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Using administrative health data to estimate prevalence and mortality rates of alcohol and other substance-related disorders for surveillance purposes

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Abstract

Introduction. *Administrative health databases (AHD) are critical to guide health service management and can inform the whole spectrum of substance-related disorders (SRD). This study estimates prevalence and mortality rates of SRD in administrative health databases.* ***Methods.*** *The Quebec Integrated Chronic Disease Surveillance System consists of linked AHD. Analyses were performed on data of all Quebec residents aged 12 and over and eligible for health-care coverage using the International Classification of Diseases (ninth or tenth revision) for case identification. Mortality rate ratios stratified by causes of death were obtained to calculate an excess of mortality.* ***Results.*** *Since 2001–2002, the annual age-adjusted prevalence rate of diagnosed overall SRD remained stable (8.6 per 1000 in 2017–2018). In any given year, the annual prevalence rate was significantly higher in males; adolescents had the lowest rate, while adults 65 years and older the highest. The annual 2017–2018 rate was 2.1 per 1000 for alcohol-induced disorder, 1.9 for other drug-induced disorder, 0.7 for alcohol intoxication and 0.6 for other drug intoxications. Cumulative rate of any diagnosis related to alcohol was 32 per 1000 females and 53 per 1000 males (2001–2018), and 33 per 1000 females and 49 per 1000 males for any diagnosis related to other drugs. There was an excess of all-cause mortality among individuals with SRD compared to the general population.* ***Discussion and Conclusions.*** *AHD can complement epidemiological surveys in monitoring SRD jurisdiction-wide. Surveillance of services utilisation and interventions, coupled with health outcomes like mortality, could be useful in guiding health services planning.* [Huỳnh C, Kisely S, Rochette L, Pelletier É, Lesage A. Using administrative health data to estimate prevalence and mortality rates of alcohol and other substance-related disorders for surveillance purposes. *Drug Alcohol Rev* 2021;40:662–672]

Key words: alcohol-related disorder, substance-related disorder, prevalence, databases, mortality.

Introduction

Alcohol and other substance-related disorders (SRD) represent a wide range of diagnoses including substance use disorders (SUD, i.e. abuse or dependence), but also acute intoxication or poisoning and substance-induced disorders (withdrawal, secondary physical diseases, induced mental disorders, etc.). These two latter

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categories are also associated with broader medical consequences [1,2] and there is a growing consensus on the need to document their trajectories [3]. One source of data is epidemiological surveys. In Quebec, the 2012 Canadian Community Health Survey (CCHS) reported lifetime prevalence rates of 13.3% for alcohol use disorder, 6.4% for cannabis use disorder and 4.3% for any other SUD as determined by the Composite International Diagnostic Interview using Diagnostic and Statistical Manual of Mental Disorders (DSM), fourth edition criteria [4–6]. In the United States, the 2012–2013 National Epidemiologic Survey on Alcohol and Related Conditions reported lifetime prevalence rates of 29.1% for DSM, fifth edition alcohol use disorders and 9.9% for DSM, fifth edition drug use disorders [7,8]. A meta-analysis of epidemiological surveys conducted in 36 countries between 1980 and 2013 reported a pooled lifetime prevalence of 10.7% for any SUD [9]. Males were more likely than females to use substances or be affected by a SUD, but less likely to use health services [6,10], while individuals of both sexes aged less than 24 years had the highest rates of self-reported SUD [6,10]. The CCHS also found that 21.1% of individuals with a SUD had been admitted or had consulted a health professional for addiction or mental health reasons in 2012 [6].

A major limitation of the CCHS survey was that it did not include other SRDs, thereby underestimating societal burden. For instance, SRDs are associated with one of the highest mortality rates among mental disorders, mainly due to external causes (i.e. suicide, unintentional injury, homicide), infectious diseases, as well as diseases of the respiratory and the digestive systems [11]. While epidemiological surveys provide the scope of a given condition in the general population, they do not produce timely data for the surveillance of changes in health outcomes at the population level because of the costs of regular updates. In addition, they rely on self-reported information that is subject to recall or desirability bias [12,13]. Furthermore, individuals with a SRD are more likely to refuse to participate in surveys, fearing repercussions of declaring criminal or socially undesirable behaviours [13]. Administrative health databases may therefore complement epidemiological surveys by circumventing some of these limitations. They cover almost the entire population, are regularly updated and rely on factual information concerning health services [14]. While epidemiological surveys estimate how many individuals may present an SRD in the general population, linked administrative health databases provide more detailed information on how many are being diagnosed or treated for this condition. These data also allow long-term follow up of cohorts with negligible attrition and give information on co-morbidities, medical treatments and outcomes like trauma, suicide and other causes of excessive mortality, which are seldom captured in epidemiological surveys [14].

