

Material and social deprivation index: A summary

OVERVIEW OF THE METHODOLOGY

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1 Introduction

In Quebec, the deprivation index was created first and foremost to overcome the lack of socioeconomic data in most administrative databases. Developing an ecological proxy was the only way to monitor social inequalities related to important health issues such as mortality, hospitalization and the use of health services. The proxy's main purpose is to assign area-based socioeconomic information to every individual by linking the geography of the census with the one found in the administrative databases. As a result, the index assists in the surveillance of social inequalities in health in Québec and Canada since the end of the 1980s. While it was shown that the deprivation index underestimates inequalities (Pampalon, Hamel, Gamache, 2009), it is the best alternative in the absence of socioeconomic information.

2 Construction

2.1 Geographical unit

The deprivation index is based on small area units from the Canadian censuses, namely the enumeration areas (EA) in 1991 and 1996 and the dissemination areas (DA) in 2001, 2006, 2011 and 2016. These territories are the smallest geographical units available in the census for which estimates are released and they are relatively homogeneous in terms of socioeconomic conditions. One of the main advantages is that these small areas can be linked to postal codes found in most administrative databases.

On the grounds of their low population number, the presence of collective households and other factors, some geographical units were excluded from the calculation of the index. Between 1991 and 2016, the proportion and number of geographical units which were included, increased significantly (from 88% to 94%). At the same time, the mean population size in these units decreased, from an average of 702 individuals in 1991 to 572 individuals in 2006, with a slight increase after 2006 (603 individuals in 2016).¹

2.2 Indicators

The deprivation index is built from six socioeconomic indicators drawn from the 1991, 1996, 2001, 2006, 2011 and 2016 censuses, including the 2011 National Household Survey (NHS). These indicators were selected because of their known relationship with health status, because of their association with both the material and the social aspects of deprivation, and because of their availability by EA/DA.

These indicators are:

- The proportion of the population aged 15 years and over without a high school diploma or equivalent;²
- The employment to population ratio for the population 15 years and over;
- The average income of the population aged 15 years and over;
- The proportion of the population aged 15 and over living alone;
- The proportion of the population aged 15 and over who are separated, divorced or widowed;
- The proportion of single-parent families.

Since the variations sought by the index are mainly socio-economic and not demographic, and because those indicators can be biased by the age and sex structure of the EA or DA populations, they were all standardized according to the age and sex structure of the Canadian population (except for the lone-parent family indicator) using the direct standardization method. When needed and possible, a linear transformation was carried out to preserve data normality.

¹ See a comparative table with the number and mean population of the base geographical units and the total population and population included in the deprivation index for Québec, from 1991 to 2006 (Pampalon, Gamache, Hamel, 2011, table 1 and 2).

² The question on which this indicator is based was reformulated in the 2006 Census. For details : <https://www12.statcan.gc.ca/census-recensement/2006/ref/rp-guides/education-eng.cfm>

2.3 Combining the indicators

The indicators were combined into a deprivation index through principal component analysis (PCA). This kind of analysis provides a general factor structure (a set of components) and, for each of these components, a factor score for every EA or DA. Many PCAs were conducted for various geographical areas and two components were systematically identified: a material component and a social component. While the former mainly reflects low income and education and a low employment to population ratio, the latter implies being separated, divorced or widowed, living alone or in a single-parent family.

In addition, when constructing the index, some EA-DAs were temporarily excluded because information on income was lacking (e.g., in sparsely inhabited areas). For these areas, an income value was imputed from the values of the other five indicators in the index, and for comparable locales (belonging to the same geographic area).³

The EAs/DAs are first ranked on the basis of their factor score - from most privileged to most deprived. Then the distribution of EAs/DAs is divided into quintiles, or increments of 20%. Quintile 1 represents the population living in the most privileged EA/DA and quintile 5 the one living in the most deprived one. These processes were performed for the material component and the social component separately. Finally, as shown in Figure 1, the quintiles of the material and social components can be cross-tabulated in order to identify the least and the most deprived EAs/DAs in both, the material and the social aspect of deprivation. The matrix thus distinguishes 25 different groups.

Over the years, the need to work with a smaller number of groups arose. Thus, the cells of the original 25-cell matrix were grouped in various ways. The choice of regrouping depends on the context of the study, the health issue of interest, the number of observations in each cell, etc. That being said, to create a combined deprivation index, we found that the two following quintile groupings are preferable in most cases.

