Socio-Economic Health Inequality in Quebec

By Irena Kemives

(6134042)

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Supervisor: Professor Paul Makdissi

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[redacted]

Abstract

This paper uses data from the 2007 Canadian Community Health Survey to examine the socio-economic health inequality in the province of Quebec using the concentration index as an inequality measure. The concentration index is also decomposed by it's eight attributes (vision, hearing, speech, ambulation, dexterity, emotion, cognition and pain) as well as the fifteen health regions of Quebec in order to see what drives the overall inequality. The results show that the level of socio-economic health inequality experienced in Quebec is lower than that of the rest of Canada. The results also show the within-region inequality contributes more to the overall result than the between-region inequality and that pain and emotional health seem to experience the most inequality out of the attributes.

Introduction

In the 1970's, a movement had begun in Canada whereby health professionals began adopting a new view on health. Up until then, the health care system was based on an individualistic view of lifestyles and focused mainly on providing care for those who are ill. The new idea of health care took on an approach focusing on the determinants of health. This movement marked a shift toward a policy orientation paying more attention to the role of social environments in health. This meant that instead of health care being only the modification of individual risk factors and behaviours, it now encompassed the context and meaning of health actions (Kickbusch 2003).

Glouberman and Millar (2003) discuss how the notion of the broader determinants of health in Canada was initially started with the ideas of Thomas McKeown. McKeown believed that the rise in the population in the industrialized world beginning in the 1700's (characterized by a decline in the mortality from infectious disease) was not due to advancements in health care and public health measures as previously believed, but due to economic growth which raised the overall standards of living. In a body of work spanning three decades beginning in the 1950's, McKeown stressed that advancements in the social and economic environment such as better nutrition and an increase in income and class level contributed more to the decline in mortality than human interventions through public health measures like improved sanitation and a decline in prevalence of infectious diseases (Colgrove 2002).

Subsequently, McKeown's work influenced two different movements which are now collectively referred to as "population health" in Canada. These two movements include health promotion, which was first presented in the Lalonde Report of 1974 (Lalonde 1974), and research on inequalities in health by Fraser Mustard and the Canadian Institute for Advanced Research (CIAR) (Glouberman and Millar 2003).

An important contribution of the Lalonde Report was that it was the first to offer an idea of health policy beyond health care in Canada (Kickbusch 2003). Arguing that "equating the level of health with the availability of physicians and hospitals is inadequate" (Lalonde 1974), the report recognizes biology, lifestyle, environment, and health care organization as the main causes and underlying factors of illness. There are many novel ideas presented in the report that had not previously been addressed in Canada like, for example, examining populations at risk and studying their characteristics in order to assess the broader risk factors of illness. Recognizing the existence of socio-economic inequalities in health, the Lalonde Report highlights the need for the federal government to re-distribute income in such a way which "ensures everyone the essentials of life" (Lalonde 1974). The report also states that there is a need for changing the value system on which health care is based in Canada. Lalonde explains that it is not only the *curing* of the ill that should be the main focus of the health care system, but that just as many resources should be channelled into *caring* for sick patients.

The report recognizes mental health as a problem which needs special attention because of the stigma associated with it. It is recommended that important steps are required in order to change the prevailing social attitudes and deal with this increasingly important

health issue. Many other strategies are recommended by the Lalonde Report including health education and social marketing as a way to inform and convince people to lead healthier lifestyles, and a need for "regional health authorities with the power to plan and manage health care requirements of a given geographical area" (Lalonde 1974).

The recommendations of the Lalonde Report were well received by the governments looking to reduce the rising cost of health care in the 1970's. Many of the interventions which were implemented after being recommended by the report have had positive outcomes including for example a significant reduction in the national smoking rate (50% to 25%) as a result of health education messages and an increased use of seat belts due to new legislation (Glouberman and Millar 2003). However, as the development of new diagnostic and therapeutic technologies continued to drive up the costs of health care, health promotion came under scrutiny by many. It was argued that health promotion did not produce adequate savings as had been expected and that this approach was not conducive to reducing the medical expenditures as it called for increased costs in the indefinite future (Glouberman and Millar 2003).

As previously mentioned, Fraser Mustard and a group of researchers who were a part of CIAR's Program in Population Health were also influenced by Thomas McKeown's idea that the environment in which people lived in had the strongest influence on health. In their book "Why are Some People Healthy and Others Not: The Determinants of Health Populations" (Evans et al. 1994), they study findings from various disciplines to gain insight on how we as a society can mobilize our resources in order to improve our health. Systematic differences in health, or

"heterogeneities", across groups are argued to hold important insights about the determinants of health that cannot be seen when studying health across individuals (Evans et al. 1994). Recognizing the accepted correlation between health and social status, medical care is thus assumed to be another socio-economic institution. Thus, as we reach the limits of health care in dealing with illness, a new view of "risk factors" is adopted where social and economic environments are believed to have a greater impact on health than individual behaviours (Evans et al. 1994). The authors of the book believe that the reason the Lalonde Report failed to bring about as much change in the health policy as its supporters had hoped was due to the fact that it required overthrowing the prevailing belief system based on curative medicine which was not an easy task and was going to take some time. They argued that this belief is embedded in the structure and professional organizations which comprise the health care system and that resistance to change was a major obstacle (Evans et al. 1994).

