

Deprivation and Cancer Mortality Among Québec Women and Men, 1994–1998

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Premature mortality caused by cancer and the public health challenge it represents have given rise to a myriad of studies on the contribution of material and social living conditions to varying risks of morbidity and mortality. Thus, European and American studies have shown that cancer mortality—and some cancers more than others—often hits disadvantaged socioeconomic groups [1-5] and regions [6-7] hardest, and that this relationship persists even when individual behavior [2, 8-9] is taken into account. Numerous studies have focused mainly on men, who are easier to characterize socioeconomically than women. Indeed, it has proven difficult to determine the socioeconomic position of women, and the indicators used are often inadequate [10-11]. An examination of the social health inequalities between the sexes shows that the mortality is sensitive to the inequality measure [12], the causes of mortality differ for men and women [13-14], these inequalities are generally less pronounced among women [11, 14-16], and the social condition of women contributes to health discrepancies between the sexes [17-19]. In Québec and the rest of Canada, the few studies [20-23] on social health inequalities show that these inequalities exist despite government support for disadvantaged families and universal access to healthcare.

Few Canadian studies on this issue exist, due to the lack of socioeconomic information in health databases. To compensate, researchers have proposed using ecological substitutes that are not only good predictors of health [24-25], but also help characterize the situation of both men and women [10]. In Québec, such a measure was recently developed [20] and used in the analysis of several health problems [26-28]. This measure allowed researchers to examine social inequalities not only from a material perspective, like most ecological substitutes, but also from a social perspective.

Our study explores the relationship between this deprivation index and cancer mortality—the leading cause of premature mortality in Québec [29]—by assessing the role of both material and social forms of deprivation. We also focus on differences between men and women to compare their mortality profiles.

METHODS AND DATA

Deprivation Index

The measure used to account for social inequalities is based on the theories and methodologies of P. Townsend and the abundant literature on socioeconomic conditions and health. The deprivation index applies to enumeration areas (EA) with an average of 750 persons. This area can be linked to the six-digits postal code that appears on Québec death certificates. Excluded from the index are sparsely populated EAs (under 250 people), those with collective dwellings, and those in the northern regions of Kativik and the James Bay Cree territories. The index covers around 96% of the Québec population, or nearly 7 million people.

According to Townsend, the index describes two aspects of deprivation: material and social. It includes six indicators which are related to either forms of deprivation, according to the results of a principal component analysis (with VARIMAX rotation). Material deprivation mainly reflects variations in the Québec population in terms of the proportion of people without high school diplomas, the employment/population ratio, and average individual income. Social deprivation mainly reflects variations in the proportion of single-parent families, people living alone, and those who are separated, widowed, or divorced. For both forms, the population was broken down by deprivation quintile (20% population group), where quintile 1 represents

the most advantaged and quintile 5 represents the most disadvantaged.

Mortality

Mortality data comes from Québec death certificates from 1994 to 1998. To ensure our analysis was reliable, we looked at total cancer-related deaths as well as the most common cancer sites (Table 1). As premature mortality is a major public health concern, our analysis focuses on deaths in those aged 25 to 74. Given the low death rate of certain cancers, this age group had to be reduced to 35–74 years or 45–74 years as needed.

Around 92% of deceased persons (Table 1) were assigned a deprivation quintile (material and social). In addition to index values, the age and area of residence of deceased persons were also taken into account. Area of residence refers to four main geographic settings: the Greater Montréal area, other metropolitan areas in Québec, midsize cities (between 10 000 and 100 000 inhabitants), small towns and rural communities. These areas respectively account for 48%, 20%, 12%, and 20% of Québec's population. Age is a variable that is closely tied to the risk of death. Whereas the area of residence is not entirely independent of material and social deprivation [20].

Analysis Strategy

Relative risk of mortality (RR) was estimated using Poisson regression [30] modeling for each material and social deprivation quintile. RR was adjusted to take into account age and area of residence differences among persons in each quintile. The reference group is the most advantaged quintile, whose RR is 1.00. The RR for the other quintiles thus expresses their risk of mortality as compared to the most advantaged quintile. For example, an RR of 1.25 for a given quintile indicates that its mortality rate is 25% higher than the reference group's.

