 4$ describes the self-reported health categories and the variables c_{a-1} and c_a represent the estimated boundaries of the categories whose values were given above. The health measurement that is used in the follow-up of the analysis is therefore calculated according to the following equation:

$$\hat{y}_i^* = \hat{\alpha} + \sum_{k=2}^{K} \hat{\beta}_k \hat{x}_{ki} \quad (2)$$

The health variable is therefore linear and is expressed in units similar to those in the Canadian HUI. It is continuous and cardinal and presents good properties for the analysis of inequalities, such as continuity and cardinality.

2.2. Measuring and explaining inequality

For several years, many foreign economists as well as the international organisations have favoured the study of health inequalities in relation to income. For the most part making use of elaborate empirical methods, these studies have met the four following objectives: measuring health inequalities, identifying their determinants, assessing the contribution of each determinant to the increase or decrease in inequality, and finally orienting policy measures aimed at reducing inequalities [24]. Traditionally, income-related health inequalities in France have been measured by comparing mortality indicators or, more rarely, morbidity indicators for different socioprofessional categories [6–9,25]. However, the socioprofessional category is an insufficiently satisfactory aggregate for the observer. First, the detailed contents of a socioprofessional category are variable within a country from one date to another. Second, the socioprofessional category makes it difficult to rank the population. According to Wilkinson [26], the socioprofessional category is an artifact and cannot comprise a determinant of health status. Health inequality by socioprofessional category may stem from cultural or material effects. In the latter case, the socioprofessional category reflects no more than an income effect.

For these reasons, when data allow it, economists most often prefer to study income-related health inequality, which does not necessarily mean that a causal link between income and health is assumed, but that the differences in the mean level of health is being measured by income groups.

Income alone, however, remains insufficient to grasp the different economic and social mechanisms that may generate social inequalities in health and the simultaneous use of several socioeconomic status indicators is particularly relevant. The methodology developed by Wagstaff et al. [4] meets these objectives since it allows us to analyse health inequality in relation to income while taking into account these diverse mechanisms, for example, by measuring the respective role of the different factors associated with income that have an impact on health (education, working status, etc.). This methodology is based on a concentration index, which is comparable to the well-known Gini index, which can be decomposed so that the relative contribution of each of the factors involved in inequality can be measured.

Concretely, the concentration index of a variable y in relation to income r is defined by the concentration curve of y as a function of r. This curve links the cumulated proportion p of individuals in a population ordered by income level to the cumulated proportion y of the total available good health for this proportion of individuals (Fig. 1). The value of this index ranges from -1 to 1. A null value would mean that health is equally distributed over income categories, for example, that $p\%$ of the population ranked according to income corresponds exactly to $p\%$ of the total health for any value of p. A negative concentration index indicates favourable inequality to the poorest and vice-versa.

Let y_i be the individual health status of an individual i with a mean $E(y_i)$ and let R_i be the income rank of this ith individual in the income distribution, for example, the cumulated proportion of the population with at most the individual's income level i. The health concentration index is proportional to the covariance between the health variable and the relative income rank, expressed as:

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

The index's calculation is based on the estimation of the linear model described in Eq. (1), which explains health

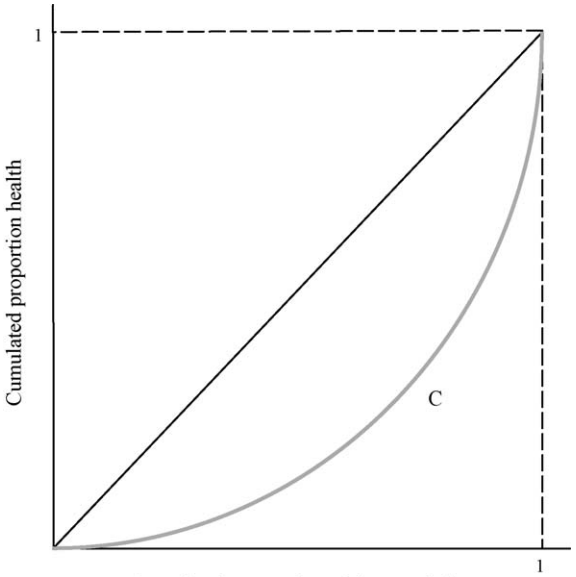

Fig. 1. The concentration curve C.

