Original Research

Socio-economic inequalities in suicide attempts and suicide mortality in Québec, Canada, 1990–2005

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A R T I C L E  I N F O

Article history:
Received 13 July 2009
Received in revised form 30 November 2009
Accepted 13 January 2010
Available online 23 February 2010

Keywords:
Suicide
Suicide attempts
Socio-economic factors
Deprivation
Québec
Area analysis

S U M M A R Y

Objectives: Little research has evaluated changes in the association between area deprivation and suicidal behaviour over time. This study investigated patterns in suicide attempts and suicide mortality according to material deprivation in the province of Québec, Canada between 1990 and 2005.

Study design: Ecological analysis.

Methods: Data on suicide attempts were extracted from the hospital discharge summary database (n = 47,516) and data on suicides were extracted from the Québec death file (n = 20,851). Gender-specific and age-specific (10–24, 25–44, 45–64 and ≥65 years) suicide attempt and mortality rates were calculated for four time periods (1990–1993, 1994–1997, 1998–2001 and 2002–2005) for the entire Québec population aged 10 years and older residing in 162 communities ranked by decile of material deprivation. Absolute and relative measures of inequality were calculated to summarize differences between the most and least materially deprived areas. Commonly used methods of suicidal behaviour were examined.

Results: Differentials in suicide attempt hospitalization between the most and least deprived areas were present for all age groups, and these decreased slightly among males and increased among females over time. Inequalities in suicide attempts were greatest among young adults (age 25–44 years) for both genders, and were smallest among the elderly (≥65 years). For suicide mortality, differentials increased among females but not males; these differentials were greatest among males and 25–44 year olds, and smallest among the elderly. Differentials in commonly used methods were evident for poisoning hospitalizations in both genders and for hanging deaths among males.

Conclusions: In Québec, differences in suicide attempts and mortality between the most and least materially deprived areas persisted or even increased over time. Inequalities were more pronounced for suicide attempts than for suicide mortality, and were greatest among adults of working age. Strategies to reduce socio-economic differences in suicidal behaviour may be important.

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Introduction

Self-inflicted injuries are a major cause of premature death and disability across the globe. According to the World Health Organization, Canada’s suicide rate ranks in the middle of 22 Western industrialized countries. However, suicide rates vary widely across the Canadian provinces. Québec has the highest suicide mortality of all provinces, with its rate even considered high relative to Western countries. The rate has not been constant over time, with steady increases during the 1990s but yearly decreases since 2000. Reasons for these patterns are not well understood.

Evaluating patterns of suicide attempts may contribute to understanding those of suicide mortality. However, relatively little epidemiological research has been conducted on suicide attempts. This is the case in Canada. In contrast to its high suicide mortality, Québec has the lowest age-standardized hospitalization rate for suicide attempts of all provinces. It is not known whether patterns in suicide attempt hospitalization in Québec over time are similar to those for suicide mortality.

Contextual socio-economic conditions, shown to be associated with suicide attempts and mortality, may assist in understanding suicidal behaviour patterns. Canadian suicide research has rarely considered contextual factors. Results from the few existing studies suggest that greater area deprivation is associated with higher rates of suicide attempts or deaths, although no association or even an inverse relationship has been reported for some socio-economic measures and demographic groups. Limited research suggests that suicide mortality disparities may have increased in Québec from 1989–1993 to 1999–2003 for males in some geographic settings but not others, but the extent of the disparities is unknown. Research is required in this area, particularly for suicide attempts and for different demographic groups.

Furthermore, it is important to examine patterns over time despite the decreasing suicide mortality rates in Québec, because health inequalities may remain or worsen even when overall health improves. The size of the gap between the most and least advantaged groups also gives an indication of the potential for improvement in health, and helps to identify groups at greatest risk to ensure that medical services and prevention strategies are appropriately targeted. Prevention strategies frequently focus on restricting access to methods commonly used in suicidal behaviour. However, research has rarely evaluated whether patterns in suicidal behaviour for different methods vary across socio-economic groups. It is therefore unclear if preventive strategies are effective where they are most needed.