Figure 1 Cross tabulation of the material and social deprivation quintiles

		Social					Total material deprivation
		Most privileged				Most deprived	
Material		Q1	Q2	Q3	Q4	Q5	
	Most privileged ↓ Most deprived	Q1					
Q2							20%
Q3							20%
Q4							20%
Q5							20%
Total social deprivation		20%	20%	20%	20%	20%	100%

³ For details: Pampalon, Gamache, Hamel, 2011.

Figure 2 First suggested grouping for the creation of a combined deprivation index from quintiles

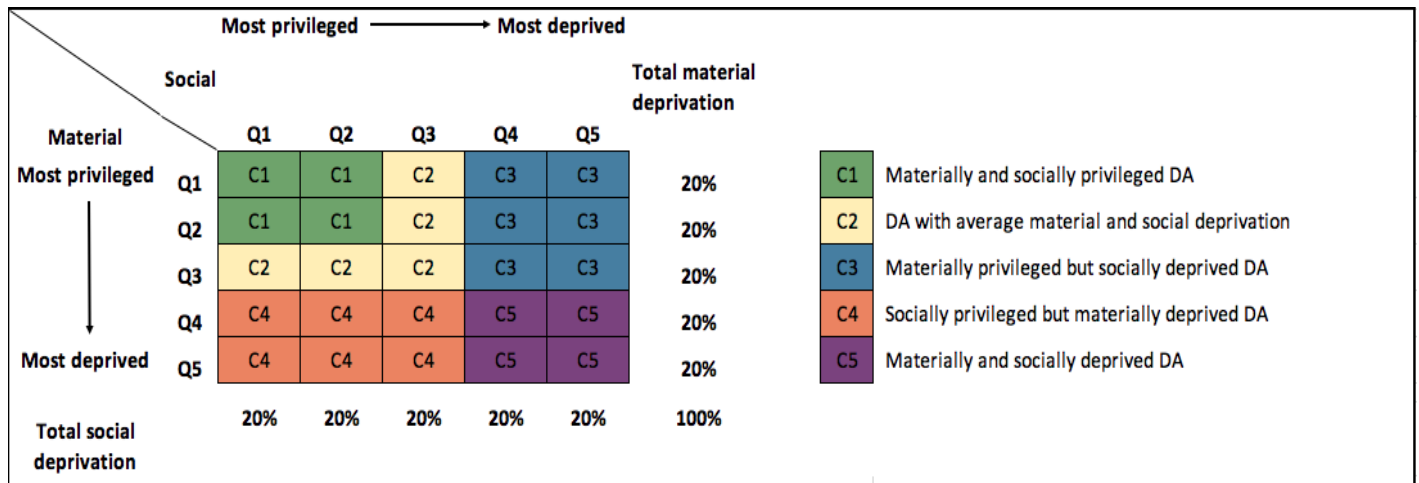
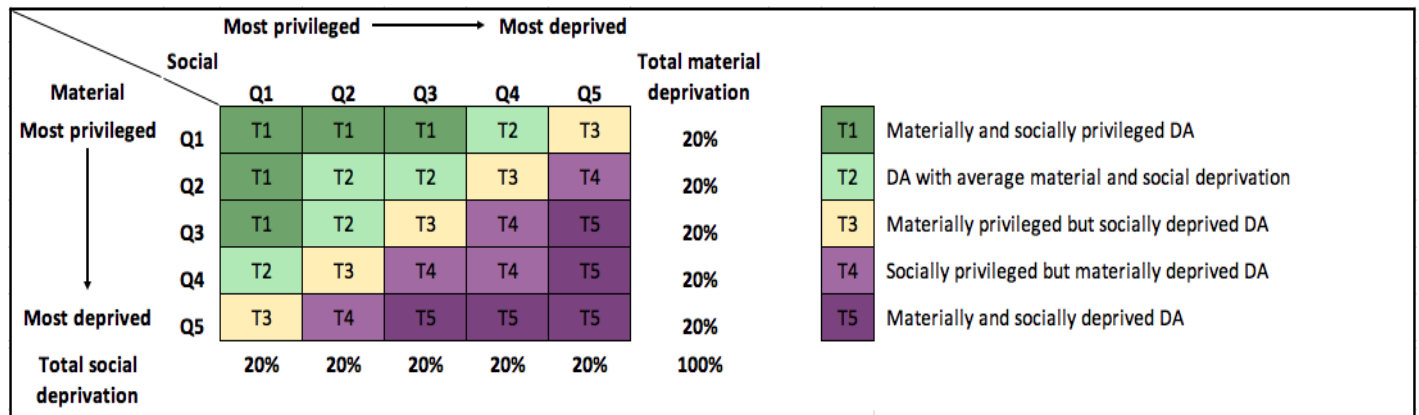