In the early 1990's the Canadian provinces underwent a re-structuring of their health care systems (with the exception of Ontario) in response to reviews of the health services organization, laws and structures (Bernier 2006). An important feature of this change was the creation of health regions based on the recommendation of the Lalonde Report. During this time, population health was integrated into the health care services structure at both the regional and provincial levels of Quebec. Up until then Quebec's health policy focused mainly on improving the distribution of health care services, and, like the rest of Canada, it lacked adequate policy development to effectively reduce inequalities in health. Starting as early as

the 1970's, Quebec's health policy has undergone a complete and coherent evolution of its public health function at the provincial, regional and local levels (Glouberman and Millar 2003).

Quebec is Canada's second largest province, yet not a lot of emphasis has been placed on its health infrastructure within a Canadian context. However, Quebec has created a number of health policy instruments to support "comprehensive and coordinated public action" to improve the population's health (Bernier 2006). Bernier (2006) discusses how Quebec has implemented the public health approach by integrating legislative, organizational and programmatic instruments. Quebec's approach addresses socially determined inequalities in health through the development of "healthy public policies" for the whole government. Quebec differs from the rest of Canada in that it has integrated health care and social services within the same government department which reinforces social action in public health (Bernier 2006). In fact it has been said that "it's public health infrastructure is so much better organized than English Canada's that it could be used as a model for reform elsewhere" (Frank & Ruggiero 2003). It has also been shown that Quebec is second only to Ontario in their use of population health and health promotion research (Paluck et al. 2001).

Based on the knowledge that Quebec's health system is structured in a way that aims to reduce socio-economic inequalities in health, it would be interesting to explore the levels of inequality in Quebec. In this paper I will employ the concentration index to analyze income related health inequality in Quebec and compare it to previous findings for Canada. The paper will also compare the inequality among the health areas of Quebec by decomposing the concentration index in two ways; by population subgroups, i.e. the fifteen health regions of

Quebec, and by the eight index attributes of health. This breakdown will give a more complete picture of the sources of inequality within the population. The decomposition also allows us to look at how sensitive the various elements as well as individual regions are to inequality.

Measuring Health Inequality

There are many ways in which inequality can be quantified. Of the six measures of health inequality most used in the literature, Wagstaff et al. (1991) have shown that the concentration index (CI) and the related index of inequality (RII) are the only two that meet the minimal requirements of a good inequality measure. They set out the characteristics of a good inequality measures as being 1) that it reflects the socio-economic dimensions of the inequality in health, 2) that it reflects the experience of the entire population, and 3) that it is sensitive to the changes in the distribution of the population across socio-economic (Wagstaff et al. 1991).

The range, a measure which compares the differences between the top socio-economic group and the bottom one, fails to account for the experience of the intermediate income groups. It is possible for the gap between the extreme groups to get smaller while at the same time widening for the groups found in the middle, and the range would not account for this. Moreover, the range does not in any way account for the sizes of the groups it compares. This may lead to misleading results when comparing groups of people or determining how inequality changes within one group over (Wagstaff et al. 1991).

The Gini coefficient (and the Lorenz curve), a popular measure of inequality, ranks people by their level of health and does consider the entire population unlike the range. The Lorenz curve is a plot of the cumulative population, starting with the sickest and ending with the healthiest person, against the cumulative proportion of health. The curve is then measured against the diagonal which indicates full equality of health across the population. The farther away the Lorenz curve is from the diagonal, the greater the degree of inequality in the population. The Gini coefficient is a measure of twice the area between the Lorenz curve and the diagonal. If the curve coincides with the diagonal the Gini coefficient is zero and there is no inequality, and at the opposite extreme the coefficient is one and there is complete inequality (Wagstaff et al. 1991). However, the Lorenz curve and the Gini coefficient are not good measures of inequality because they fail to account for the socio-economic dimension of the inequality.

The pseudo-Lorenz curve attempts to overcome the shortcomings of the Lorenz curve. Using data grouped into occupational classes, the pseudo-Lorenz curve plots the cumulative percentage of the occupational classes (in terms of their health) against the cumulative percentage of death (Wagstaff et al. 1991). Since this approach still ranks individuals by their health it is still bound by the problem of the Lorenz curve in that it does not address the socio-economic dimension of inequality in health.

Another measure, the index of dissimilarity compares each socio-economic group's health share to their population share. However, once again, we run into the problem of omitting the socio-economic aspect of health inequality (Wagstaff et al. 1991).

The concentration index and the associated concentration curve are superior to the above mentioned measures of health inequality because they meet all three requirements set out by Wagstaff et al. (1991). The concentration curve can be used to analyze inequality in health as well as any other health variable of interest, and it can be used to compare inequality across time and across countries (O'Donnell et al. 2008). In order to plot the concentration curve, we need to have data on an individual's living standards, but it is possible to use grouped data when data at the individual level is unavailable. We also need a continuous measure of health because we are interested in the distribution of health, an example of such a measure is an index of health status, or we could also use a measure of ill-health such as child mortality. Thus the concentration curve plots the cumulative percentage of the sample ranked by income (beginning with the poorest and ending with the richest) on the x axis against the cumulative level of health (or ill health) on the y axis. In the case of grouped data, the mean level of health for each income group is plotted against the percentage of sample falling into each group. Figure 1 shows an example of a concentration curve. If each person's health was equal, regardless of their socio-economic status, the curve would be a straight 45 degree diagonal line known as the line of equality. If the measure of health is a positive like the level of health measured by an index where a higher value means better health, then when health is concentrated in the higher income groups the curve will be below the diagonal. This is because those better off will have higher levels of health status which would indicate a disproportionate concentration of health. The concentration curve would look the same as the previously mentioned Lorenz curve only if the ranking by health coincided with the ranking by socio-economic status (O'Donnell et al. 2008, Wagstaff et al. 1991)).