Currently, there is limited information on how many individuals in the general population are treated for SRD, which, in turn, could inform health service planning. This study therefore aims to demonstrate the utility of administrative databanks in this regard by providing estimates of diverse indicators, including treated prevalence and mortality rates. We used the Quebec Integrated Chronic Diseases Surveillance System (QICDSS), which consists of linked administrative health databases covering almost all Quebec residents to report the following:

1. the prevalence rates of SRD diagnoses, thus providing an estimate of the burden on the health system, according to age group and sex from 2001–2002 to 2017–2018;
2. the mortality rate ratio by cause of death and sex among individuals who received an SRD diagnosis since 2001–2002.

While the data are specific to Quebec, these indicators could be used in other jurisdictions with similar administrative health databases, including the Canadian Institute on Health Information [15], the American Veteran Health Administration [16] or the Danish linked registries [11,17].

Methods

Setting

Quebec is the second most populous Canadian province, with an estimated population of 8.3 million inhabitants on 1 January 2018 [18]. Under the *Canada Health Act* 1984, all Canadian residents are entitled to in-patient or out-patient care that is free at the point of delivery [19]. Patients receive treatment at publicly funded facilities or are seen by private psychiatrists or general practitioners in the community, who then bill the provincial health plan. However, the provincial health plan does not cover visits to private psychologists or other psychosocial professionals (e.g. counsellors, social workers) in private practice. There are no private psychiatric beds. Quebec's linked administrative databases therefore cover health service use in the public and private medical sectors across the whole province, including in-patient, out-patient and community contacts with both specialist services and primary care.

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Data source

The QICDSS received anonymised data of physician billings and hospital visits from the Quebec Health Insurance Board linked using an encrypted health identification number given to every Canadian citizen or permanent resident [20]. We used the following four datasets [21]: (i) the health insurance registry, which contains demographic information and insurance eligibility; (ii) the hospitalisation database, which contains principal and secondary diagnoses associated with hospital admission; (iii) the physician claims database, which contains the principal diagnosis associated with a medical consultation; and (iv) the death registry. The ninth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-9) is still currently used to code diagnoses in the physician claims database [22], while the tenth revision (ICD-10) has replaced ICD-9 in the hospitalisation database since 1 April 2006 [23]. This present study covers from 1 April 2001 to 31 March 2018, except for mortality data, which was only available from 1 April 2003 to 31 March 2017. Fiscal instead of calendar years were used for pragmatic reasons, because each file in the databases only covered one fiscal year at a time. The use of the QICDSS for research projects on health surveillance was approved by the Public Health Ethics Committee and the Access of Information Commission of Quebec.

Data quality

The QICDSS covers approximately 98% of the entire Quebec population. The linkage success rate with the health insurance registry for the hospitalisation and the physician claims database exceeds 99% while the linkage rate with the death registry is approximately 97% [20]. All the hospital records and 90% of claims in the physician billings database had a diagnostic code. There were no missing data concerning age and sex.

Case identification

All Quebec residents aged 12 years and over and eligible for health-care coverage were considered. To be identified as an SRD case, an individual had to receive at least one of the ICD codes (Table 1) in the hospitalisation database or the physician claims database. As described elsewhere [24], the SRD indicators were based on a literature review and expert consultation (researchers, psychiatrists, general practitioners and an emergency physician). There was an overall indicator composed of six different sub-indicators, each representing a broad SRD category [22,23,25]. 'Alcohol use disorders' and 'other drug use disorders' were behavioural and cognitive syndromes defined by continued use despite significant problems. 'Alcohol-induced disorders' and 'other drug-induced disorders' were psychiatric or physical syndromes arising directly from substance use, such as withdrawal, secondary psychoses and diseases 100% attributable to substance use. 'Alcohol intoxication' and 'other drug intoxication' were clinically relevant physiological effects during or shortly after use. Cannabis, opioids, cocaine, other stimulants, hypnotics, sedatives, solvents and hallucinogens were analysed together while alcohol