To illustrate the effects of material and social deprivation on cancer mortality, we developed several models. For causes of death in both sexes, we first asked whether the role played by deprivation could vary by sex. To do so, we designed an initial model adjusted by age, area of residence, and the relationship between sex and deprivation forms. If no statistically significant relationship was found ($p < 0.10$), we kept the model. If there was a relationship, we produced a second model adjusted by age, area of residence, and deprivation form for men and women separately ($p < 0.05$). This second model was consistently applied to sex-specific causes of death.

We observed very different mortality rates for all cancers and lung cancer based on age in women and men: Excess death occurred in women aged 30 to 49 and in men aged 50 to 74 (data not presented). To better understand the effect of deprivation on

these differences, other models adjusted by area of residence and deprivation form were produced for men and women aged 30 to 49 and men and women aged 50 to 74.

RESULTS

The mortality profiles of men and women converge for stomach, pancreatic, and bladder cancers, whether linked to material or social deprivation (Tables 2 and 3, upper section). Of these cancers, only stomach cancer mortality had an ongoing and statistically significant ($p < 0.0001$) relationship with material deprivation.

Female Mortality and Deprivation

Among women, there was a more or less ongoing and statistically significant relationship between all-cause cancer ($p < 0.0001$), lung cancer ($p < 0.0001$), and cervical cancer ($p < 0.01$) mortality and material deprivation (Table 2). Material deprivation has a substantial impact on lung and cervical cancer, increasing the risk of mortality by around 63% and 72% respectively. After controlling for this form of deprivation, we also noted an ongoing relationship between mortality from all cancers ($p < 0.0001$), lung cancer ($p < 0.0001$), and cervical cancer ($p = 0.14$) and social deprivation (Table 3). The combination of material and social deprivation shows the vulnerability of women in the most disadvantaged quintile. Their relative risk of mortality reaches 2.61 (1.72×1.52) for lung cancer, 2.09 (1.63×1.28) for cervical cancer, and 1.34 (1.19×1.13) for all cancers.

TABLE 1

Population studied, reference age group, total number of deaths from cancer, number and percentage of deaths assigned a deprivation index by sex and cancer site, Québec, 1994 to 1998

Site (CIM9)	Population Studied (Reference Group)	Total Deaths		Deaths with Index			
		Men	Women	Men		Women	
		No.	No.	No.	%	No.	%
All causes (140 to 208)	25–74 years (25–44)	27,657	20,964	25,567	92.4	19,353	92.3
Stomach (151)	25–74 years (25–44)	1,131	564	1,053	93.1	529	93.8
Colon-rectum (153–154)	25–74 years (25–44)	3,024	2,224	2,803	92.7	2,033	91.4
Pancreas (157)	35–74 years (35–44)	1,323	1,016	1,230	93.0	932	91.7
Lung (162)	25–74 years (25–44)	11,062	5,524	10,234	92.5	5,131	92.9
Breast (174)	25–74 years (25–44)	---	4,281	---	---	3,949	92.2
Cervix (180)	25–74 years (25–44)	---	322	---	---	298	92.5
Uterus (182)	45–74 years (45–64)	---	260	---	---	230	88.5
Ovaries (183)	35–74 years (35–44)	---	1,097	---	---	1,000	91.2
Prostate (185)	45–74 years (45–64)	1,396	---	1,263	90.5	---	---
Bladder (188)	45–74 years (45–54)	542	166	509	93.9	153	92.2

Source: 1994 to 1998 death files, ministère de la Santé et des Services sociaux du Québec.

TABLE 2

Relative risk of cancer mortality¹ and confidence interval ($p < 0.05$) by sex, cancer site, and material deprivation quintile, Québec, 1994–1998