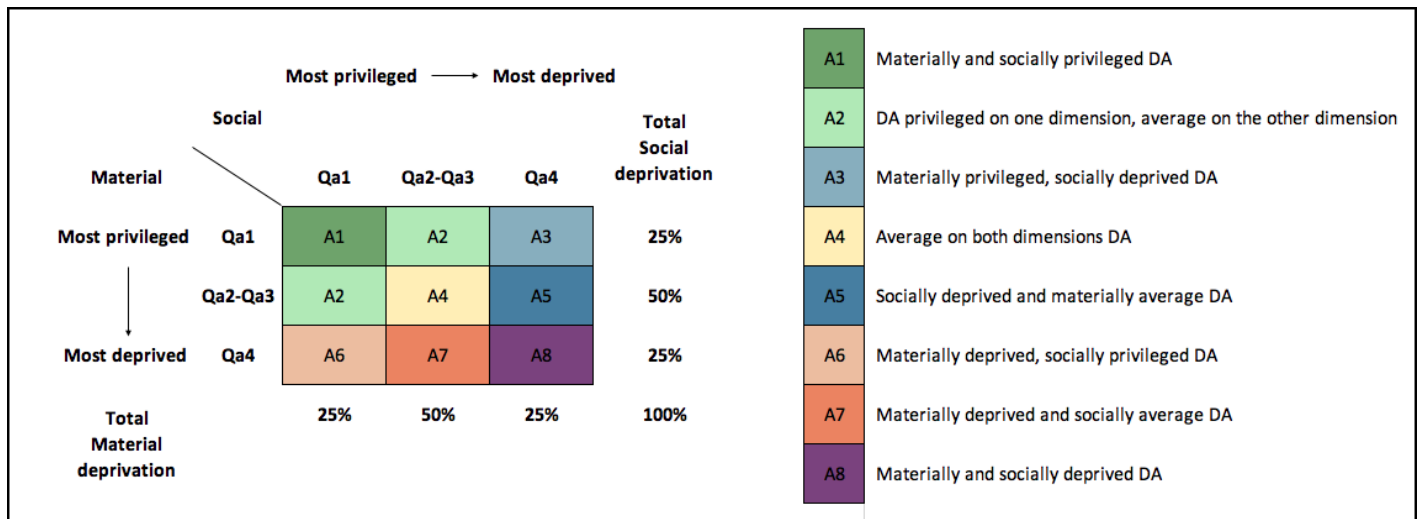
Figure 3 Second suggested grouping for the creation of a combined deprivation index from quintiles



The first suggested grouping (figure 2) has the advantage of creating clear deprivation profiles: privileged on both dimensions (group 1), slightly deprived (group 2), privileged on one dimension but deprived on the other dimension (groups 3 and 4) and finally deprived on both dimensions (group 5). However,

this proposition creates five groups of unequal sizes. Indeed, groups 1 and 5 are usually smaller, while groups 3 and 4 are larger. The second grouping proposition (figure 3) creates groups of mostly equal sizes and basically creates new quintiles.

Figure 4 Suggested grouping for the creation of a combined deprivation index from quartiles



When working with only a small part of the Quebec territory, such as the CLSC areas, the population living in that area could have a different quintile distribution than the population of the whole of Quebec. Thus, it is possible that an entire local community appears as deprived when compared to all of Quebec even though, inside the local community, individuals show varying levels of deprivation. In order to bypass this problem, the DAs and their populations were grouped using only the index values occurring in the CLSC area. In this manner, a local (instead of the national) reference for deprivation variations is created. To do so, the index values on both dimension of deprivation were first sorted from the least to the most deprived AD and then grouped into quartiles (25% of the population), creating the most privileged group (quartile 1), an average deprived group (quartiles 2 and 3) and the most deprived group (quartile 4). Finally, the quartiles were cross-tabulated into 9 cells showing the variation in material and social deprivation simultaneously.