Table 1. *ICD-9 and ICD-10 diagnostic codes*

Indicator	ICD-9	ICD-10
Alcohol use disorder	303.x, 305.0	F10.1, F10.2
Other drug use disorder	304.0-304.9, 305.2-305.7, 305.9	F11.1, F12.1, F13.1, F14.1, F15.1, F16.1, F18.1, F19.1, F11.2, F12.2, F13.2, F14.2, F15.2, F16.2, F18.2, F19.2, F55
Alcohol-induced disorder	291.x, 357.5, 425.5, 535.3, 571.0-571.3	F10.3-F10.9, K70.0-K70.4, K70.9, G62.1, I42.6, K29.2, K85.2, K86.0, E24.4, G31.2, G72.1, O35.4
Other drug-induced disorder	292.x	F11.3-F11.9, F12.3-F12.9, F13.3-F13.9, F14.3-F14.9, F15.3-F15.9, F16.3-F16.9, F18.3-F18.9, F19.3-F19.9
Alcohol intoxication	980.0, 980.1, 980.8, 980.9	F10.0, T51.0, T51.1, T51.8, T51.9
Other drug intoxication	965.0, 965.8, 967.0, 967.6, 967.8, 967.9, 969.4, 969.5, 969.7, 969.6, 969.8, 969.9, 970.8, 982.0, 982.8	F11.0, F12.0, F13.0, F14.0, F15.0, F16.0, F18.0, F19.0, T40.0-T40.9, T42.3, T42.4, T42.6, T42.7, T43.5, T43.6, T43.8, T43.9, T50.9, T52.8, T52.9

ICD-9, International Classification of Diseases, ninth revision; ICD-10, International Classification of Diseases, tenth revision.

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was considered separately. These six sub-indicators were further divided into 11 subcategories (see Table 1).

Analyses

All analyses were conducted using SAS Enterprise Guide 7.1. Annual prevalence represents the rate per 1000 individuals who received an SRD diagnosis within a fiscal year (1 April to 31 March), characterising the annual burden of SRD on the medical health system. Cumulative prevalence represents the rate of individuals who received an SRD diagnosis at any time since 1 April 2001 and are therefore indicators of the long-term burden including chronic medical conditions and mortality that would not be captured in the annual if they did not occur within the same year of an initial SRD diagnosis [3]. Deceased individuals were excluded from the cumulative analyses in the years following their death.

Prevalence rates were age-standardised to the 2006 Census data of the Quebec population. Based on previous work, results were stratified by age groups that reflected lifespan benchmarks (e.g. graduating, entering the workforce, retiring) [26,27]. Adolescence was represented by 12–17-year-olds, emerging adulthood by 18–24-year-olds, young adulthood by 25–49-year-olds, middle-age adulthood by 50–64-year-olds, and older age by individuals aged 65 years and over. Rates were stratified by demographic groups (e.g. the rate of alcohol use disorder within adolescent males). Considering the very low prevalence numbers of some SRD, rates per 1000 individuals are presented instead of percentages.

To assess mortality rates for cumulative cases of SRD and non-SRD individuals between 1 April 2003 and 31 March 2017, a proportion (per 1000) was generated, which was then used to calculate a mortality rate ratio (MRR). We determined excess mortality by dividing the proportion of SRD cases who died from a specific cause by the proportion of cases without SRD who died from the same cause. Similar to a previous Danish publication, MRR were calculated using these cumulative rates [11]. An MRR of one suggests that mortality rates are similar between the two groups. An MRR greater than one suggests that the mortality rate is higher among individuals with SRD compared to the general population.

Considering the large size that is almost equivalent to that of the Quebec population, we used a conservative approach for comparing the two groups in that non-overlapping 99% confidence intervals (CI) were interpreted as significant differences between groups [28]. Performing formal statistical inference and using *P*-values were not deemed appropriate with a very large sample size, because even small differences were considered significant.

Results

In 2001–2002, QICDSS included 6 381 285 individuals aged 12 years and older, representing 99.4% of the relevant Quebec population. By 2017–2018, there were 7 211 235 individuals, representing 98.6% of Quebecers who were 12 years and older. Females represented 51% of the whole sample.

Annual prevalence rates

The annual age-adjusted prevalence of overall SRD increased from 9.4 per 1000 (99% CI 9.3, 9.5) in 2001–2002 to 9.9 per 1000 (CI 9.8, 10.0) in 2005–2006. Rates remained stable until 2012–2013 (9.9 per 1000 [CI 9.8, 10.0]) before showing a decrease to 8.6 per 1000 (CI 8.6, 8.7) in 2017–2018. In crude numbers, this represented in 2017–2018, 40 375 men and 23 495 women aged 12 years and over. Figure 1 describes crude trends over time by sex and age group.