according to K individual variables such as age, sex, socioeconomic characteristics, etc. Taking into account the expression of the concentration index, the following composition is obtained:

$$C = \sum_{k=1}^{K} \left(\frac{\hat{\beta}_k \bar{x}_k}{\bar{y}} \right) C_k + \frac{2 \times cov(u_i, R_i)}{\bar{y}} \quad (4)$$

The concentration index of y is therefore equal to the sum of the two elements. The first represents the weighted sum of the concentration indices related to each determinant k, represented by C_k. Each of these concentration indices is weighted by the degree of sensitivity of health y compared to this kth determinant, which is also called health elasticity in relation to k. The second is a residual term representing the portion of inequality not explained by the model; it is null if the regression model includes income. In these models satisfying the moment condition, the errors are orthogonal to the income ranking [27].

Decomposition therefore specifies how each regressor explains total inequality in relation to income: its contribution is the result of its impact on health through elasticity and its inequality of distribution in relation to income expressed by the concentration index.

2.3. Data and variables

The data used in this study come from the IRDES Health and Health Insurance Survey (*Enquête Santé Protection sociale*) conducted in 2004.[5] Even though it is common to study health inequalities on the entire population [27,28], we underscore the relevance of conducting an analysis on a reduced age group, a working-age population, i.e. individuals aged 16–60 years. The particular relation between health and aging warrants this restricted population sample. Indeed, health status deteriorates with age and is therefore less influenced by income after 60 years of age. It has been demonstrated that income-related inequalities of poor health are more reliable for subjects over the age of 65. Using income, which is at the heart of our analysis, is also a motivating factor in opting for this reduced sample. However, income cannot be easily compared in working-age and retired populations. According to van Ourti [29], a rank based on permanent income is different from a rank based on current income and consequently the rank potentially provides a different degree of income-related health inequality. We therefore chose to base our analysis on the 16- to 60-year-old age group, giving us a sample of 7250 individuals.

The concentration index is based on ranking individuals according to income. We used monthly household income by unit of consumption. The monthly household income was generated from the Health and Health Insurance Survey data based on different sources of declared income. However, slightly less than 20% of households did not declare the exact amounts of their difference sources of income but instead declared their total income in income brackets. For these individuals, the continuous monthly income was attributed from interval regression analysis, based on their other sociodemographic characteristics. An income by consumption units was then calculated using an OCDE equivalence scale that attributes a weight of 1 to the first adult living in the household and then 0.5 to the other adults and 0.3 to every household member under 14 years of age. The analysis used the logarithm of income because this simple transformation gives good properties to the residual terms.

Table 1 describes the variables in the analysis. The mean household income by consumption units totals 1945 euros per month. This value is high, which is explained by the particular population studied and the fact that we were using an overall income level. Nevertheless, it should be remembered that the mean monthly income of a working-age individual was 1610 euros in 2004.[6]

As for the CMU, our data underestimate the proportion of beneficiaries since in 2004 it was 7% [30]. These differences between the real figures and our data stem from both our sample restricted to the working-age population and the inability to survey underprivileged households in most general populations surveys.

3. Results

First we estimated the interval regression model that explained self-reported health so as to generate the health indicator predicted from the HUI and then used in the inequality analysis. Then we analysed inequality in the two steps of the decomposition method. The first step involved the concentration indices of each regressor in relation to income. The second step was based on the value of overall inequality in relation to income and observed how each regressor contributed to the size of this inequality. In addition, this step evaluated the strength of the relationship between health and each regressor using elasticities.

3.1. The linear model explaining health

It is important to underscore that interval regression analysis does not provide a structural model of health; the estimators that come from this model therefore cannot be interpreted from a causal point of view. Nevertheless, this type of model is similar to a static model of health demand whose estimators give an indication on how the exogenous variations of the health determinants can affect the level of income-related health inequality [21].

Table 2 presents the results of the regression analysis. As expected, health decreases sharply with age independently of sex. Income positively and significantly influences health. Similarly, the most educated individuals have a significantly better health status than individuals without a secondary school

[5] For a detailed presentation of the Health and Health Insurance survey, please see the IRDES web site: http://www.irdes.fr/EspaceRecherche/Enquetes/ESPS/EnqueteESPS.html.