The choice of quartiles rather than quintiles (such as the one used for all of Quebec) is required because of the smaller populations at the local level and the need for maintaining a certain statistical precision. Figure 4 illustrates these groupings, detecting differences between extreme groups and facilitating the study of deprivation in small areas which would not show a variation in deprivation at the Quebec level. The only drawback is the unequal size in the groupings, ranging from 6,25 % to 25,0 %.

3 Index versions

Several versions of the index were created in order to cover the different census years and geographical areas. Different versions of the index for national, regional, local and geographical zones (Table 1) are created for each census year through different PCAs and population redistributions.

For Canada, the national version covers all ten provinces and the three territories. The regional version presents the variations in deprivation within the five Canadian regions, namely the Atlantic Provinces, Québec, Ontario, the Prairies and British Columbia. The three territories are excluded from this version. The metropolitan version compares inequalities within each of the three largest census metropolitan areas (CMAs) which are Montreal, Toronto and Vancouver. Finally, the version for geographical zones distinguishes four large geographical entities, i.e. the three largest CMAs (Toronto, Montreal and Vancouver) together; all the other CMAs combined (between 100 000 and one million people); all the census agglomerations (CA) combined (between 10 000 and 100 000 people) and the small towns and rural regions combined (less < 10 000 people).

Table 1 Different versions of the Material and Social Deprivation Index

	1991	1996	2001	2006	2011	2016
Canada						
National	X	X	X	X	X	X
Regional	X	X	X	X	X	X
Metropolitan	X	X	X	X	X	X
Geographic zones	X	X	X	X	X	X
Québec						
National	X	X	X	X	X	X
Regional	XY	XY	XY	XY	XY	XY
Local RTS					XY	XY
Local RLS			Y	Y	Y	XY
Local CLSC			Y	Y	Y	XY

X = Quintile

Y = Quartile

For Quebec, the national version of the index covers the entire province. As a matter of fact, this version is the same as the Canadian regional version for Quebec. Here, the regional and local versions of the index were created by using the PCA for Québec as a whole and by re-distributing populations into quartiles (and quintiles in 2016) in each health region and, at a local level, in each *Réseau local de services* (RLS) and *Centre local de services communautaires* (CLSC). In these three cases, along with the quintiles, three deprivation levels were defined: 1- the quartile of the least deprived EAs/DAs (25% of the population), 2- both median quartiles (50% of the population) and 3- the most deprived EAs/DAs (the remaining 25% of the population).

In 2015, the *Ministère de la santé et des services sociaux* (MSSS) reorganized its health network. Among the changes, new territorial entities called the *Réseaux territoriaux de services* (RTS) were created. RTS are the territories that defined the newly created *Centres intégrés universitaires de santé et de services sociaux* (CIUSSS). Also included in the reorganization was the transfer of two RLS from the Montérégie health region to the Estrie health region. Accordingly, the Québec 2011 and 2016 deprivation indices are available for both the old and the new health network configuration. The indices for the new configuration have an additional version for the RTS.

4 Methodological note about the 2011 deprivation index

In 2011, the mandatory long-form census was replaced by the voluntary National Household Survey (NHS). This major change increased the global non-response rate, introducing risks of bias. A non-response bias is possible when specific subgroups of the population (wealthier or less wealthy, older or younger, immigrants, aboriginals, etc.) are under-represented among the respondents. Mainly for that reason, the data quality of the NHS was widely questioned, especially for smaller geographical units like the dissemination area.

Three of the index indicators come from the NHS: average income, employment to population ratio and proportion of the population without a high school diploma or equivalent. An extensive validation process leads us to believe the 2011 deprivation is still valid. Various analyses showed the robustness of the deprivation index, partly because it combines six indicators instead of using only one. Moreover, using quintiles instead of continuous scores minimizes the impact of any bias. Based on our validation, we therefore believe the 2011 deprivation is still a great proxy to monitor temporal and spatial inequalities and to use as a socioeconomic control variable in statistical models. More locally, the higher non-response rate likely increased the number of dissemination areas with an erroneous quintile. However, analyses showed this situation remains negligible.