Table 2 details the 2017–2018 annual prevalence rates for overall SRD, as well as for all six SRD broad indicators and 11 specific sub-indicators. Annual prevalence rates were significantly higher in males (11.1 per 1000 [CI 11.0, 11.3]) than in females (6.3 per 1000 [CI 6.2, 6.4]). Among males, the annual prevalence of alcohol use disorders was highest among middle-aged (5.4 per 1000 [CI 5.2, 5.6]) and older men (6.0 per 1000 [CI 5.7, 6.2]). Among females, emerging adults (2.0 per 1000 [CI 1.8, 2.2]) and middle-aged women (2.1 per 1000 [CI 2.0, 2.2]) had the highest rates. Men over 25 years old had higher rates of alcohol intoxication than women in the corresponding age group. Concerning drug use disorders, men had a higher prevalence than women in almost all age groups, except for 65 years or older where women had a significantly higher rate (1.2 per 1000) than men (1.0 per 1000). Concerning other drug-induced disorders, male (4.0 per 1000 [CI 3.8, 4.3]) and female (2.2 per 1000 [CI = 2.0, 2.4]) emerging adults had the highest rate. Adult males aged between 18 and 64 years old had significantly higher rates of intoxication than adolescents. Adolescent girls had higher other drug intoxication rates than their male counterparts.

Additional results not reported in Table 2 suggest that the adolescent group had the lowest overall SRD

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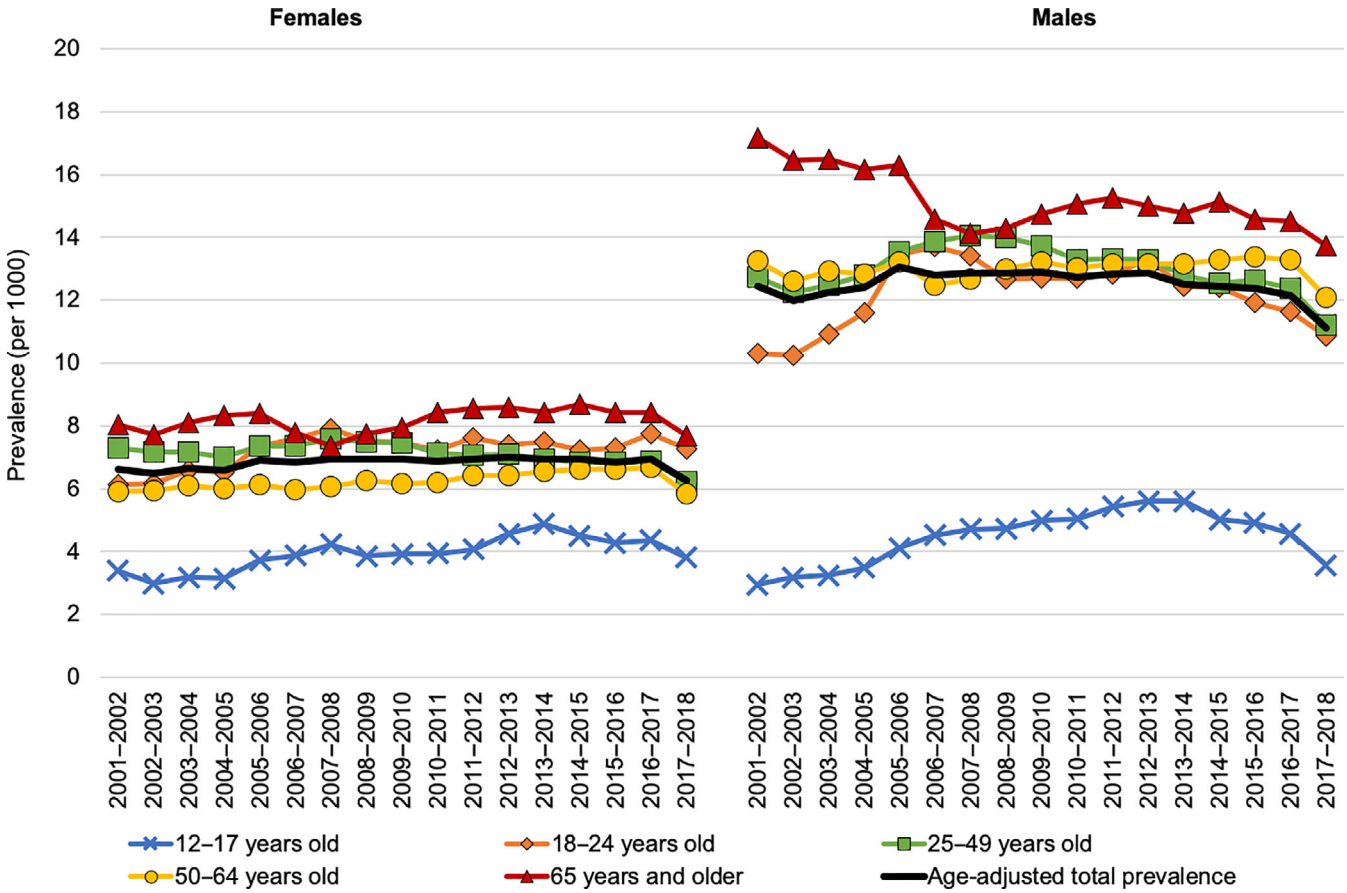


