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The Challenges of Updating the Deprivation Index with Data from the 2011 Census and the National Household Survey (NHS)

BIESP BUREAU D'INFORMATION ET D'ÉTUDES EN SANTÉ DES POPULATIONS

In 2011, the Canadian National Household Survey (NHS) replaced the long-form census, introducing a potential bias regarding the small-scale use of NHS data and having an incidence on the deprivation index update.

This document outlines the methodological scenarios that were tested in order to update the 2011 deprivation index.

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Highlights

- The replacement of the long-form census by the voluntary National Household Survey (NHS) in 2011 led to a sharp increase in the global non-response rate.
- Updating the material and social deprivation index (MSDI) with 2011 data risks to introduce a non-response bias and lead to inaccurate results.
- Four versions of the 2011 MSDI featuring various adjustments were tested to assess its quality and to identify the most comparable and accurate version for longitudinal analyses.
- Differences between versions proved to be minimal. The version without any adjustments produces similar results to the other versions. It was selected as the simplest and easiest to compare to previous indexes.
- The 2011 MSDI update delivers very satisfactory results for the various analyzed criteria, but requires a complex and lengthy procedure needing the collaboration of Statistics Canada for use of their master file.
- The deprivation index remains a very good means of measuring social inequalities at the national, provincial, and regional level, especially when individual socioeconomic information is unavailable in administrative databases.

Québec

Introduction

From 1991 to 2006, the material and social deprivation index (MSDI) was developed on the basis of the Canadian Census of Population conducted every five years by Statistics Canada, applying a similar methodology. The index is composed of six indicators, three of which are taken from the short census form and three from the long-form version.

In 2011, the long-form census, which had previously covered 20 % of households, was replaced by the National Household Survey (NHS). The NHS form was sent to 30 % of households, but its voluntary nature led to a sharp increase in the proportion of non-respondents. A higher global non-response rate results in a heightened risk of bias that could make NHS estimates less reliable than those gathered from the long census form, especially at lower geographic levels. Since the deprivation index is based on the dissemination area (DA), the smallest enumeration unit for which data is released, we wondered whether the elaboration of a deprivation index along the same parameters as before was still a valid or reliable option. Could adjustments be made in the 2011 MSDI to take into account potential bias?

Methodology

To make it chronologically comparable, the 2011 deprivation index was produced (with a few exceptions) using the same basic methodology as applied in the original version based on 1991 Census data (Pampalon *et al*., 2009a). The same indicators employed to form the two material and social components of the index were kept.

Social component

- Proportion of individuals living alone.
- Proportion of lone parent families.
- Proportion of separated, divorced, or widowed individuals.

Material component

- Average income.
- Proportion of individuals without a high school diploma.
- Proportion of employed individuals.

These three material component indicators are provided by the NHS for 2011 data.

After adjusting five[1] of the six indicators using the direct standardization method to account for age and gender, a principal component analysis was performed to integrate the individual indicators calculated for the selected dissemination areas.

To try to minimize the impact of potential bias due to the use of the NHS, four versions of the 2011 deprivation index were produced and are briefly described below.

1. Version 1: Standardisation (direct method) of the three NHS indicators without adjustments to account for a higher non-response rate. It uses the conventional methodological approach employed to produce the MSDI.

2. Version 2: Similar to version 1, except that each NHS indicator was adjusted according to the 2006 estimates for dissemination areas (DA) presenting a high risk of bias.

3. Version 3: Similar to version 1, except that the value of each NHS indicator for DAs presenting a high risk of bias was adjusted based on estimates for neighbouring DAs deemed to have acceptable response rates.

4. Version 4: Similar to version 1, except the value of each NHS indicator was adjusted according to estimates derived from a higher geographic level, *i.e.* the census subdivision (municipality) for rural areas or the census tract for urban areas. Again, adjustments were only made to DAs presenting a high risk of bias. The higher a DA's non-response rate, the greater were the adjustment.

[1] The proportion of lone parent families could not be adjusted because, in this case, the family is the unit of analysis, unlike the other five indicators that use the individual as the unit of analysis.

Results

Many criteria were considered in order to assess the quality of the 2011 deprivation index compared to the 2006 version and to determine whether one or more of the four versions were better than the others.

First of all, the factorial structure of the 2011 index is similar to that of previous censuses for all four versions tested. The same two components — material and social — are readily apparent, and the total variability explained by these components is even higher than in 2006 (70 % in 2011 compared to 65 % in 2006 for Canada).