[6] According to the INSEE web site, www.insee.fr, heading *La France en faits et en chiffres*.

Table 2
Estimated coefficients of interval regression (ESPS 2004).

Variable	Coefficient	Standard error	*P*-value
Female 16–25 years	0.031	0.005	0.000
Female 26–35 years	0.008	0.004	0.063
Female 36–45 years	−0.011	0.004	0.008
Female 46–55 years	−0.043	0.004	0.000
Female 56–65 years	−0.049	0.006	0.000
Male 16–25 years	0.043	0.005	0.000
Male 26–35 years	0.011	0.004	0.010
Male 36–45 years	Ref		
Male 46–55 years	−0.036	0.004	0.000
Male 56–60 years	−0.052	0.006	0.000
Logarithm of household income by consumption units	0.011	0.002	0.000
No degree	Ref		
With elementary or middle school degree	0.008	0.003	0.007
With high school degree or higher	0.010	0.003	0.001
Supplementary coverage	0.014	0.004	0.000
No supplementary coverage	Ref.		
CMU (universal health care coverage)	−0.015	0.006	0.018
Employed	Ref		
Inactive	−0.140	0.007	0.000
Housewife	−0.005	0.005	0.011
Retired	0.009	0.008	0.222
Unemployed	−0.016	0.004	0.000
Student	−0.011	0.004	0.273
Employee	Ref		
Farmer	0.022	0.008	0.008
Independent	0.016	0.005	0.002
Executive	0.009	0.004	0.023
Technician	0.010	0.003	0.003
Skilled worker	0.001	0.003	0.804
Unskilled worker	−0.009	0.004	0.039
Constant	0.803	0.014	0.000

degree. Compared to individuals who are employed, being a housewife, retired, or unemployed significantly reduces the declaration of a good health status. The low proportion of inactive individuals in our sample probably indicates that these individuals are not working because of their health status. Nevertheless, we cannot rule out the fact that these individuals may declare a poor health status to explain their inactive status; this has already been demonstrated in the literature [30]. Whatever the case may be, unemployment as well as an inactive status remains associated with a higher risk of mortality in both men and women among individuals aged 16–60 years. Our result is comparable to recent research demonstrating that during the 5 years following a period of unemployment, the unemployed experience an approximately three times higher risk of death than the overall group of 16- to 60-year-olds, all other things being equal [7]. Unskilled workers declared a worse health status than white-collar workers, whereas independent workers, executives, and technicians declared a significantly better health status. Finally, having supplementary health insurance seems to be positively correlated to self-reported health. As expected, the CMU was negatively correlated with reported health: the eligibility conditions target the poorest individuals, who often are those in poorest health as well. The results of Boisguérin [31] also show that individuals tend to claim their right to CMU when they anticipate healthcare needs.

3.2. The income-related concentration indices

The first step of the decomposition method consists in calculating the concentration indices of each regressor as well as income-related health, presented in the second column of Table 3. A positive concentration index reflects a concentration of individuals in the upper income categories and inversely.

Our results demonstrate that the concentration index associated with health designated by $\hat{C}$ is positive and thus describes health inequalities in favour of the wealthiest individuals. The concentration indices of each regressor will now be interpreted. These concentration indices reflect the income distribution within each of the categories of the variables studied. The concentration indices associated with the youngest age groups are negative: the youngest individuals are concentrated in the lowest income groups, whereas individuals 46 years and older are concentrated in the higher income categories, independently of sex. Contrary to men, middle-aged women are among the poorest in the income distribution. Moreover, the income inequalities observed are most often to the advantage of men. Indeed, when the concentration indices are positive (respectively, negative) they are higher (respectively, lower) for men than for women. The concentration index associated with the logarithm of income is a one-dimensional concentration index and is therefore comparable to the Gini index.[7] Its positive value is an indication of significant inequalities in income distribution within the population. This inequality is greater than the total health inequality depending on income. As expected, having earned a secondary school degree or higher concerns individuals belonging to high-income groups, whereas access to elementary and middle school seems to be less socially inegalitarian. Housewives, students, the inactive, and the unemployed are concentrated in the lowest income levels, the poorest being housewives. As for the retired, they are concentrated among the higher incomes. Given that the sample concerns 16- to 60-year-olds, we can therefore assume that individuals who have left the labour market early did so for health reasons because they have no economic advantage to doing so. It is easy to imagine that the poorest individuals, even if they are in poor health, will either stop working for health reasons or continue to work despite their health concerns.