Figure 1. *Crude annual prevalence of substance-related disorder among individuals aged 12 and over, Quebec, 2001–2002 to 2017–2018, by sex and age group.*

prevalence rate (3.7 per 1000 [CI 3.5, 3.9]), while adults 65 years and older had the highest (10.4 per 1000 [CI 10.2, 10.6]). For both sexes, adults 65 years and older had the highest prevalence of alcohol-induced disorder (5.3 per 1000 [CI 5.2, 5.5]). Concerning acute alcohol intoxication, emerging adults had the highest prevalence (1.0 per 1000 [CI 0.9, 1.1]), with no significant sex differences. In both males and females, the highest diagnosed prevalence of other drug use disorders was found among 25–49-year-olds (3.6 per 1000 [CI 3.5, 3.7]) and 18–24-year-olds (3.3 per 1000 [CI 3.1, 3.5]).

Cumulative prevalence rates

In 2001–2002, the SRD age-standardised rate was 33.2 per 1000 (99% CI 33.0, 33.4). By 2017–2018, the cumulative rate was 69.4 per 1000 (CI 69.2, 69.7). This represented 511 655 Quebecers aged 12 years and over (304 970 men and 206 685 women). Among females, the age-standardised rate for any diagnosis related to alcohol went from 13.6 per 1000 (CI 13.4, 13.7) in 2001–2002 to 31.7 per 1000 (CI 31.5, 32.0) in 2017–2018; among males, the rate was 28.9 per 1000 (CI 28.7, 29.2) in 2001–2002 to 52.7 per 1000 (CI 52.4, 53.0) in 2017–2018. The age-standardised rate for any disorder related to other drugs was 13.9 per 1000 females (CI 13.7, 14.1) and 19.5 per 1000 males (CI 19.3, 19.7) in 2001–2002, and 33.2 per 1000 females (CI 33.0, 33.5) and 48.6 per 1000 males (CI 38.3, 38.9) in 2017–2018.

Figure 2 describes the cumulative prevalence for each indicator over time by sex, where a constant increase is observed from one year to another. Among males, the cumulative prevalence for other drug use disorders increased at a higher rate, from 16.3 per 1000 (CI 16.1, 16.5) in 2001–2002 to 39.4 per 1000 (CI 39.1, 39.7) in 2017–2018, than for alcohol use disorders, from 22.8 per 1000 (CI 22.6, 23.1) in 2001–2002 to 37.4 per 1000 (CI 37.1, 37.1) in 2017–2018, suggesting an increased incidence of either the disorder or its detection. In females, in any given year, the cumulative prevalence of other drug use disorders was always higher than for alcohol use disorders. In 2017–2018, for both males and females, other drug use disorders (31.4 per 1000 [CI 31.3, 31.7])

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Table 2. *Crude annual prevalence (per 1000) of substance-related disorder diagnoses in individuals aged 12 and over, Quebec, 2017-2018*