Second, it was important to verify that the proportion of the population covered by the 2011 index still represented a large majority of the population. We observed that the presence of dissemination areas with high global non-response rates had no major impact on the population covered by the index: 85 % of the population is used for the principle component analysis and only 3.5 % of the population is not covered by the index. This situation can be compared to that of the 2006 index. Version 3 is the least adequate according to this criterion.

Third, we examined the evolution of indicators by quintile, particularly the material component indicators derived from the NHS. Since the NHS is voluntary, we expected lower response rates for certain demographic groups, such as the wealthiest, the poorest, and the youngest. In consequence, we also expected fewer differences between the quintile groups in 2011 for the income, employment and education indicators constituting the five quintiles. The long term trend observed since 1991, therefore, should have been broken. This, however, was not the case. In Canada and in Québec, large discrepancies still exist between the material quintiles of the deprivation index for the income, employment, and education indicators (figure 1). This finding is valid for all versions.

Fourth, a look at quintile changes in DAs whose geographic links remained unchanged for two successive censuses shows that half of DAs maintained the same deprivation quintile. Most DAs that changed quintiles showed only limited movement (± 1), shifting from the third quintile to the fourth, for example. Analysis of these DA quintile changes between 2006 and 2011 shows that the distribution of discrepancies is similar to what it was between 2001 and 2006 (a period without changes to the census). There are slightly more changes, but the increase is not significant. Table 1 displays these comparisons for Canada with version 1. The results are comparable for all versions.

Fifth, we tested the 2011 deprivation index's ability to detect social health inequalities (SHI). We had already shown that the index, an ecological measure, underestimates real social health inequalities compared to the indexes calculated on the basis of individual data (Pampalon *et al*., 2009b); Pampalon *et al*., 2009c). However, in previous index updates, we found that using the version of the index that is centred on the period covered by the data (e.g. the 2006 version of the index used with the 2004-2008 death period instead of the 2001 version of the index) uncovered wider SHIs. The best version of the 2011 index should, therefore, also lead to the detection of wider SHIs when it is centred on a health data period. To accomplish this, we used the 2006 index (the version not centred on the data period) and the four versions of the 2011 index (the versions centred on the data period) to compare the: premature mortality rate (under 75), the suicide rate and the teenage fertility rate (under 20). The ratios of the most underprivileged group (Q5) over the most privileged group (Q1) of the adjusted mortality and fertility rates for the 2009-2013 period were compared.

Figure 1 **Evolution of average personal income, proportion of individuals without a high school diploma and proportion of employed individuals by material quintile of the deprivation index, 1991 to 2011, Canada**

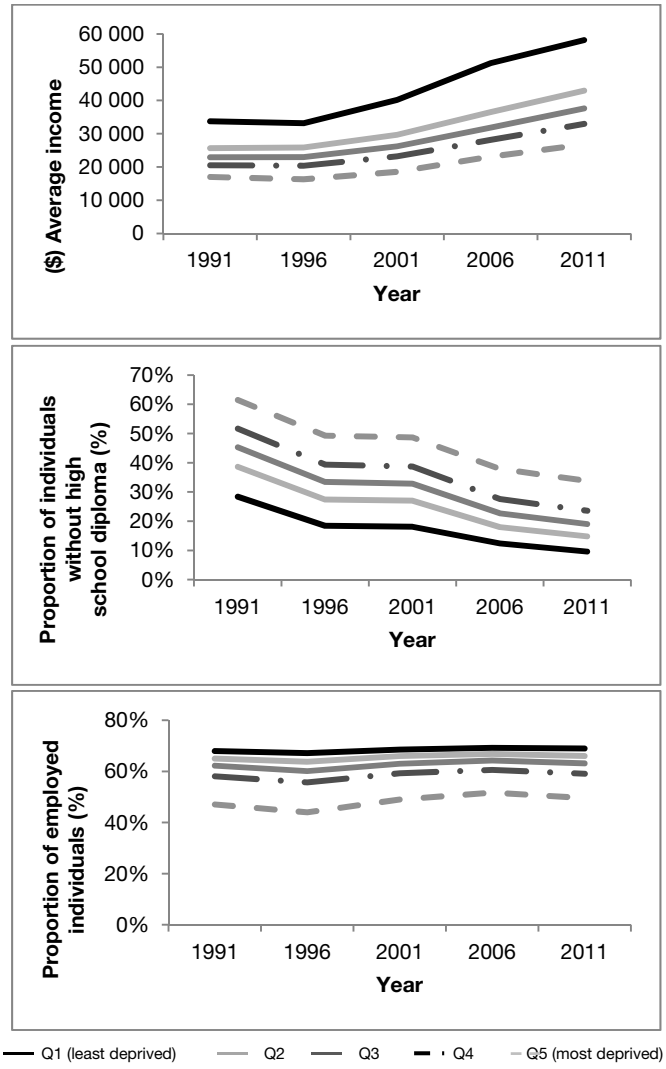


Table 1 **Quintile differences for material and social components between the deprivation indices 2001 and 2006 and between those of 2006 and 2011, version 1, Canada**