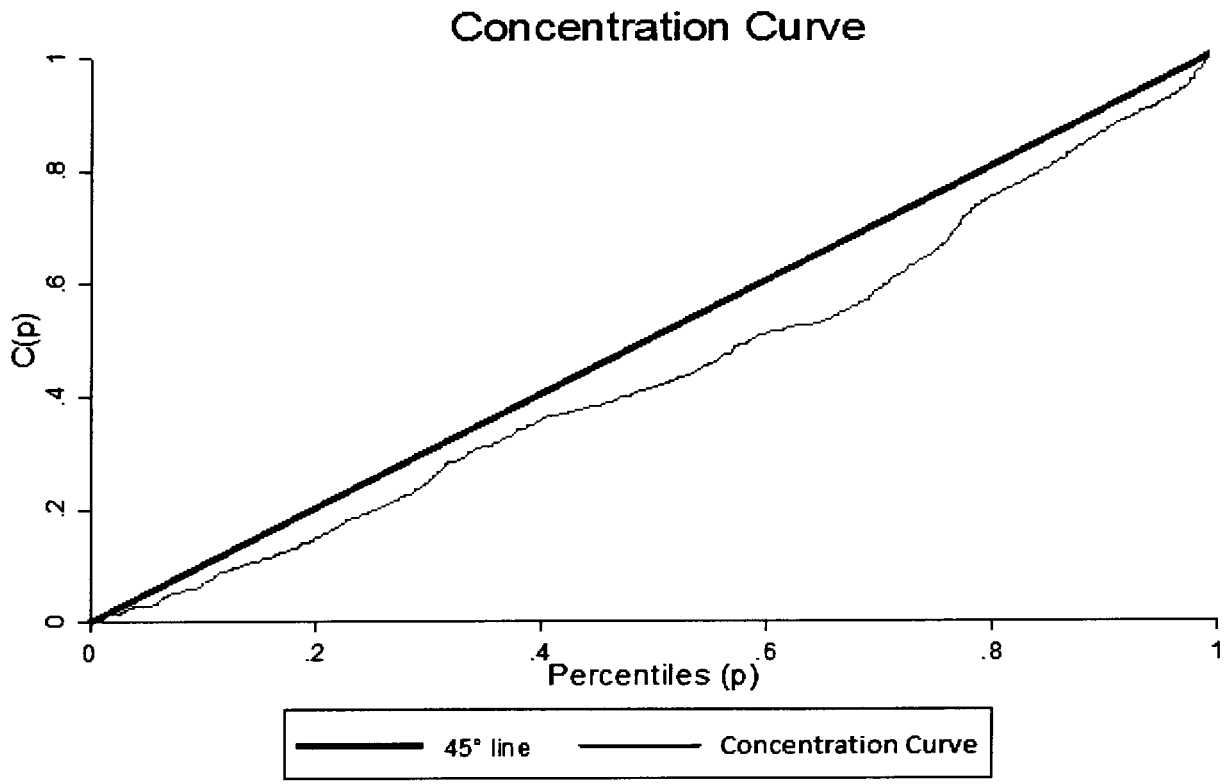

Fig. 1. Example of a concentration curve

The concentration index (CI) allows for a measure of magnitude of inequality that is captured by the concentration curve. This allows for convenient comparisons across time or different regions which are not possible by just using the concentration curve. The concentration index is defined as twice the area between the diagonal and the concentration curve. At one extreme, the CI can take on a value of -1 when the curve is above the line of equality (shape) and all the health is in the hands of the most disadvantaged. The opposite would be if the concentration index is 1 indicating the curve lies below the equality line

(⌊shape) and all the health is in the hands of the least disadvantaged (i.e. well off). If there is no inequality, the concentration curve coincides with the diagonal and the CI is zero. The measure of health can also be a "bad" such as child mortality and therefore a positive value would indicate that mortality is more pronounced among poor children.

As described in O'Donnell et al. (2008), the concentration index is formally defined as:

$$C = 1 - 2\int_0^1 L(\mathrm{p})dp$$

In this formula, $L(\mathrm{p})$ is the concentration curve. This can also be expressed as:

$$C = \frac{2}{\mu} cov(h, r)$$

In the case of individual data, h represents the person's health, μ is the mean level of health and r is the relative rank of a person within the cumulative distribution of income from poorest to richest (r_i=i/N for i=1 for poorest and i=N for richest). When group data is used, we can modify this expression to be:

$$C = \frac{2}{\mu} cov(\sum \lambda_t \mu_t, R_t)$$

Where λ_t is the population share of group t and μ_t is the group's mean health level such that the expression $\sum \lambda_t \mu_t$ represents the cumulative mean health level. R_t is the relative rank of the t^{th} income group.

From these equations it is clear that when we are using grouped data, the relative sizes of the groups, indicated by λ_t, are taken into account when calculating the concentration index. This is not the case for the range measure as previously discussed (Kakwani et al. 1997).