In light of the above, the objective of this study was to evaluate patterns of gender-, age- and method-specific suicide attempts and suicide mortality over time according to material area deprivation in Québec.

Methods

Study population

The study population consisted of people aged 10 years and older, resident in the Canadian province of Québec between 1990 and 2005. Children under 10 years of age were excluded because of low levels of suicidal behaviour in this age group. Data on inpatient admissions for suicide attempts (n = 48,416) were obtained from the Québec hospital discharge summary database (MED-ÉCHO), and data on suicide deaths (n = 21,067) were extracted from Québec health ministry vital statistics files (ICD-9 codes E950–959; and for deaths alone, ICD-10 codes X60–84, Y87.0 for 2000 onwards). Cases were categorized according to the most frequent methods used: poisoning (ICD-9 codes E950–E952; ICD-10 codes X60–X69), hanging/suffocation/suffocation (ICD-9 code E953; ICD-10 code X70) and cutting/piercing (ICD-9 code E956; ICD-10 code X78). Suicide attempts and deaths were grouped into four 4-year periods (1990–1993, 1994–1997, 1998–2001 and 2002–2005) to ensure sufficient numbers of cases in each period. Admissions resulting from transfers from a previous hospital and repeated suicide attempts within a period were not included to ensure that a single case was only documented once per period.

Area classification

Local community services centre (CLSC) residential districts recorded in the death and hospital files were used as they represent areas for which disadvantage varies (n = 166, average 42,121 inhabitants per CLSC, range 1355–133,465). Contextual socio-economic status of CLSCs was computed from a composite material deprivation index for the 1996 Census enumeration areas (n = 9058) that has been widely used in provincial studies. The index combines census information on employment, income and education using a methodology similar to the Townsend index. The deprivation index of enumeration areas was used to calculate a population-weighted deprivation index for CLSCs (enumeration areas are nested in CLSCs). Four northern CLSCs with incomplete or missing census data and cases with missing CLSC data were excluded (897 attempts, 1.9%; 216 deaths, 1%). The remaining CLSCs (n = 162) were ranked according to decile of deprivation (approximately 16 CLSCs per decile). The mean unemployment rate, household income and proportion of persons without a high school diploma was 9.6% (range 4.0–34.1%), $47,752 CAD (range $28,129–$102,101) and 35.0% (range 8.4–63.6%), respectively, across all CLSCs; 6.1% (range 4.0–9.6%), $68,083 CAD (range $44,220–$102,101) and 18.3% (range 8.4–23.3%), respectively, across CLSCs in the least deprived decile; and 17.5% (range 10.6–34.1%), $35,574 CAD (range $28,129–$47,317) and 47.3% (range 39.4–63.6%), respectively, across CLSCs in the most deprived decile. Deprivation index scores ranged from 4.5 to 5.0 in the most deprived deciles and from 1.0 to 2.1 in the least deprived deciles. The 1996 CLSC ranking was used for all study periods, as any change in CLSC deprivation over time would have been minor and unlikely to modify the relative ranking of CLSCs in other periods. This assumption is supported by the observation that the broad geographical distribution of deprivation has changed little over the past decades in the USA and Britain.

Data analysis

Mid-period population counts from census projections adjusted for under-enumeration were used to calculate age-
standardized hospitalization and death rates per deprivation decile. Rates were calculated by the direct method using the 2001 Québec population as the standard. Ninety-five percent confidence intervals for rates were computed using the log method. As there are marked differences in suicide attempt and mortality rates by gender and age, analyses were performed separately for males, females and age-specific groups (10–24, 25–44, 45–64 and ≥65 years). Rates for the two most common methods of suicide attempt and suicide mortality were computed, and all other methods were grouped in a separate category due to small counts.

Differentials between the most and least materially deprived deciles were examined for suicide attempts and suicide mortality according to gender, age and method using the Slope Index of Inequality (SII) and Relative Index of Inequality (RII). In contrast to measures such as the rate ratio and rate difference, the SII and the RII are summary measures of the risk distribution that take into account the whole distribution of deprivation and the population size of deciles. The SII corresponds to the coefficient obtained from linear regression of age-standardized suicide rates on a transformation of deprivation deciles. The transformed deciles are based on a score for the midpoint of the decile’s range in the cumulative distribution of the population. The SII is equivalent to the absolute difference in the suicide rate between the most and least deprived deciles. The RII is obtained by dividing the SII with the age-standardized suicide attempt or mortality rate over all deciles. The RII measures the proportionate decrease in suicide attempt or mortality between the bottom and top deciles.