Cancer Site	Material Deprivation Quintile				
	1 (Advantaged)	2	3	4	5 (Disadvantaged)
Men and Women					
Stomach (151)	1.00	1.28 (1.07–1.52)	1.32 (1.11–1.57)	1.43 (1.21–1.69)	1.6 (1.36–1.88)
Pancreas (157)	1.00	1.06 (0.92–1.22)	1.08 (0.94–1.24)	1.07 (0.93–1.23)	1.15 (1.00–1.31)
Bladder (188)	1.00	1.13 (0.88–1.47)	1.02 (0.79–1.33)	1.21 (0.95–1.55)	1.22 (0.96–1.56)
Women					
All causes (140 to 208)	1.00	1.1 (1.05–1.15)	1.14 (1.09–1.19)	1.12 (1.07–1.17)	1.19 (1.13–1.25)
Colon-rectum (153 to 154)	1.00	1.12 (0.97–1.30)	1.09 (0.95–1.26)	1.07 (0.93–1.23)	1.14 (0.99–1.31)
Lung (162)	1.00	1.29 (1.17–1.42)	1.4 (1.27–1.54)	1.44 (1.30–1.58)	1.63 (1.48–1.80)
Breast (174)	1.00	0.95 (0.86–1.05)	1.02 (0.92–1.12)	0.95 (0.86–1.05)	0.93 (0.83–1.03)
Cervix (180)	1.00	1.09 (0.74–1.59)	0.77 (0.51–1.16)	1.17 (0.81–1.69)	1.72 (1.22–2.42)
Uterus (182)	1.00	0.81 (0.54–1.20)	0.75 (0.50–1.13)	0.74 (0.49–1.12)	0.78 (0.51–1.19)
Ovaries (183)	1.00	0.94 (0.78–1.14)	0.87 (0.71–1.06)	0.89 (0.73–1.08)	0.83 (0.68–1.00)
Men					
All causes (140 to 208)	1.00	1.25 (1.20–1.31)	1.28 (1.23–1.34)	1.3 (1.24–1.35)	1.4 (1.34–1.47)
Colon-rectum (153 to 154)	1.00	1.17 (1.03–1.32)	1.16 (1.02–1.31)	1.1 (0.98–1.25)	1.15 (1.02–1.30)
Lung (162)	1.00	1.41 (1.31–1.51)	1.55 (1.45–1.67)	1.6 (1.49–1.72)	1.82 (1.69–1.95)
Prostate (185)	1.00	1.19 (0.99–1.42)	0.98 (0.82–1.18)	0.91 (0.75–1.09)	0.91 (0.75–1.10)

¹ Relative risk is adjusted by age, sex (for the first three sites only), social deprivation quintile, and area of residence.

Source: 1994 to 1998 death files, Ministère de la Santé et des Services sociaux du Québec.

TABLE 3

Relative risk of cancer mortality¹ and confidence interval ($p < 0.05$) by sex, cancer site, and social deprivation quintile, Québec, 1994–1998

Cancer Site	Social Deprivation Quintile				
	1 (Advantaged)	2	3	4	5 (Disadvantaged)
Men and Women					
Stomach (151)	1.00	1.01 (0.86–1.19)	0.96 (0.82–1.13)	1 (0.85–1.17)	1.06 (0.90–1.24)
Pancreas (157)	1.00	0.98 (0.85–1.13)	1.07 (0.93–1.23)	1.04 (0.91–1.20)	1 (0.87–1.15)
Bladder (188)	1.00	0.92 (0.71–1.21)	0.93 (0.72–1.22)	1.21 (0.95–1.55)	1.12 (0.87–1.44)
Women					
All causes (140 to 208)	1.00	1 (0.95–1.05)	0.99 (0.94–1.04)	1.04 (0.99–1.09)	1.13 (1.08–1.19)
Colon-rectum (153 to 154)	1.00	0.94 (0.81–1.09)	0.92 (0.80–1.07)	0.91 (0.79–1.05)	0.94 (0.81–1.08)
Lung (162)	1.00	1.01 (0.91–1.12)	1.02 (0.93–1.13)	1.08 (0.98–1.19)	1.28 (1.16–1.40)
Breast (174)	1.00	1 (0.90–1.12)	1.04 (0.94–1.16)	1.09 (0.98–1.21)	1.08 (0.97–1.21)
Cervix (180)	1.00	1.05 (0.70–1.59)	1.17 (0.78–1.74)	1.28 (0.87–1.88)	1.52 (1.05–2.20)
Uterus (182)	1.00	0.94 (0.59–1.51)	0.9 (0.56–1.43)	1.03 (0.66–1.60)	1.25 (0.81–1.94)
Ovaries (183)	1.00	0.98 (0.79–1.21)	1.02 (0.83–1.25)	0.96 (0.78–1.18)	1 (0.82–1.23)
Men					
All causes (140 to 208)	1.00	1.03 (0.98–1.07)	1.09 (1.05–1.14)	1.16 (1.12–1.21)	1.32 (1.27–1.38)
Colon-rectum (153 to 154)	1.00	0.89 (0.78–1.01)	1.08 (0.96–1.22)	1.08 (0.96–1.22)	1.19 (1.06–1.34)
Lung (162)	1.00	1.05 (0.98–1.13)	1.08 (1.01–1.16)	1.21 (1.13–1.29)	1.48 (1.38–1.58)
Prostate (185)	1.00	1.03 (0.85–1.25)	1.14 (0.95–1.38)	1.13 (0.94–1.37)	1.33 (1.10–1.61)