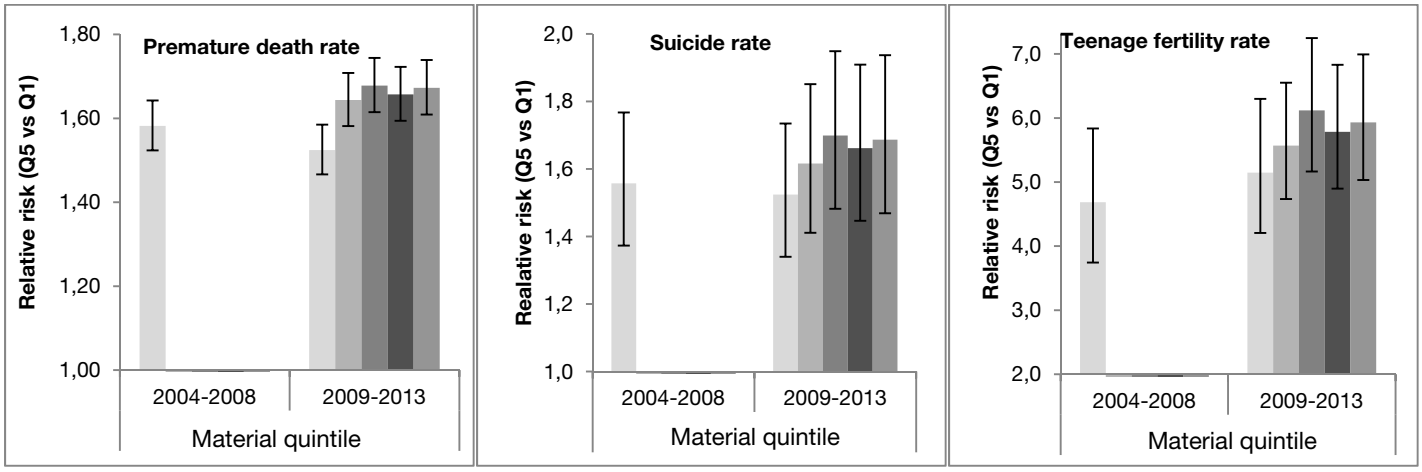
2001 versus 2006		
Absolute difference	**Material %**	**Social %**
0	**45.08 %**	**51.66 %**
1	**38.28 %**	**37.19 %**
2	13.12 %	9.16 %
3	3.08 %	1.71 %
4	0.45 %	0.27 %
Total	100.00 %	100.00 %

2006 versus 2011 (version 1)		
Absolute difference	**Material %**	**Social %**
0	**44.02 %**	**58.02 %**
1	**38.37 %**	**35.35 %**
2	13.89 %	5.87 %
3	3.35 %	0.71 %
4	0.38 %	0.06 %
Total	100.00 %	100.00 %

Figure 2 shows that the 2011 material component reveals greater inequalities in the premature mortality rate (under 75), the suicide rate and the teenage fertility rate (under 20) compared to the 2006 material components, regardless of which deprivation index version is used. In all three cases, version 2 of the 2011 index (adjusted according to the 2006 indicators) shows the largest disparities, though differences with the three other versions are not substantial.

A local validation study of the 2011 deprivation index was carried out with the help of regional stakeholders from two Québec health regions: Estrie and Montérégie. The validation study's purpose was to determine whether major quintile differences (± 3 or ± 4) between 2006 and 2011 in certain dissimination areas were the result of actual changes at the local level between the two censuses. The study proved inconclusive due to memory bias (e.g. Did the changes happen before or after 2010-2011? What was the situation on the ground in 2005-2006 in the involved DAs?) and the absence of comparison bases (it was the first validation study of its kind). Stakeholders nonetheless reported that only a third of major changes were wholly explainable. These results could have been similar in 2006 had this validation study been carried out back then.

Figure 2 **Relative risk[a] of premature death, suicide, and teenage fertility (under 20) among the most disadvantaged (Q5) compared to that of the most advantaged (Q1) group in the material component of the 2006 deprivation index and the four versions of the 2011 index, 2004-2006 and 2009-2013, Quebec**



[a] Relative risk adjusted for age, geographic area, and the other dimension of deprivation (social component).