As population growth over time that is greater in the most (or least) deprived deciles may also account for changes in the SII or RII over time, the analyses were re-run using the population distribution of the first study period (1990–1993) to ensure that similar SIIs were obtained.

Analyses were performed using Statistical Package for the Social Sciences Version 12.0.1 (SPSS Inc., Chicago, IL, USA). This study was conducted under the Population Health Surveillance Plan of the Québec Health Ministry approved by the Québec Public Health Ethics Committee.

Results

Hospitalized suicide attempts

Rates of hospitalization for suicide attempts were higher among females than males for all study periods (Fig. 1). After an initial increase from 1990–1993 to 1994–1997, overall suicide attempt rates among males and females stabilized, and then decreased by 2002–2005. For males, differentials in suicide attempt hospitalizations between the most and least deprived deciles were greatest in 1990–1993 and decreased substantially in 1994–1997, with little decrease in the remaining study periods. In contrast, differentials for females varied across the study periods, but were generally greater than male differentials.

Summary measures of inequality between the most and least deprived deciles (i.e. SII and RII) indicate that inequalities in suicide attempts have persisted over time (Table 1). For both males and females, inequalities were greatest among 25–44 year olds and smallest among the elderly (≥65 years). Inequalities were generally more pronounced among males compared with females in 1990–1993, and less pronounced than females in 2002–2005.

Suicide mortality

Suicide mortality rates followed a pattern similar to suicide attempts, increasing early on, stabilizing and then decreasing in 2002–2005 (Fig. 2). However, rates were considerably lower among females than males. For males, differentials between the most and least deprived deciles fluctuated across periods and were highest in 2002–2005. For females, there was little difference over time.

Like suicide attempts, inequalities in suicide mortality between the most and least deprived deciles persisted or even increased over time (Table 2). Inequalities were typically much greater among males than females. With some exceptions, inequalities were greatest among 25–44 year olds and smallest among the elderly (≥65 years) and youth (10–24 years). Inequalities fluctuated over time for younger males (<45 years) but increased over time among their older counterparts.
For females, inequalities increased over time for the middle age groups (25–64 years), with unclear patterns among youth and the elderly.

Methods of suicidal behaviour

Poisoning (n = 36,500) was the most common method of suicide attempt hospitalization for both males and females (age-adjusted rates 26.1 and 45.7 per 100,000, respectively). This was followed by cutting/piercing (5.3 per 100,000 for males, 3.7 for females). Differentials between the most and least deprived deciles were greatest for poisoning attempts (Table 3). For males, differentials were greatest in 1990–1993 and slightly lower but constant for the other study periods. For females, they were greatest in 2002–2005. Differentials for cutting/piercing suicide attempts fluctuated over time with no clear pattern for males or females. However, for both poisoning and cutting/piercing attempts, statistically significant differentials tended to emerge in 2002–2005. Inequalities for ‘other’ suicide attempts were more common in males than females and tended to decrease over time.

The leading method of suicide mortality was hanging/strangulation/suffocation (age-adjusted rate 15.6 per 100,000 for males, 3.6 for females), followed by poisoning (5.7 per 100,000 for males, 2.9 for females). Unlike suicide attempts, inequalities between the most and least deprived deciles were much greater for males than for females. For males, differentials in hanging/strangulation/suffocation and ‘other’ suicides were fairly consistent across the study periods, while those for poisoning suicides were negligible in all periods except for 2002–2005. Differentials among females, although for the most part low, tended to increase over time for each method.