It is important to note that multiplying the health level variable by a constant does not affect the index as the CI is a measure of the *relationship* between the health variable and the rank in living standards. Another important consideration is that although the concentration index is a convenient measure of income-related health inequality shown by the concentration curve, it loses some of the information which the curve contains. For example, the index can be zero because no inequality exists, or because the areas above and below the diagonal cancel each other out. For this reason, it is best to examine the index in conjunction with the concentration curve (O'Donnell et al. 2008).

Like the concentration curve and index, the slope index of inequality (SII) and its counterpart, the relative index of inequality (RII) also meet the minimum requirements of an inequality measure. This approach involves calculating the mean level of health of each income group and ranking classes by their income. The SII is the slope of the regression line showing the relationship between the group's level of health and its relative rank. When using grouped data, the error term of this regression is heteroskedastic. Therefore, since Ordinary Least Squares is not an efficient estimator to use in this case, Weighted Last Squares is used instead. Wagstaff and Van Doorslaer, (1991) describe the method for calculating the SII and RII and show how they are related to the concentration index. The estimate of WLS can be obtained by running the following regression:

$$h_t\sqrt{\lambda_t} = 0 + \alpha\sqrt{\lambda_t} + \beta R_t\sqrt{\lambda_t} + u_t$$

Where h_t is the mean health level of the t[th] socio-economic group, $\sqrt{\lambda_t}$ is the square root of the proportion of the population of the group, R_t is its rank in the socio-economic distribution and u_t is a homoskedastic error term.

The regression is transformed by multiplying each term by the square root of the proportion of the population in each socio-economic group and there is no constant term. The SII measures the absolute effect of the rank in socio-economic status on a person's health level. Thus if a population's health doubled, the SII would double as well. However, this would only measure the change in the absolute differences, but the relative difference between health levels, which is measured by the RII, would not be changed. We can obtain the Relative Index of Inequality by dividing the SII by the mean level of health. Therefore, SII and RII are reliable measures of socio-economic differences in health levels because they rank individuals by their socio-economic status instead of health, they account for the distribution of the population and they reflect the experience of the population as a whole.

It can also be shown that the Concentration Index and the SII/RII are related (Wagstaff et al. 1991). Note that the calculation of the covariance between x and h can be obtained by running a regression of h on x. The coefficient from this regression is therefore:

$$\beta = \frac{cov(R_t, h_t)}{var\ (R_t)}$$

Thus we have:

$$C = 2\, var(R_t)(\frac{\beta}{\mu_t})$$

Thus the RII (and the SII) which is (β/μ_t) can be calculated using C and vice versa (Wagstaff et al. 1991).

Humphries and Van Doorslaer (2000) use the concentration index to measure the level of income related health inequality of Canadians using the 1994 National Population Health Survey (NPHS) data. The NPHS contains a self-assessed health question with the ability of describing five health states, referred to as the "subjective" measure of health status. The inequality measured by the concentration index using this question is then compared to that of the concentration index calculated by using the McMaster Health Utility Index (Mark III), seen as the "objective" measure of self-assessed health status because it is designed such that attribute weights are derived from the general population. Furthermore, the index takes into consideration important interaction terms between states of health in eight health dimensions (described in more detail in the next section) and thus has the ability of describing 972,000 health states. Their results show a concentration index of -0.1214 based on the (self-assessed) ill health question, and -0.0990 for the Health Utility Index. Although the inequality in terms of self-assessed ill health appears to be larger, the difference in the two was shown to be statistically insignificant.

Furthermore, using regression analysis, Humphries and Van Doorslaer (2000) examine whether there is a relationship between the objective and subjective measures of self-assessed

health status and income. Their findings show that both the intercept and the slope of the relationship between the two measures are affected by income. The authors show that income-related health inequality is likely to be higher when using a more subjective measure of health.

These results indicate that self-assessed health in Canada favours those who are better off, although somewhat less so when a more subjective measure of health is used. Van Doorslaer et al. (1997) showed an international comparison of inequality based on the concentration index using data from nine industrialized countries (eight European countries and the US). The results show the presence of income-related health inequalities, where those with higher incomes are healthier, in all nine countries. The concentration index calculation using a self-assessed measure of health (increasing in ill-health) ranges from -0.0347 in Sweden to -0.1360 in the US.

Data and Methodology

This paper will be using data from the 2007 Canadian Community Health Survey (CCHS), a cross-sectional survey which collects information related to health status, health care utilization, and health determinants for the Canadian population. The large sample of respondents is designed to provide reliable estimates at the health region level. In 2007, the CCHS became an annual survey (as opposed to bi-annual), and major changes were made to its design at this time. Furthermore, in this year of data collection, more detailed health status data is obtained at the level of sub-provincial health regions of Quebec.

The objectives of the CCHS as of 2007 are:

- support health surveillance programs by providing health data at the national, provincial and infraprovincial levels,
- provide a single data source for health research on small populations and rare characteristics,
- timely release of information easily accessible to a diverse community of users, and
- create a flexible survey instrument that includes a rapid response option to address emerging issues related to the health of the population.

Overall, there are 19, 261 observations across fifteen regions. Since data on individual income is not available in the CCHS, household income is used as an indicator of socio-economic status. Overall, there are six income categories. The target population of the survey is Canadians aged twelve and over. Excluded from the sample are individuals who live on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Forces, and residents of certain remote regions. Its coverage is in the range of 98% in the provinces, and smaller in the territories primarily due to the fact that some remote regions are excluded.