As for socioprofessional category, contrary to executives and technicians who belong to the most privileged social groups, all the other socioprofessional categories are subject to income inequalities. In particular, unskilled workers and farmers are the most affected by these inequalities.

[7] It should be noted, however, that a traditional Gini index is not calculated based on a logarithmic value but on a real value and that the logarithmic transformation implies a lower Gini index.

Table 3
Decomposition of the concentration index of income-related health inequality (ESPS 2004).

		Concentration index		
Total inequality $\hat{C}$		0.0064		
Variable	$\hat{C}_k$	Elasticity	Contribution	(%)
Female 16–25 years	−0.1555	0.004	−0.0006	−9.17
Female 26–35 years	−0.0136	0.001	0.0000	−0.23
Female 36–45 years	−0.0697	−0.002	0.0001	1.72
Female 46–55 years	0.0854	−0.006	−0.0005	−7.84
Female 56–65 years	0.1832	−0.003	−0.0005	−7.76
Male 16–25	−0.1284	0.005	−0.0007	−10.98
Male 26–35 years	0.0265	0.001	0.0000	0.51
Male 36–45 years	Ref			
Male 46–55 years	0.1116	−0.005	−0.0005	−7.90
Male 56–60 years	0.1549	−0.003	−0.0004	−6.56
Logarithm of household income by consumption units	0.0425	0.091	0.0039	61.00
No degree	Ref			
With elementary or middle school degree	−0.0297	0.002	−0.0001	−0.87
With high school degree or higher	0.2564	0.003	0.0009	13.96
Supplementary coverage	0.0537	0.014	0.0008	11.87
No supplementary coverage	Ref			
CMU (universal healthcare coverage)	−0.6969	−0.001	0.0004	7.05
Employed	Ref			
Inactive	−0.3157	−0.005	0.0014	22.60
Housewife	−0.3505	0.000	0.0001	1.78
Retired	0.2019	0.000	0.0000	0.72
Unemployed	−0.3253	−0.001	0.0004	6.09
Student	−0.1427	−0.002	0.0002	3.86
Employee	Ref			
Farmer	−0.2797	0.000	−0.0001	−1.84
Independent	−0.0553	0.001	0.0000	−0.72
Executive	0.4726	0.001	0.0007	10.46
Technician	0.2235	0.002	0.0005	8.13
Skilled worker	−0.2073	0.000	0.0000	−0.64
Unskilled worker	−0.3676	−0.001	0.0003	4.75

Finally, the concentration indices associated with supplementary health insurance confirm our suspicions. Having supplementary private health insurance is widespread in the overall population; nevertheless, the associated concentration index is positive and confirms that social inequalities exist in terms of obtaining supplementary private health insurance. In general, individuals who are not covered by supplementary private health insurance are the youngest individuals in good health, who have lower preferences for health, individuals who discontinue such insurance for financial reasons, or elderly women who had benefitted from their husband's coverage and who did not take out coverage for herself after their spouse's death [32]. This concentration index therefore confirms that generally speaking, access to supplementary private health insurance is difficult and particularly costly for low-income households [33]. As for the concentration index associated with the CMU, it is the highest of the concentration indices in absolute value and is negative since it is, by definition, in favour of the poorest.

3.3. Evaluation of the contributions to income-related health inequalities

The second step of the decomposition method evaluates the contribution of each regressor to total health inequality in 2004. The two right-hand columns of Table 3 present these contributions in exact values and in proportions of total inequality. The estimated elasticities are presented in the third column.