	Rate per 1000 [99% confidence interval]												
	Females						Males						Total
	12–17 years	18–24 years	25–49 years	50–64 years	65 years or older	Age-adjusted total (females)	12–17 years	18–24 years	25–49 years	50–64 years	65 years or older	Age-adjusted total (males)	Age-adjusted total
Any substance-related disorder	3.8 [3.5, 4.2]	7.3 [6.9, 7.6]	6.2 [6.1, 6.4]	5.8 [5.6, 6.0]	7.7 [7.4, 7.9]	6.3 [6.2, 6.4]	3.6 [3.3, 3.9]	10.9 [10.4, 11.3]	11.2 [11.0, 11.4]	12.1 [11.8, 12.4]	13.7 [13.4, 14.1]	11.1 [11.0, 11.3]	8.6 [8.6, 8.7]
1. Alcohol use disorder	0.6 [0.5, 0.8]	2.0 [1.8, 2.2]	1.7 [1.6, 1.8]	2.1 [2.0, 2.2]	1.8 [1.7, 1.9]	1.7 [1.7, 1.8]	0.6 [0.5, 0.7]	2.5 [2.3, 2.7]	3.2 [3.1, 3.4]	5.4 [5.2, 5.6]	6.0 [5.7, 6.2]	3.9 [3.8, 3.9]	2.8 [2.7, 2.8]
1a. Alcohol abuse	0.6 [0.4, 0.7]	1.4 [1.3, 1.6]	0.8 [0.8, 0.9]	0.7 [0.6, 0.8]	0.4 [0.3, 0.5]	0.8 [0.7, 0.8]	0.5 [0.4, 0.6]	1.8 [1.6, 2.0]	1.4 [1.3, 1.5]	1.4 [1.3, 1.6]	1.0 [0.9, 1.1]	1.3 [1.3, 1.4]	1.0 [1.0, 1.1]
1b. Alcohol dependence	0.1 [0.0, 0.1]	0.6 [0.5, 0.7]	1.0 [0.9, 1.1]	1.6 [1.5, 1.7]	1.5 [1.4, 1.6]	1.1 [1.0, 1.1]	0.1 [0.0, 0.1]	0.8 [0.7, 1.0]	2.1 [2.0, 2.2]	4.4 [4.3, 4.6]	5.2 [5.0, 5.4]	2.8 [2.8, 2.9]	1.9 [1.9, 2.0]
2. Other drug use disorder	1.3 [1.1, 1.5]	2.2 [2.0, 2.4]	2.4 [2.3, 2.5]	1.5 [1.4, 1.6]	1.2 [1.1, 1.3]	1.9 [1.8, 1.9]	1.5 [1.3, 1.7]	4.3 [4.0, 4.6]	4.8 [4.6, 4.9]	2.9 [2.8, 3.0]	1.0 [0.9, 1.1]	3.4 [3.3, 3.5]	2.6 [2.6, 2.7]
2a. Other drug abuse	0.7 [0.5, 0.8]	0.7 [0.6, 0.9]	0.5 [0.5, 0.6]	0.3 [0.2, 0.3]	0.1 [0.1, 0.2]	0.4 [0.4, 0.5]	0.6 [0.5, 0.7]	1.4 [1.3, 1.6]	1.2 [1.1, 1.3]	0.5 [0.5, 0.6]	0.2 [0.1, 0.2]	0.8 [0.8, 0.9]	0.6 [0.6, 0.7]
2b. Other drug dependence	0.7 [0.6, 0.9]	1.6 [1.4, 1.7]	2.0 [1.9, 2.1]	1.3 [1.2, 1.4]	1.1 [1.0, 1.2]	1.5 [1.5, 1.6]	1.0 [0.8, 1.1]	3.1 [2.9, 3.4]	3.8 [3.7, 4.0]	2.5 [2.3, 2.6]	0.8 [0.7, 0.9]	2.7 [2.6, 2.8]	2.1 [2.1, 2.2]
3. Alcohol-induced disorder	0.3 [0.2, 0.4]	0.6 [0.5., 0.7]	0.9 [0.9, 1.0]	1.6 [1.5, 1.8]	4.1 [3.9, 4.2]	1.5 [1.5, 1.6]	0.2 [0.1, 0.3]	0.9 [0.7, 1.0]	1.8 [1.7, 1.9]	3.9 [3.7, 4.0]	6.9 [6.6, 7.1]	2.8 [2.8, 2.9]	2.1 [2.1, 2.2]
3a. Alcohol withdrawal	0.0 [0.0, 0.1]	0.1 [0.0, 0.1]	0.2 [0.2, 0.2]	0.4 [0.3, 0.4]	2.5 [2.3, 2.6]	0.6 [0.5, 0.6]	0.0 [0.0, 0.1]	0.1 [0.1, 0.2]	0.5 [0.4, 0.5]	1.1 [1.0, 1.2]	2.9 [2.7, 3.1]	0.9 [0.9, 1.0]	0.7 [0.7, 0.8]