The data in the CCHS has three components: the common content, the optional content and the rapid response content. The common content is asked to all respondents and in general remains unchanged over a period of several years. The data collected in the rapid response content changes over time and it is collected in order to be offered to organizations who are

interested in obtaining national information regarding emerging issues related to the health of the population. The optional content is province-specific but harmonized across each province, and is asked as a response to a need for data at the regional level. This year, the optional content is asked to Quebec respondents and data collected in two different CCHS modules - Pain and discomfort (HUP) and the Health utilities index (HUI) allows for the calculation of a multi-attribute health status classification system for measuring generic health status and health-related quality of life (HRQL). The version of the index used by CCHS is called the HUI Mark 3 (HUI3), and it was developed in Canada at McMaster University by Health Utilities Inc.

The HUI3 allows for the calculation of a generic health status index based on eight attributes found in the HUI and has been used extensively in clinical studies as well as five major population health surveys in Canada (Feeny et al 2002).

The formula for the HUI3 is as such:

$$(1 + C) \times (W_1 \times W_2 \times W_3 \times W_4 \times W_5 \times W_6 \times W_7 \times W_8) - C$$

Where C is a constant in the model and W_1 to W_8 are preference weights for each attribute level. The constant used in the HUI3 is 0.371 (Kopec and Williamson 2003).

The eight attributes used for the calculation of the HUI3 are: vision, hearing, speech, ambulation or mobility (ability to get around), dexterity (use of hands and fingers), emotion (feelings), cognition (memory and thinking) and pain. They are scored such that each attribute is represented by two or more levels of health ranging for example from 1-"No Visual

Problems" to 5-"Problems seeing close and distance/No sight". The levels are chosen so that they imply structural independence. In other words, it is possible to choose a particular level in one attribute in combination with any level in any of the remaining seven attributes. Thus, levels across attributes are not assumed to be mutually exclusive and it is possible to have any combination of levels across categories (Kopec and Willison 2003). The weights are such that for example, Vision level 1 has the weight of 1, level 2 is 0.98, level 3 is 0.89 and so on. However, for Mobility, level 1 has the weight of 1, level 2 is 0.93 and level 3 has the weight of 0.86. The attributes are weighted using a previously defined model such that interaction between the different attributes is an assumption of the model. This interaction between attributes allows them to be either preference substitutes or preference complements. Preference substitutes means that a loss of function in one attribute has a lower effect on the measure of HRQL than an equal loss split between two different attributes, whereas preference complements implies that losing function in two attributes would have a worse effect on the level of HRQL than an equal loss in only one attribute (Feeny et al. 2002).

In a comparative review of four preference-weighted measures of HRQL, Kopec and Willison (2003) show that only the HUI3 captures sensory and cognitive impairments. Furthermore, because of its multiplicative form, the HUI3 has the highest descriptive power of the other measures because it has the capability of describing 972,000 health states.

Feeny et al. (2002) provide empirical evidence to show that the multiplicative form of the HUI3 accommodates important interactions in the preference between attributes and conclude that the eight attributes of the HUI3 system are preference complements. They show

this by conducting a modelling survey which allows for the estimation of preference scores for various health states. Furthermore, a direct survey is undertaken in order to obtain direct measurement of utility scores for a variety of health states. It is shown that the HUI3 performs well when directly measured scores for 73 health states are compared to scores from this function. They conclude that the HUI3 multi-attribute function has a high level of predictive validity.

As previously noted, each of the eight attribute scores are presented in two or more categories ranging from no problems to a loss of function in the specific attribute. However, calculating the concentration index from ordinal data would require an assumption on the distribution of the levels for each attribute. In other words, constructing an index with ordinal data would mean assuming that categories are scored such that they are relative to each other, which is not the case. For example, it would be false to assume that someone indicating level 2-"Somewhat happy" in the Emotion module is twice as happy as someone who indicates 4-"Very unhappy". There have been a number of ways presented to alleviate this problem, each with their benefits and shortcomings.

The first solution used by many researchers is to dichotomize the categorical variable by choosing a cut-off point at which health is either good or bad. Wagstaff and Van Doorslaer (1994) criticize this approach because of a loss of information when dichotomizing the variable as well as the effect of the arbitrary choice of cut-off point on the results. Another problem arising with this method is that it makes comparisons across countries and time periods harder and dependent on using the same scale and cut-off points which is generally not the case

(Wagstaff and Van Doorslaer 1994). An alternative way to handle this problem is suggested and it involves transforming the categorical responses into a continuous standardized latent variable. This solves the problem by analyzing inequalities in the continuous latent health variable rather than in the ordinal health indicator. However, this approach imposes a mean of zero on the health status variable thus making the standard concentration curve inappropriate. The standard concentration curve requires a positive mean on the health status variable whose distribution is being analyzed. As a result, Wagstaff and Van Doorslaer (1994) suggest using a generalized concentration curve. This curve is different from the standard concentration curve described in this paper because the generalized curve runs along the horizontal axis as opposed to being compared with the diagonal as is the case with the standard curve. Thus when there is no inequality in the newly constructed health variable, the curve would run along the horizontal axis. Negative values would then indicate health is concentrated in the lower income groups and positive values indicate health is concentrated in the higher income groups. The further away the curve is from the horizontal axis, the larger the level of income related health inequality, such that twice the area between the curve and the horizontal gives a measure of the level of inequality (Wagstaff and Van Doorslaer 1994). The main drawback of this approach (and other similar ways to impose cardinality by imposing a distribution on the ordinal variable) is the effect that the choice of distribution has on the final outcomes since it is chosen arbitrarily (O'Donnell et al. 2008).