The greatest contributions to income-related health inequalities come from income, inactivity, having a high school degree, having supplementary private health insurance, and being in management or a technician. Income explains 60% of the inequality. This result is similar to other European analyses: it has been demonstrated that income explains approximately 60% of inequality based on Swiss data [34] and 102.5% based on Spanish data [21]. Moreover, based on the HUI, the health indicator predicts the most powerful relation to be with income: health elasticity is positive with income and particularly high. Income's strong contribution is independent

of the choice of income as a ranking variable in constructing the indicator.[8]

Inactivity also explains a large proportion of inequalities. In the population analysed, the inactive individuals for the most part do not work for health reasons and they are heavily concentrated among the poor and therefore are subjected to strong social inequalities in health.

Education level is strongly correlated to income: having an advanced degree is an important determining factor of inequality. Several studies referenced in the literature have demonstrated the protective role on health played by a high level of education [35,36].

In the question of whether individuals take out supplementary private health insurance and its high level of elasticity with health, social inequality makes access to this supplementary insurance another important income-related determinant.

Being an executive or a technician contributes to increasing income-related health inequalities in favour of socially privileged individuals. Those who belong to these socioeconomic categories enjoy better health status, as illustrated by the positive health elasticity with these variables. This result duplicates other health inequality analyses related to socioeconomic status that use a health measurement different from what was used in the current study, such as mortality or particular diseases [9,37].

Finally, certain age groups have a great influence on inequality, such as the oldest groups of the sample, particularly women. Their contribution is negative, thus contributing to a reduction in income-related health inequality. This reduction stems from the fact that the oldest individuals in the sample are both in poorer health (negative health elasticity with the categories concerned) and the wealthiest (concentration indices estimated to be positive). Asymmetrically, health elasticity with being a female between 16 and 25 years of age is positive and the strong negative contribution of this group to total inequality stems from its concentration among the lowest incomes despite these individuals' better health status.

Finally, it is interesting to point out that CMU provides 7% of the contribution to the size of the inequality. Since the concentration index of this variable was negative, its positive contribution is interpreted as a trend toward increasing the income-related health inequalities and can be explained by the negative relation between health and benefitting from the CMU: the individuals in poorest health are also the poorest, which increases their motivation to activate their right to the CMU.

4. Conclusion

This analysis brings out innovative results from both a qualitative and a methodological point of view.

The first step of the decomposition method makes it possible to analyse the concentration index of each factor depending on income distribution. These concentration indices are independent of the health measurement. They demonstrate income-related health inequalities in favour of the oldest individuals in our sample, in particular men, and in favour of the individuals with the highest education level, executives, and technicians. Moreover, they confirm income-related inequalities in the access to supplementary the private health insurance.

The second step of decomposition measures the relative contribution of each of the factors to total income-related health inequality and one can observe the power of the relation between health and this factor. Total income-related health inequality in favour of the highest income categories is explained essentially by the strong contributions of income level (61%), inactive status, mainly involving individuals in poor health (22.6%), social class (20%), level of education (13%), and access to supplementary private health insurance. Our research demonstrates that income and health are closely related and that income inequalities explain a large share of the social inequalities in health. However, income is not the only important factor. Other social determinants are the parameters of inequalities favouring the highest income groups: more egalitarian access to supplementary private health insurance and to employment as well as a reduction in income-related inequalities between social categories could reduce the contributions of these dimensions to total inequality, consequently lowering social health inequalities.

We also studied the role of universal healthcare coverage initiated in 2000 and observed that it is indeed those individuals in greatest need who benefit from the universal healthcare coverage, i.e. the poorest individuals and those in poorest health. However, although a similar analysis on the French data demonstrated that the CMU contributed to a reduction in inequalities concerning healthcare consumption (Huber, PhD dissertation, University of Paris X-Nanterre, 2006), our analysis only verifies that the reform indeed targets the population concerned. If changes in healthcare consumption can be observed over short periods of time, demonstration of changes in individual health status require long-term data.

This study stands out from other published works on the subject on several points. First of all, it provides an analysis of the French data centered on the measurement of income-related health inequalities based on health indicators of general health status that are supported by the WHO, the OCDE, and the European Community [38].