¹ Relative risk is adjusted by age, sex (for the first three sites only), material deprivation quintile, and area of residence.

Source: 1994 to 1998 death files, Ministère de la Santé et des Services sociaux du Québec.

Male Mortality and Deprivation

Among men, all-cause ($p < 0.0001$) and lung cancer ($p < 0.0001$) mortality rises equally with material and social deprivation (Tables 2 and 3). This joint effect increases the risk of mortality among the most deprived men by 1.85 (1.40×1.32) for all cancers and 2.69 (1.82×1.48) for lung cancer. Material deprivation ($p = 0.08$) has less of an impact on colorectal cancer mortality than social deprivation ($p < 0.0001$), while both forms together raise the risk of death for the most disadvantaged to 1.37 (1.15×1.19). For prostate cancer, there is an inverse and statistically significant ($p = 0.03$) relationship between mortality and both deprivation forms. Mortality rises with social deprivation and falls with material deprivation.

Varying Mortality of Men and Women

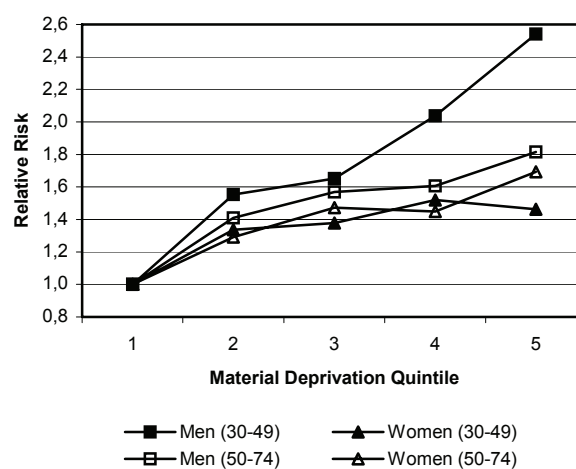
Belonging to the most socially and/or materially advantaged group confers a net benefit with respect to cancer mortality, regardless of sex. However, if social and/or material deprivation are equal, men have a slightly higher risk of cancer mortality than women.

An in-depth examination of total cancer mortality by age showed that excess death was higher in women aged 30 to 49 compared to men of the same age (data not presented). This is due to the high number of lung and breast cancer-related deaths among women in this age group. With regard to lung cancer, this excess death is not caused by material deprivation

(Figure 1), but rather social deprivation (Figure 2). Moreover, we noted that the relative risk of lung cancer mortality among socially disadvantaged (quintiles 2 to 5) women aged 30 to 49 greatly exceeds not only that of similarly disadvantaged men, but also that of older women.

FIGURE 1

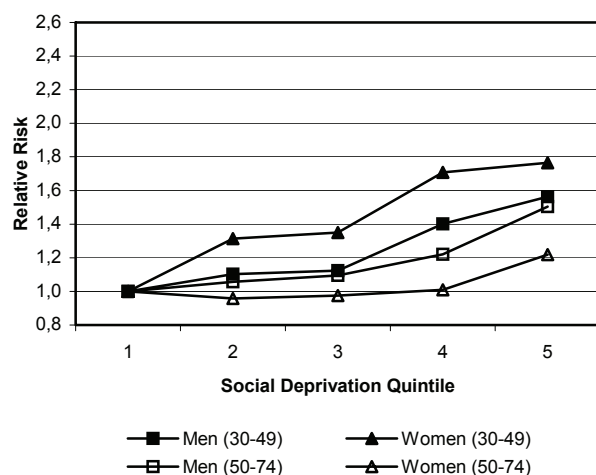
Relative risk of lung cancer mortality in men and women aged 30 to 49 and 50 to 74 by material deprivation quintile, Québec, 1994–1998



Source: 1994 to 1998 death files, Ministère de la Santé et des Services sociaux du Québec.