Van Doorslaer and Jones (2003) propose another solution to the problem of studying inequalities when dealing with categorical health variable measuring overall health. They use an

OLS, ordered probit, and interval regression approach to scale the categories of the self-assessed health and validate the results by comparing them with the HUI measure in the Canadian National Population Health Survey. They conclude that the interval regression approach is superior to the other two because its results are closest to that of the HUI score (Van Doorslaer and Jones 2003). The main criticism of this method is that it relies heavily on the variables included in the prediction equation (O'Donnell et al. 2008).

Another solution proposed by researchers is the use of a scoring algorithm to construct a scale. This approach has been used in constructing generic index scores such as the HUI3 (O'Donnell et al. 2008).

Despite the caveats associated with dichotomizing the categorical variables, this technique is employed in this paper in order to construct standard concentration curves and calculate a concentration index for each of the attributes. The reason for this is to allow for comparison of the individual attribute scores with the overall index, the HUI, since we are looking to investigate which attributes contribute more or less to socio-economic inequality in health measured by the overall index. Furthermore, since the main goal is comparison, imposing a distribution on the data may result in incomparable results across categories since the scores in each attribute may have a different distribution as they have different number of categories and different levels of severity depending on the attribute. The variables are broken up so that for each attribute, a lack of problems or good health (level 1) is given a value of one and the rest of the categories (2 and up) indicating some problems, or bad health, are coded as

a zero. Thus for each socio-economic group the mean of the dichotomized attribute variable indicates the percentage of people who are in good health.

Another consideration we must make when calculating inequalities in health are the unavoidable effects of demographics. Surely, some inequality will always exist due to the fact that as people get older their health deteriorates, and these effects are expressed differently for men and women. Therefore, in order to account for this, we must standardize the health variable to consider the inequalities in income-related health conditional of age and sex, so that over-estimating these inequalities can be avoided.

There are two different methods of standardization, direct and indirect. Direct standardization is used when we would like the distribution of health across income groups to look like all the groups have the same age structure, but each group has its own intercept and age effect. On the other hand, indirect standardization corrects the distribution to what it would be if all groups had different age structures but the same mean age effect (O'Donnell et al. 2008). Since the higher income groups tend to have more people concentrated in the higher age groups, indirect standardization is more appropriate to use with this data set.

Using the indirect standardization method described in O'Donnell et al. (2008), we run a health regression:

$$y_i = \alpha + \sum_j \beta_j \chi_{ij} + \varepsilon_i$$

Where y_i is the indicator of health for individual i, χ_{ij} are dummies for each age-sex group (sixteen groups in total) and β_j are parameters. The age-sex dummies and the parameters are then used to generate an expected value for the health indicator as such:

$$\hat{y}_{\mathrm{i}}^{\mathrm{EX}} = \alpha + \sum_{j} \hat{\beta}_j \chi_{ij}$$

The indirectly standardized health variable, in this case either the HUI or the individual attributes, are given by the difference between actual and predicted values of the health variable, plus the sample mean.

$$y_i^{IS} = y_i - \hat{y}_{\mathrm{i}}^{\mathrm{EX}} + \bar{y}$$

The standardized variable gives us the distribution of the health status variable we expect to see if there were no differences on age and sex across income.

Decomposing the Concentration Index

While the Concentration index is a good measure of health inequality which takes into consideration socio-economic differences, it is possible to gain more information about the

specific sources of inequality within and between populations by means of decomposing the concentration index.

Clarke et al.(2003) demonstrate the decomposition of the concentration index in two different ways. One way that the index can be disaggregated is in terms of the components that it is made up of. For instance, when a health index is comprised of a sum of indices of physical health, mental health and emotional health then focusing on these parts separately will provide a clearer picture of how these components contribute to the overall inequality measure. Of course, how the components contribute to the index will also depend on how the index is calculated and what weight each component has.

Another way that the concentration index can be decomposed is by population subgroup. This may be based on characteristics such as gender, geographical location, occupation, or employment status.

The overall index is then a sum of three components:

$$CI = CI_W + CI_B + R$$

Where:

$$CI_W = \sum_{i=1}^{I} \frac{\mu_i}{\mu} \P_i CI_i$$

Where CI_B is the measure of "in between group" inequality and CI_W is the "within group" component and R is the residual that is a non-zero value when the income ranges within subgroups overlap. The within group component takes account of the mean health level of the groups (μ_i), the overall mean (μ) and the proportion of the population each region represents $(¶_i)$.

Clarke et al (2003) use Australian data to demonstrate the insights that are gained from decomposing the concentration index. They find that when decomposing by component (ten items) not all items contribute equally to inequality. Different items are shown to contribute between 5 % and 13% respectively to overall inequality when they contribute 10% and 5% of the total score. When decomposing by sub-group (employed vs. unemployed) they find that the inequality between groups is five times greater that of the inequality within each group.

Results

Decomposition by region

Table 1 presents the results of the concentration index for each region, as well as the overall concentration index for Quebec. It can be seen that the level of income related health inequality in Quebec is 0.01751. Figure 2 presents the concentration curve for Quebec. The positive results across regions show that health in Quebec favours those who are better off which is also seen in Figure 2 because the curve is above the line of equality.