Discussion

Main findings

This study assessed patterns in age-, gender- and method-specific suicide attempts and suicide mortality according to material area deprivation. After initial increases in both

Table 1 – Summary measures of inequality for age-specific hospitalized suicide attempts by gender, Québec, 1990–2005.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SII (P-value)</td>
<td>31.3 (0.02)</td>
<td>26.3 (0.02)</td>
</tr>
<tr>
<td>RII</td>
<td>0.97</td>
<td>0.63</td>
</tr>
<tr>
<td>10–24 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SII (P-value)</td>
<td>26.2 (0.02)</td>
<td>17.2 (0.11)</td>
</tr>
<tr>
<td>RII</td>
<td>0.82</td>
<td>0.45</td>
</tr>
<tr>
<td>25–44 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SII (P-value)</td>
<td>53.5 (0.03)</td>
<td>45.9 (0.006)</td>
</tr>
<tr>
<td>RII</td>
<td>1.15</td>
<td>0.76</td>
</tr>
<tr>
<td>45–64 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SII (P-value)</td>
<td>18.0 (0.04)</td>
<td>21.9 (0.06)</td>
</tr>
<tr>
<td>RII</td>
<td>0.74</td>
<td>0.63</td>
</tr>
<tr>
<td>≥65 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SII (P-value)</td>
<td>13.7 (0.06)</td>
<td>2.1 (0.76)</td>
</tr>
<tr>
<td>RII</td>
<td>1.00</td>
<td>0.11</td>
</tr>
</tbody>
</table>

SII, Slope Index of Inequality: absolute difference in suicide attempt hospitalization between the bottom and top deciles, obtained from regression of age-standardized rates on mean relative rank of deciles; RII, Relative Index of Inequality: proportionate increase in suicide attempt hospitalization between highest and lowest deciles.
suicide attempt hospitalization and death in the first half of the 1990s, rates decreased in the first half of the 2000s. However, despite the favourable patterns in hospitalization and mortality, inequalities associated with material deprivation persisted, or even increased, over time. To the authors’ knowledge, this is the first study to demonstrate such patterns in Canada for both suicide hospitalization and mortality.

Research from other countries has found similarly persistent or increasing material deprivation inequalities in both suicide attempts and mortality.33–37 With the exception of young females in some research,33,38–40 most studies have found smaller material deprivation inequalities in suicide attempts among females compared with males.40–42 In contrast, the present study found that suicide attempt

### Table 2 – Summary measures of inequality for age-specific suicide mortality by gender, Québec, 1990–2005.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>SII (P-value)</td>
<td>RII</td>
</tr>
<tr>
<td></td>
<td>18.8 (&lt;0.000)</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>24.2 (&lt;0.000)</td>
<td>19.4 (0.006)</td>
</tr>
<tr>
<td></td>
<td>1.4 (0.32)</td>
<td>2.6 (0.1)</td>
</tr>
<tr>
<td></td>
<td>RII (P-value)</td>
<td>RII</td>
</tr>
<tr>
<td>10–24 years</td>
<td>13.0 (0.05)</td>
<td>21.5 (0.001)</td>
</tr>
<tr>
<td></td>
<td>0.55</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>–2.4 (0.04)</td>
<td>1.0 (0.63)</td>
</tr>
<tr>
<td>25–44 years</td>
<td>22.7 (&lt;0.000)</td>
<td>29.3 (&lt;0.000)</td>
</tr>
<tr>
<td></td>
<td>0.61</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>3.3 (0.31)</td>
<td>4.4 (0.12)</td>
</tr>
<tr>
<td>45–64 years</td>
<td>18.0 (0.002)</td>
<td>23.4 (&lt;0.000)</td>
</tr>
<tr>
<td></td>
<td>0.56</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>2.2 (0.32)</td>
<td>3.0 (0.24)</td>
</tr>
<tr>
<td>&gt;65 years</td>
<td>19.2 (0.08)</td>
<td>17.7 (0.01)</td>
</tr>
<tr>
<td></td>
<td>0.74</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>0.9 (0.51)</td>
<td>0.1 (0.94)</td>
</tr>
</tbody>
</table>
| SII, Slope Index of Inequality: absolute difference in suicide attempt hospitalization between the bottom and top deciles, obtained from regression of age-standardized rates on mean relative rank of deciles; RII, Relative Index of Inequality: proportionate increase in suicide attempt hospitalization between highest and lowest deciles.