FIGURE 2

Relative risk of lung cancer mortality in men and women aged 30 to 49 and 50 to 74 by social deprivation quintile, Québec, 1994–1998



Source: 1994 to 1998 death files, Ministère de la Santé et des Services sociaux du Québec.

DISCUSSION

Our results corroborate the conclusions of the international literature: In Québec and elsewhere, those from disadvantaged environments are more likely to die prematurely from cancer. Our findings also show that male and female mortality profiles converge for stomach, pancreatic, and bladder cancers, but diverge for other cancers found in both sexes. In addition, the socioeconomic gap among women of various quintiles is smaller than it is in men. Material and social deprivation also has less of an impact on female mortality than on male mortality. For total cancer mortality, the

combination of both social and material deprivation increases the risk of mortality in the most disadvantaged men and women. However, male mortality is around 20% higher than female mortality. This difference between the sexes is similar to that found in Great Britain [31] and the United States [32].

Our results prove the role played by material deprivation with respect to cancer mortality, particularly for lung and digestive system cancers. This accords with other studies done elsewhere using individual [3, 5] or ecological [7] measurements of socioeconomic status. In addition, the risk of dying of cervical cancer, which stands at 72% (CI: 1.22–2.42) among the most disadvantaged women, is very high. This slow-growing cancer, which is easy to detect even at a precancerous stage, should no longer cause death, especially since Canada was a cancer-testing pioneer with the PAP test. There is also reason to look at underlying causes and their contribution to the very high cervical cancer mortality rate.

Social deprivation, which is statistically independent of material deprivation—both forms were taken into account for modeling—has an additional impact on cancer mortality in both men and women. In men, social deprivation significantly increases mortality for all cancers. In women, it contributes to mortality in disadvantaged women with cervical cancer, but is a key factor in excess death from lung cancer in those aged 30 to 49.

The social form of deprivation refers to the proportion of separated, divorced, or widowed persons as well as single-person and single-parent households in an enumeration area. Studies have measured the impact of marital status and household form on mortality. For all-cause mortality, unmarried men are at greater risk of mortality than married men [33-34]. But the results are less conclusive with respect to cancer mortality [34]. A British study has shown that among women, this relationship is not significant for cancer mortality [35]. Another study has shown that lone mothers in Sweden were at greater risk of dying of cancer compared to mothers with a partner [36], and this risk is even greater for lung cancer [37].

Our measure of social deprivation, however, is ecological and can therefore refer to a different construct from those of marital status and household type. Québec studies have shown that social deprivation is closely tied to other indicators such as move frequency and tenant status [27], at the EA level. In addition to material conditions of existence, social deprivation may reflect the fragility of the local social network in terms of the quality of neighbourhood relations and access to health, social, or community services conducive to wellbeing. It therefore seems important to clarify the significance of social deprivation by continuing to analyze the relationship between it and other measurements, notably social cohesion, the sense of belonging to a

local community, and the presence of services in the community [38].

There are several hypotheses regarding excess death by lung cancer in young, socially disadvantaged Québec women. High smoking rates in single, separated, and divorced women, as well as lone mothers—common situations for those aged 30 to 50—can be seen as a response to stress that is common to these women in particular and to materially disadvantaged persons in general. Moreover, with equal exposure to tobacco, women run a greater risk of developing lung cancer, as they are more predisposed to retaining certain carcinogens found in cigarette smoke [39-40]. However, we cannot exclude the fact that excess death may be due to other causes of mortality. A Québec study [28] identified a close link between social and material deprivation and suicide, the main cause of death in young men. This could therefore eliminate a certain number of men from the cancer sufferers cohort and partially account for the difference observed.

As the results of our study show, despite government support for the most disadvantaged families and universal health care and services, serious health disparities remain between the various subgroups of Québec's population. The government and public health services must continue their efforts to reduce excess morbidity and mortality in these subgroups and their environments. A striking finding of our study is the contribution of social deprivation to

cancer mortality, particularly in men and young women. We must therefore continue not only to study the specific impact social deprivation seems to have on health, but also, eventually, take it into account when developing health policies and measures.

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