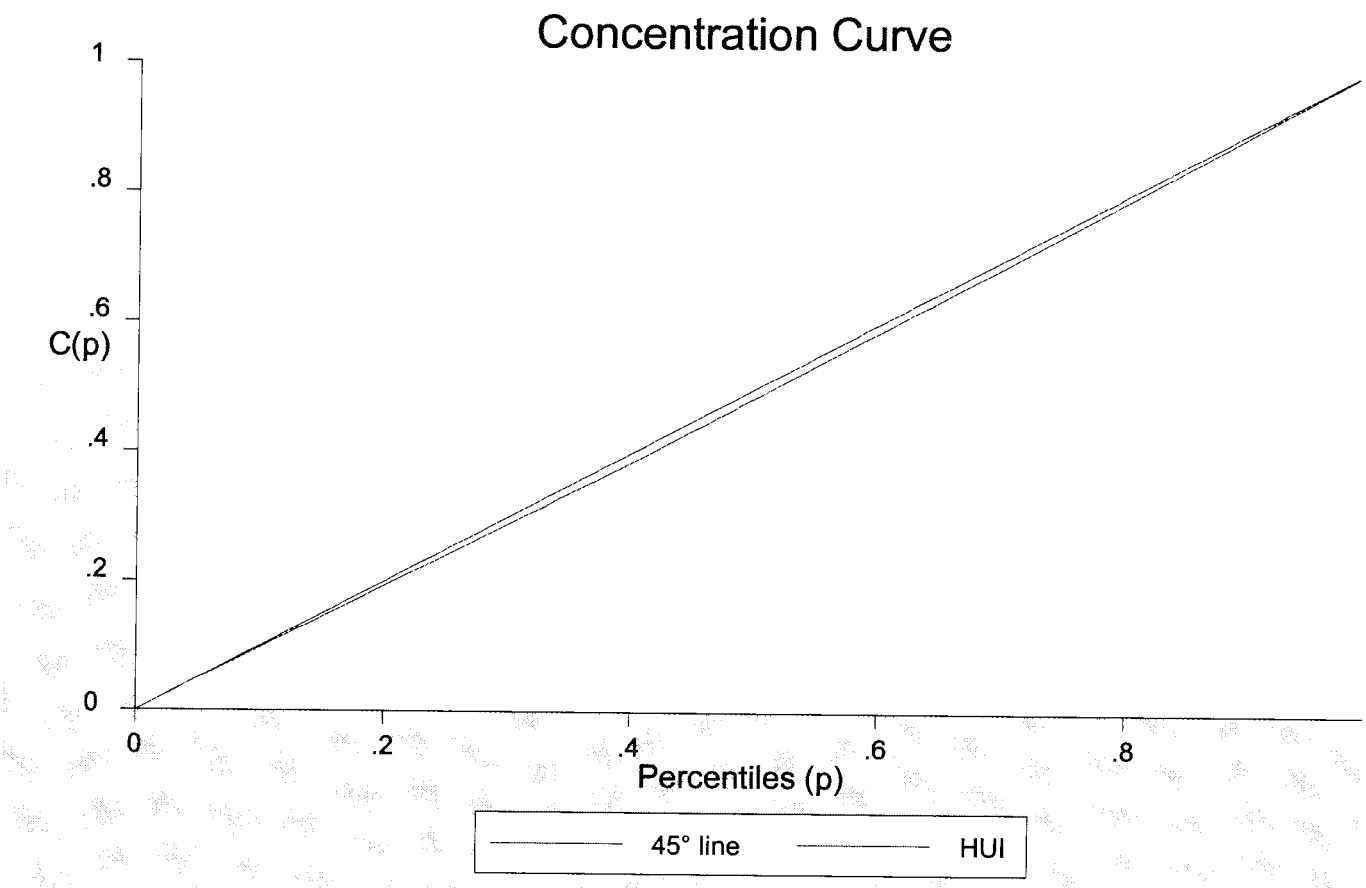

Fig. 2. Concentration Curve for Québec

REGION	Obs	CI_i	SE
Région du Bas-Saint-Laurent	1005	0.019324	0.003536
Région du Saguenay-Lac-Saint-Jean	1009	0.013114	0.003432
Région de Capitale-Nationale	1592	0.017491	0.002631
Région de Mauricie-Centre-du-Québec	1380	0.020783	0.002907
Région de l'Estrie	922	0.012525	0.003102
Région de Montréal	2424	0.019435	0.002433
Région de l'Outaouais	1060	0.01567	0.003352
Région de l'Abitibi-Témiscamingue	1102	0.030509	0.004147
Région de la Côte-Nord	1012	0.0156	0.003088

Région de la Gaspésie-Îles-de-la-Madeline	995	0.014336	0.003940
Région de la Chaudière-Appalaches	1163	0.014743	0.003195
Région de Laval	1081	0.012581	0.003330
Région de Lanaudière	1195	0.019549	0.003346
Région des Laurentides	1194	0.016282	0.003215
Région de la Montérégie	2127	0.01628	0.002405
Québec	**19261**	**0.01751**	**0.000809**

Table 1. Decomposition of the concentration index by region

The in-between region health inequality is 0.000173 and the residual is -0.000101132. The results show that most of the socio-economic health inequalities in Quebec come from the inequality within regions, and only a small portion is due to the inequalities between the different regions. The range of estimates of the concentration index for each region, C_i, goes from 0.012525 in region l'Estrie up to 0.030509 in region of l'Abitibi-Témiscamingue.