That said, many studies have emphasised that the choice of the health indicator influences the analysis of the underlying inequalities [22,39,40]. The cardinalisation method used herein can improve the self-reported health variable and construct a high-quality model to measure inequalities; nevertheless, it has certain limits. It would be preferable to have available the French health-related distribution of the utility index, so as not to have to rely on the correspondence established for a given population in Canada at a given date between the distribution of subjective health indicator and the distribution of the HUI indicator. Without a French health utility index similar to the

[8] Studies on intergenerational health inequalities show that the variable that contributes the most to inequalities was the income even though the ranking variable used to generate the index was father's longevity (Tubeuf, PhD dissertation, economics, Aix-Marseille University, GREQAM, 2008).

HUI, the health measurement method could be improved if the survey had vignettes[9] to correct any differences in how health is self-reported [41]. Cardinalisation in this case would be carried out on the corrected standards of self-reported health.

Finally, this research contributes more generally to the assessment of the reduction of inequalities. Decomposition can assess the contribution to inequality of some variables, thus shedding light on specific groups warranting policy improvements. In particular, these analyses suggest that reducing the association between income and health through different social determinants would be favourable to reducing social inequalities in health. Public decisions favouring equitable access to healthcare and supplementary health insurance coverage should be encouraged to reduce inequalities because they will likely decrease the strength of the relation between high income and better health.

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References

[1] Desplanques G. L'inégalité sociale devant la mort. La société française : données sociales 1993. Paris: INSEE ed; 1993.
[2] Marmot M, Wilkinson R. Social determinants of health. Oxford: Oxford University Press; 1999.
[3] Berkman LF, Kawachi I. Social epidemiology. New York: 2000.
[4] Wagstaff A, van Doorslaer E, Watanabe N. On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. J Econometrics 2003;112(1):207–23.
[5] van Doorslaer E, Koolman X. Explaining the differences in income-related health inequalities across European countries. Health Economics 2004;13(7):609–28.
[6] Mesrine A. Les différences de mortalité par milieu social restent fortes. Données sociales. Paris: INSEE ed; 1999.
[7] Mesrine A. La surmortalité des chômeurs : un effet catalyseur du chômage ? Economie et Statistique 2000;4:33–48.
[8] Leclerc A, Fassin D, Grandjean H, Kaminski M, Lang T. Les inégalités sociales de santé. Paris: La Découverte;2000.
[9] Menvielle G, Chastang JF, Luce D, Leclerc A, le groupe EDISC. Évolution temporelle des inégalités sociales de mortalité entre 1968 et 1996. Étude en fonction du niveau d'études par cause de décès. Rev Epidemiol et de Sante Publique 2007;55:97–105.
[10] Mackenbach JP, Stirbu I, Roskam AJR, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. New England J Med 2008;358:2468–81.
[11] Jusot F. The shape of the relationship between mortality and income in France. Ann d'Economie et de Statistique 2006;(83–84):89–122.
[12] Cambois E, Jusot F. Ampleur, tendances et causes des inégalités sociales de santé et de mortalité en Europe : une revue des études comparatives. Bull Epidemiol Hebdomadaire 2007;2–3:10–5.
[13] Boissonnat V, Mormiche P. Handicaps et inégalités sociales en France. Bull Epidemiol Hebdomadaire 2007;2–3:26–8.
[14] Melchior M, Berkman LF, Kawachi I, Krieger N, Zins M, Bonenfant S. Lifelong socioeconomic trajectory and premature mortality (35–65 years) in France: findings from the GAZEL Cohort Study. J Epidemiol Comm Health 2006;60:937–44.
[15] Elbaum M. Inégalités sociales de santé et santé publique : des recherches aux politiques. Rev Epidemiol Sante Publique 2007;55:47–54.
[16] Grignon M, Jusot F. Commentaire sur l'article de G. Menvielle et al. Évolution temporelle des inégalités sociales de mortalité en France entre 1968 et 1996. Étude en fonction du niveau d'études par causes de déces 2, RESP 2007, 55:97–105. Rev Epidemiol Sante Publique 2008; 56:209–13.
[17] Tubeuf S, Rochaix L. Mesures de l'équité en santé : fondements éthiques et implications. Rev Économique 2008;2(60).
[18] Quesnel-Vallée A. Self-rated health: caught in the crossfire of the quest for true health? Int J Epidemiol 2007;36(6):1161–4.
[19] Perronnin M, Rochaix L, Tubeuf S. Construction d'un indicateur continu d'état de santé agrégeant risque vital et incapacité. Questions d'économie de la Santé, IRDES 2006(special issue Health–Insurance–Equity); Méthodes (107).
[20] Tubeuf S. Income-related inequalities in self-assessed health: comparisons of alternative measurements of health, HEDG Working Paper Series 2008;WP 08/04.
[21] Garcia Gomez P, Lopez AN. Regional differences in socio-economic health inequalities in Spain 1973/74–2003. 2007.
[22] Lecluyse A, Cleemput I. Making health continuous: implications of different methods on the measurement of inequality. Health Econ 2006;15(1):99–104.
[23] van Doorslaer E, Jones A. The determinants of self-reported health inequalities: validation of a new approach to measurement. J Health Eco 2003;22:61–87.
[24] Wagstaff A, van Doorslaer E. Income inequality and health: what does the literature tell us? Ann Rev Public Health 2000;21:543–67.
[25] Monteil C, Robert-Bobée I. Différentiels sociaux et familiaux de mortalité aux âges actifs : quelles différences entre les femmes et les hommes. Econ Stat 2007;398–9. 11–31.
[26] Wilkinson R. Unhealthy societies: the afflictions of inequality. New York: Routledge ed; 1996.
[27] Gravelle H, Sutton M. Income-related inequalities in self-assessed health in Britain: 1979–1995. J Epidemiol Community Health 2003;57:125–9.
[28] Gakidou E, Murray CJL, Frenk J. Defining and measuring health inequality: an approach based on the distribution of health expectancy. Bull World Health Org 2000;78(1):42–54.
[29] van Ourti T. Socioeconomic inequality in ill-health amongst the elderly. Should one use current or permanent income? J Health Econ 2003;22:219–41.
[30] Kerkhofs M, Lindeboom M. Subjective health measures and state dependent reporting errors. Health Econ 1995;4:221–35.
[31] Boisguérin B. Les bénéficiaires de la CMU au 31 décembre 2003. Études et Résultats, DREES 2005; 381.
[32] Allonier C, Guillaume S, Rochereau T. Enquête Santé et Protection Sociale 2004 : premiers résultats. Questions d'économie de la santé, IRDES 2006;110.