4.1 Products

In order to fulfill the initial purpose, which was to introduce a deprivation index in administrative databases, a SAS assignment program was created for every census year, for both Canada and Québec. The Canadian program assigns the index versions for the national, regional, metropolitan and geographical zones while the Québec program assigns the national, regional, local (RTS, RLS, CLSC) version. The assignment is made possible by linking the EA/DA with the Canadian postal codes available in most administrative databases. The availability of census subdivision codes can improve the quality of the assignment, but it is optional. The assignment procedure is simple: the user needs to enter the input file name, the output file name, the postal code variable

name and, if available, the census subdivision code variable name. The output file will include the variables of the input file plus the deprivation indices and some geographical variables, such as the geographical zone.

The deprivation index can be directly added to databases that already include the EAs or DAs by using an equivalence table. In addition to indices and geographical variables, this Excel table also includes factor scores for every EA or DA. The creation of groups other than the predefined quintiles or quartiles can be achieved using those factor scores.

Excel population tables are also available. They provide a breakdown of the Canadian and Québec populations into either eight or twelve age groups for each sex, in line with the chosen geographical area and the material and social component of the index. Therefore, these tables provide the denominators needed to calculate crude and adjusted rates. Finally, [geographical maps](#) for Québec⁴ are available and offer a visual indication of the level of deprivation for a desired area.

The [2011](#) and [2016](#) deprivation index data for Québec are also available on [Données Québec](#), in different formats, among which those used to create maps.

4.2 How to use the index?

The fact that there are several versions of the deprivation index might create some confusion. Before introducing an index into a database, the user must clarify his or her analysis' objectives. First, the study period needs to be established. Because Canadian censuses are held every five years, each index should cover five years as well. Ideally, these five years should be as close as possible to the census years. Hence, the 1991 index is recommended for databases covering the 1989-1993 period, the 1996 index for 1994-1998 period and so on. Until the 2021 index can be created, it is recommended to keep using the 2016 for the most recent years.

The next crucial step is to determine the study area. If a research project covers the entire country and the main goal is to compare inequalities in Canada as a whole, the Canadian national version is the right choice. Instead, if the objective is to compare socioeconomic

discrepancies between the three largest CMAs of Canada, then the metropolitan version should be used. And if the analysis' objectives are to evaluate the effect of social inequalities on primary care services at the CLSC level in Montréal, then the local CLSC version would be the most useful version of the index.

Once the user has chosen the appropriate version, he can introduce it in his databases. If the EA or DA variable is already available in the databases, it is best to link the indices directly using the equivalence table. Otherwise, the databases must have a six-digit postal code (census subdivision code is optional) in order to use the SAS assignment program. Note that the program does not assign an index to every observation because there is a small proportion of the population (between 2 % and 4 %) that is initially excluded from the index calculation because of their living situation. This percentage will vary according to the health indicator of interest. For example, since many elderly people live in nursing homes, a high percentage of death records (about 15%) will not be attributed an index value (missing values). For birth records, this percentage is only around 3%. In addition, if the postal code is not valid, the program automatically assigns a null value to both components of the deprivation index and to other variables such as the geographical zone.

Once the index is added to a database, it can lead to many different types of analysis. One of the easiest measures to generate are frequency tables. Calculating crude and age- and sex-adjusted rates in order to compare different levels of deprivation is also possible, as long as the correct denominators are used. Crude and adjusted rates can be calculated with the help of the population tables. Once these rates are calculated, researchers can measure ratios and rate differences in order to illustrate the magnitude of inequalities between various groups. A [memory aid](#) (English version forthcoming) and an [interpretative aid](#) are available on INSPQ's website (limited access) to help with the inequality measures. Time-trend analysis can be achieved with the help of ratios and rate differences to show the evolution of social inequalities in health through time. Finally, when other socioeconomic information is missing the index can be an interesting variable to add to regression models such as logistic, log-binomial, Poisson or Cox (survival analysis)

⁴ Click on the star under the Home menu to choose "Indice de défavorisation 2011 et 2016".

regression and multilevel analyses, usually as a socioeconomic control variable.

Some analyses require statistical power. Assigning the deprivation index to files with a low number of observations does not usually lead to statistically significant results. For example, the stillbirths' database in Quebec consists of a few hundred observations. In this case, it is recommended to carry out analyses for three to five-year periods. For bigger files, such as hospitalizations files, there should be no risk working with annual data except for very specific causes with a low prevalence rate.

To learn more about the methodology behind the deprivation index and about the different types of analysis that can be carried out with the index, please refer to the following publications written by the team as well as to the internet pages on [deprivation, the material and social deprivation index and the new indices of multiple deprivation](#).

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