The in-between region inequality is obtained by assuming each person within a region has the mean level of health for that region. The small estimate for this indicates that the mean health status across regions in Quebec is relatively constant.

Decomposition by attribute

The estimates of the health inequality for each attribute are shown in Table 2. It can be seen by the positive results across all the attributes that better health is concentrated in higher income groups regardless of the kind of health problem we are focusing on.

ATTRIBUTE	CI	Mean	SE
Speech	0.001592	0.99512	0.000313
Dexterity	0.001939	0.993978	0.000306
Hearing	0.002123	0.973677	0.000642
Vision	0.002972	0.370749	0.0004910
Mobility	0.005201	0.966097	0.000711
Cognition	0.019675	0.802432	0.002028
Emotions	0.020943	0.746638	0.002404
Pain and Discomfort	0.022228	0.827216	0.001853

Table 2. Decomposition of the concentration index by attribute

The lowest level of inequality in all eight health attributes is seen for Speech at 0.001592 which means that speech problems seem to be more concentrated among the poor but only slightly. On the other side of the spectrum, the inequality in Pain and Discomfort is most pronounced among the attributes at 0.022228 and emotional health is a close second at 0.020943, meaning that poor people are more likely to experience pain and that those who are better off are less likely to have problems coping with their emotions.

Discussion

Decomposing the concentration index for Quebec has allowed us to break down the socio-economic inequalities in health into its components in order to gain more insight into the source and magnitude of these inequalities coming from various components. The decomposition by region allows us to see which regions are experiencing more inequity and the results have shown that the majority of the inequalities in Quebec which favour those who are better off stem from within-region inequalities as opposed to inequalities between the various regions. It has also been shown that pain and emotional health contribute more to inequality

than health problems involving loss of dexterity or speech ability. However, the concentration index for Canada at 0.1214, as reported by Humphries and Van Doorslaer (2000), shows that the inequality experienced in Canada as a whole is almost seven times that of the inequality experienced in province of Quebec (0.01751). In fact, Quebec has the lowest estimates of socio-economic health inequality using the concentration index when compared to the estimates for eight European countries and the United States calculated by Doorslear et al. (1997).

The relatively low levels of income related inequality in Quebec provides some empirical evidence that Quebec's approach to population health has been more effective in eliminating these inequalities than the rest of Canada. According to Glouberman and Millar (2003), the current public dialogue regarding health in Canada has been focused on the costs of delivery of health such that emerging issues related to inequality have not been adequately addressed. These issues such as aboriginal health, obesity and family poverty continue to worsen over time. Glouberman and Millar (2003) believe that Canada still lacks a national plan to deal with these major health issues which contribute to health inequality.

However, there are some precautions that need to be taken when interpreting the results. The dichotomization of the attribute variables from categories allows for comparison across attributes since the same cut-off point is used for all, but it may not provide accurate conclusions if used in comparison with data from other provinces or data from other years unless the same categories and cut-off points are used. Also, Wagstaff (2005) has shown that the mean of the binary variable places bounds on the values that the concentration index can

take where, the higher the mean, the lower the range of values of the concentration index. The index tends to zero as the mean reaches one and it tends to one as the mean reaches zero. However, a higher mean does not mean less inequality, and if the mean increases over time thereby increasing the value of the concentration index, inequality has not necessarily been reduced (Wagstaff 2005). Therefore, we must take the mean into account when analyzing these results. Lastly, it is important to consider the fact that people differ in how they assess their health and since the HUI is a self-assessed measure (even though it is considered to be "objective") there is some room for overestimating the index because of how people report their health status. As Humphries and Van Doorslaer (2000) have shown, the more subjective the measure, the more it is correlated with income level, thus overestimating the overall inequality. As pain and emotional health are the most subjective of the attributes, it makes sense that these would have the highest value of the concentration index, and therefore the effect of these on the overall inequality should be examined further.

A provincial comparison of inequality across Canada based on the Health Utility Index would be useful in determining which provinces are contributing to health inequality in Canada, and how inequality compares in between provinces. However, this has not been done to date because detailed data on health status across Canada for the same time period is not yet available. Future research on health inequalities in Quebec may want to examine how income needs to be re-distributed in order to achieve a concentration index of zero. Koolman and Van Doorslaer (2004) propose a linear redistribution scheme and show that it is superior to a lump sum redistribution scheme often used because the total amount of money that needs re-

distributing is smaller. This is because there is more money transferred to and from extreme income households (Koolman and Van Doorslaer 2004). This information would be useful in formulating policies outside the field of health while taking into consideration how this re-distribution may affect health or creating wealth redistribution programs specifically aimed at reducing inequalities in health.

It may also be useful to decompose the change in inequality over time in Quebec. Wagstaff et al. (2003) show that the changes in inequality over time can be decomposed into three parts: the effect of the changes in the mean level of the determinants of health, inequality in the determinants, and the changes in the effects of the various determinants on health levels (Wagstaff et al. 2003). This breakdown would allow for a clear picture of the reasons why inequality may change over time, in order to better show what impact certain policies may have on overall inequality and evaluate their effectiveness.

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