3b. Alcohol-induced psychotic disorder	0.0 [0.0, 0.1]	0.1 [0.0, 0.1]	0.1 [0.1, 0.2]	0.1 [0.1, 0.2]	0.2 [0.2, 0.3]	0.1 [0.1, 0.1]	0.0 [0.0, 0.1]	0.2 [0.2, 0.3]	0.3 [0.3, 0.3]	0.3 [0.2, 0.3]	0.4 [0.3, 0.4]	0.3 [0.2, 0.3]	0.2 [0.2, 0.2]
3c. Other alcohol-induced mental or behavioral disorder	0.2 [0.1, 0.3]	0.4 [0.3, 0.5]	0.4 [0.4, 0.5]	0.3 [0.3, 0.4]	0.4 [0.4, 0.5]	0.4 [0.3, 0.4]	0.1 [0.1, 0.2]	0.4 [0.3, 0.5]	0.6 [0.5, 0.6]	0.6 [0.5, 0.7]	0.8 [0.7, 0.8]	0.5 [0.5, 0.6]	0.5 [0.4, 0.5]
3d. Physical diseases attributable to alcohol	0.0 [0.0, 0.1]	0.1 [0.1, 0.1]	0.3 [0.2, 0.3]	0.9 [0.8, 1.0]	1.0 [1.0, 1.1]	0.5 [0.5, 0.5]	N/A	0.1 [0.1, 0.2]	0.6 [0.5, 0.6]	2.3 [2.1, 2.4]	3.2 [3.0, 3.4]	1.3 [1.2, 1.3]	0.9 [0.8, 0.9]
4. Other drug-induced disorder	0.9 [0.8-1.1]	2.2 [2.0, 2.4]	1.7 [1.6, 1.8]	0.9 [0.8, 0.9]	0.6 [0.5, 0.7]	1.3 [1.2, 1.4]	0.9 [0.8, 1.1]	4.0 [3.8, 4.3]	3.3 [3.2, 3.5]	1.7 [1.6, 1.8]	0.7 [0.7, 0.8]	2.4 [2.3, 2.5]	1.9 [18, 1.9]
4a. Other drug withdrawal	0.1 [0.1, 0.2]	0.2 [0.2, 0.3]	0.4 [0.3, 0.4]	0.3 [0.3, 0.4]	0.3 [0.2, 0.3]	0.3 [0.3, 0.3]	0.1 [0.1, 0.2]	0.5 [0.4, 0.6]	0.7 [0.6, 0.8]	0.7 [0.6, 0.8]	0.4 [0.3, 0.4]	0.6 [0.5, 0.6]	0.4 [0.4, 0.5]
4b. Other drug-induced psychotic disorder	0.4 [0.3, 0.5]	1.0 [0.9, 1.2]	0.7 [0.6-0.8]	0.3 [0.2, 0.3]	0.2 [0.1, 0.2]	0.5 [0.5, 0.6]	0.4 [0.3, 0.5]	2.0 [1.8, 2.2]	1.5 [1.4, 1.6]	0.5 [0.5, 0.6]	0.2 [0.2, 0.2]	1.0 [1.0, 1.1]	0.8 [0.7, 0.8]
4c. Other drug-induced mental or behavioral disorder	0.5 [0.4, 0.7]	1.1 [1.0, 1.2]	0.7 [0.7, 0.8]	0.3 [0.2, 0.3]	0.1 [0.1, 0.2]	0.5 [0.5, 0.6]	0.4 [0.3, 0.5]	1.9 [1.7, 2.1]	1.5 [1.4, 1.6]	0.6 [0.5, 0.7]	0.2 [0.1, 0.2]	1.0 [1.0, 1.1]	0.8 [0.8, 0.8]
5. Alcohol intoxication	0.5 [0.4, 0.6]	0.9 [0.8, 1.1]	0.5 [0.5, 0.6]	0.4 [0.4, 0.5]	0.2 [0.2, 0.3]	0.5 [0.5, 0.5]	0.4 [0.3, 0.5]	1.0 [0.9, 1.2]	0.9 [0.8, 0.9]	1.0 [1.0, 1.1]	0.7 [0.6, 0.8]	0.9 [0.8, 0.9]	0.7 [0.6, 0.7]
6. Other drug intoxication	0.7 [0.5, 0.8]	0.8 [0.7, 0.9]	0.7 [0.6, 0.7]	0.6 [0.5, 0.7]	0.5 [0.5, 0.6]	0.6 [0.6, 0.7]	0.3 [0.2, 0.4]	0.7 [0.6, 0.8]	0.7 [0.7, 0.8]	0.6 [0.5, 0.6]	0.5 [0.4, 0.6]	0.6 [0.6, 0.6]	0.6 [0.6, 0.6]