<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suicide attempt</td>
<td>Poisoning</td>
<td></td>
</tr>
<tr>
<td>SII (P-value)</td>
<td>21.1 (0.06)</td>
<td>15.7 (0.08)</td>
</tr>
<tr>
<td>RII</td>
<td>0.94</td>
<td>0.55</td>
</tr>
<tr>
<td>Cutting/piercing</td>
<td>SII (P-value)</td>
<td>3.0 (0.06)</td>
</tr>
<tr>
<td>RII</td>
<td>0.66</td>
<td>0.16</td>
</tr>
<tr>
<td>Othera</td>
<td>SII (P-value)</td>
<td>8.2 (0.000)</td>
</tr>
<tr>
<td>RII</td>
<td>1.13</td>
<td>1.05</td>
</tr>
<tr>
<td>Suicide mortality</td>
<td>Hanging/ strangulation/suffocation</td>
<td>SII (P-value)</td>
</tr>
<tr>
<td>RII</td>
<td>0.56</td>
<td>0.62</td>
</tr>
<tr>
<td>Poisoning</td>
<td>SII (P-value)</td>
<td>0.4 (0.74)</td>
</tr>
<tr>
<td>RII</td>
<td>0.06</td>
<td>0.16</td>
</tr>
<tr>
<td>Othera</td>
<td>SII (P-value)</td>
<td>12.0 (0.000)</td>
</tr>
<tr>
<td>RII</td>
<td>0.92</td>
<td>1.00</td>
</tr>
</tbody>
</table>
| SII, Slope Index of Inequality: absolute difference in suicide attempt hospitalization between the bottom and top deciles, obtained from regression of age-standardized rates on mean relative rank of deciles; RII, Relative Index of Inequality: proportionate increase in suicide attempt hospitalization between highest and lowest deciles.
| a Other methods primarily included hanging/strangulation/suffocation, firearms and jumping for suicide attempts; and firearms, drowning and jumping for suicide deaths.
inequalities in Québec were of similar magnitude for males and females. On the other hand, the smaller material deprivation inequality in suicide mortality among Québec women is consistent with the literature.

Differentials between the most and least deprived areas were present primarily among adults of working age (25–64 years) for both suicide attempts and deaths. In general, these persisted or even widened over time. In line with other research, associations between deprivation and suicidal behaviour tended to be smallest for the elderly. There was a substantial increase in differentials for suicide mortality among elderly males (≥65 years) in 2002–2005 to a level resembling men of working age. This might be explained by factors such as income inequality, which has been found to be associated with suicide mortality in the elderly. Income inequality in working Québec increased between 1989 and 2000, which supports this possibility. Alternatively, the recent restructuring of the labour market towards greater technology-based employment, coupled with a decrease in manufacturing jobs (hence, more unemployment in older men) might explain the increase.

In line with other Canadian research, poisoning and cutting/piercing were the two most common methods of suicide attempt hospitalization, while hanging and poisoning were the two leading methods for suicide mortality. Inequalities between the most and the least deprived deciles were observed for poisoning suicide attempts, which over time decreased among males and increased among females. A Scottish study similarly reported greater hospitalizations for paracetamol poisoning (i.e. acetaminophen) among males and females from more deprived quintiles, but found that the relationship between deprivation and hospitalization was constant over time for both genders. The study also evaluated the effects of restrictive legislation on deprivation-related inequalities, which is important because broad-based approaches that target entire populations may reduce levels in less well-off groups, potentially reducing health inequities. However, the study found that although restrictions on paracetamol pack sizes reduced levels of paracetamol-related self-harm for all social groups initially, the effect was short lived and rates returned to pre-legislation levels. To the authors’ knowledge, no other study has evaluated the effects of restrictive legislation on socio-economic inequalities in suicide. In Canada, legislation to restrict the use of firearms was introduced in 1991 (Bill C-17) and 1995 (Bill C-68). As firearm cases were relatively infrequent and grouped with ‘other’ methods in the present analysis, the results cannot be used to evaluate the impact of this legislation. However, differentials in suicide mortality among men between the most and least deprived areas for ‘other’ methods were slightly lower in the second half of the study period, which suggests that firearm legislation may have reduced inequalities in suicide mortality related to material deprivation in Québec.