Choosing a version of the 2011 index

Analysis of the results obtained from the four versions of the index's material component indicates that version 2 is slightly more effective at detecting inequalities. Differences between versions are, however, minimal in the majority of cases. At first glance, there is little noticeable difference between relative risk estimates obtained with any of the four versions. However, versions 1 and 2 have the most advantages on the operational and technical level. Version 2 is better at detecting inequalities and, by definition, at reducing the differences between 2006 and 2011, but it does have a major drawback in that it could be rendered obsolete in the future if the NHS were carried out again. In fact, it would be impossible to rely on 2011 NHS data to obtain data as reliable as that gathered in 2006.

The two other alternatives that were tested (versions 3 and 4) have a number of problems. When using version 3, it is sometimes difficult to find neighbouring DAs with overall non-response rates deemed "acceptable." The main shortcoming of version 4 is that the DA is contingent on the higher geographic level. As the size of the higher geographic level, especially for the census subdivisions, can vary considerably, comparisons are harder to draw.

As a result of these considerations, version 1, which does not adjust the value of the three indicators constituting the material deprivation component, is selected. Our preference is justified because version 1 gives results similar to the other versions, but without the adjustments. It is also the simplest and easiest version to compare to previous indexes. Furthermore, version 1 does not introduce a new form of bias, as could be the case with the other versions. In fact, had the NHS not been replaced, the original version (which is identical to version 1) would have been reproduced in 2016 (which would not have been the case with version 2, for instance, which was adjusted according to the 2006 indicators).

Findings and recommendations

Most of our findings bode well for the validity of the 2011 deprivation index, which is partially based on NHS data at the dissemination area level. Not only is the factorial structure similar to that of past index versions, but the total variance explained by the material and social components is even higher than in 2006. The proportion of the population covered by the index is nearly as large as for previous censuses. Quintile analysis of the six deprivation indicators continues to reveal severe inequalities, particularly between the most advantaged and disadvantaged groups. Despite slightly wider variations, changes in quintiles observed at the DA level between 2006 and 2011 are not distributed differently from those reported between 2001 and 2006. Furthermore, the 2011 index continues to not only detect significant health inequalities, but it also represents a clear improvement over the 2006 index when used to analyze recent data from 2009 to 2013.

None of the four versions is truly superior to the others. Therefore, version 1 of the index, which uses no adjustments, is our choice. It is the simplest and the easiest to compare to previous indices, and the most readily reproducible. Not to mention that selecting any of the three adjusted versions risked introducing a new form of bias.

Although the 2011 MSDI update delivers very satisfactory results for the various analyzed criteria, it was a complex and lengthy procedure that would have been impossible without the collaboration of Statistics Canada for use of their master file.

We recommend the index for assessing the breadth of social inequalities at the national, provincial, and regional level or for introducing a socioeconomic measurement as a control and adjustment variable in statistical analyses that would otherwise have to be performed without it. The deprivation index is in this instance a very good means of measuring social inequalities, especially when individual socioeconomic information is unavailable in administrative databases.

Nevertheless, the index has never been a perfect tool and cannot meet all needs. Because of the problems related to the National Household Survey, it should be used with considerable caution. We also caution prudence when the index is used at the low local level, especially when comparing dissemination areas. We note that a significant share of DAs changed quintiles in between censuses, sometimes markedly so compared to the previous census. These changes may result from concrete differences in the field, but this could not be verified. In other cases, they can be caused by methodological bias, especially the overall non-response rate. When used at the local level, an interpretation of the 2011 deprivation index should always include the global non-response rate for each dissemination area and an indicator of the discrepancy between census-estimated population numbers and those provided by the National Household Survey. Whenever possible, the 2011 index should be compared to the 2006 deprivation index and, eventually to the 2016 deprivation index, with the last two serving as validation tools. Despite the above caveats, the deprivation index remains much more robust at the local level than income, education, and employment estimates considered separately.

References

Pampalon, R., Hamel, D., Gamache, P., & Raymond, G. “A deprivation index for health planning in Canada.” Chronic Diseases in Canada, Maladies Chroniques au Canada (2009a), 29 (4): 178–191.

Pampalon, R., Hamel, D. & Gamache, P. “Health inequalities in urban and rural Canada. Comparing inequalities in survival according to an individual and area-based deprivation index.” Health & Place (2009b), 16: 416–420.

Pampalon R., Hamel, D. & Gamache, P. “A comparison of individual and area-based socio-economic data for monitoring social inequities in health.” Health Reports (2009c), 20 (4): 85–94

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