[9] These vignettes correspond to typical cases of health status for which the survey assesses the health status of a fictive individual. This method is based on the hypothesis that postulates that the scale of responses used for these fictitious cases is identical to the scale that the individual uses for self-assessing his or her own health.

[33] Kambia-Chopin B, Perronnin M, Pierre A, Rochereau T. La complémentaire santé en France en 2006 : un accès qui reste inégalitaire. Questions d'économie de la Santé, IRDES 2008; 132.
[34] Leu RE, Schellhorn M. The evolution of income-related health inequalities in Switzerland over time. CESif Econ Stud 2006.
[35] Feinstein L, Sabates R, Anderson TM, Sorhaindo A, Hammond C. What are the effects of education on health? In: Desjardins R, Schuller T, editors. Measuring the effects of education on health and civic engagement – Proceedings of the Copenhagen Symposium. OECD ed. 2006. p. 171–313.
[36] Kunst AE, Mackenbach JP. The size of mortality differences associated with educational level in nine industrialised countries. Public Health 1994;84(6).
[37] Mackenbach JP. Health inequalities: Europe in profile. Report EU 2006; 272358 1p 2k Feb 06.
[38] Atkinson T, Cantillon B, Marlier E, Nolan B. Indicators for social inclusion in the European Union. Oxford: Oxford University Press. 2001.
[39] Humphries KH, van Doorslaer E. Income-related health inequality in Canada. Soc Sci Med 2000;50:663–71.
[40] Couffinhal A, Dourgnon P, Tubeuf S. Outils de mesure des inégalités : quelques débats d'actualité. Santé Société et Solidarité 2004;2004(2): 163–71.
[41] Lardjane S, Dourgnon P. Les comparaisons internationales d'état de santé subjectif sont-elles pertinentes ? Une évaluation par les méthodes des vignettes-étalons. Econ Stat 2007;403–4. 165–77.