In addition to the well-established link between mental illness and suicidal behaviour, several studies have reported higher levels of psychopathology and psychiatric healthcare utilization in more materially deprived areas. While this study cannot account for the confounding role that these factors could play between deprivation and suicidal behaviour, a previous study found that deprivation remained significantly associated with suicide mortality after accounting for the prevalence of psychiatric symptomatology. The present study results are therefore unlikely to be explained by psychopathology alone. Furthermore, it is unclear whether psychopathology should be viewed from a perspective of social causation or one of social selection. The social causation hypothesis proposes that low socio-economic status causes psychopathology through adversity and stress. The social selection hypothesis argues that psychopathology results in low socio-economic status, with self-selection into materially deprived areas. Social selection mechanisms require preventive efforts that include mental services and pharmacotherapy. However, social causation mechanisms require social and economic policies that assist the less well-off in efforts to prevent mental disorders and suicidal behaviour. Unfortunately, analyses such as those undertaken in the present work cannot be used to tease out which mechanism is at play.

The role of the community environment in influencing suicidal behaviour is also of interest, in part because of the possible policy implications. In Québec, it is unknown if particular policies or interventions contributed to the decreases in suicide attempts and mortality in the 2000s. While any such strategies may have been successful in improving the health of the population overall, the persistence or increase in inequalities related to material deprivation suggests that such strategies may not have had the desired effect where they are most needed. Policies and interventions aimed at narrowing the health divide between the worst-off and the better-off or focusing primarily on people in poverty may help to decrease suicide attempt and mortality rates in deprived areas.

**Limitations**

Despite international literature indicating that suicide cases may be underestimated (and misclassified in the undetermined death category), underestimation is negligible in Québec, and therefore cases in the undetermined category were not included in the current study as they may represent deaths from other causes. The extent of underestimation for Québec suicide attempt hospitalizations is unknown; however, potential underestimation is unlikely to have been differential across areas, and any bias in the summary measures of inequality would be expected to be towards the null.

Suicide attempts requiring hospitalization reflect the higher end of the severity spectrum. The authors did not have data on suicidal ideation or on suicide attempts not severe enough to be admitted to hospital, so it is not known whether similar patterns are present between deprivation and less severe suicidal behaviour. Hospitalized cases may also be biased towards particular socio-economic groups because of unequal access to healthcare services (e.g. availability, ease of getting to the health facility). If people who attempt suicide from more deprived areas have more limited access to health centres, the associations are likely to be underestimated.

As analyses were based on relatively large areas (CLSCs), dilution of deprivation across deciles is possible and may
underestimate the differences. The size of the areal unit has been shown to be important, with large areas less likely to detect associations between area-level variables and suicidal behaviour.\textsuperscript{55,56} In this study, deciles were used rather than quintiles, thereby minimizing attenuation. Although this study cannot account for heterogeneity in intra-area deprivation, a previous study found no association between income inequality and suicide mortality for Québec CLSCs,\textsuperscript{57} which suggests that heterogeneity is unlikely to have influenced the present results. Furthermore, this study could not account for individual-level confounders such as individual socio-economic status,\textsuperscript{53,58,59} as these data were not available. Finally, this study did not account for potential area-level confounders, such as social fragmentation or rural–urban residence, which have been associated with suicide mortality.\textsuperscript{8,27,46,60}

**Conclusion**

While suicide attempts and mortality decreased overall in the latter part of this study, socio-economic inequalities persisted or even increased over time. Findings from this study underline the importance of monitoring socio-economic inequalities in the spectrum of suicidal behaviours. In addition to interventions aimed at reducing suicidal behaviour in entire populations, strategies that attempt to narrow socio-economic differences in suicidal behaviour should be considered.\textsuperscript{7}

**Acknowledgements**

The authors wish to thank Denis Hamel for assistance with data preparation.

**Ethical approval**

This study was conducted under the Population Health Surveillance Plan of the Québec Health Ministry approved by the Québécois Public Health Ethics Committee.

**Funding**

None declared.

**Competing interests**

None declared.

**References**