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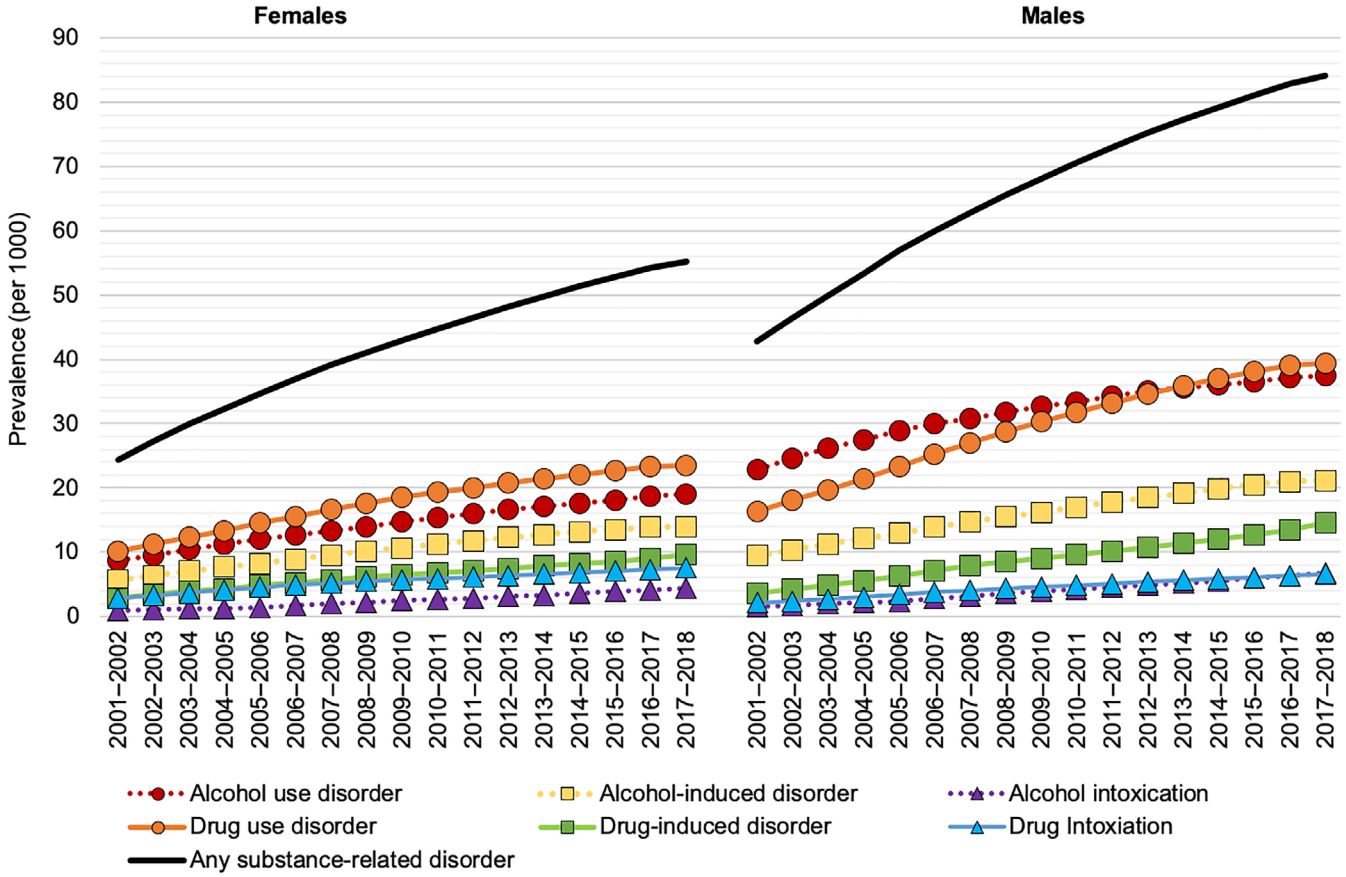


Figure 2. *Age-adjusted cumulative prevalence of substance-related disorder among individuals aged 12 and over, Quebec, 2001–2002 to 2017–2018, by sex and type of disorder.*

had the highest cumulative prevalence, followed by alcohol use disorders (27.9 per 1000 [CI 27.8, 28.1]), alcohol-induced disorders (17.5 per 1000 [CI 17.3, 17.6]), other drug-induced disorders (12.2 per 1000 [CI 12.1, 12.3]), other drug intoxication (7.1 per 1000 [CI 7.0, 7.1]) and alcohol intoxication (5.5 per 1000 [CI 5.5, 5.6]).

Mortality rates

Between 1 April 2003 and 31 March 2017, the all-cause mortality rates among cumulative SRD cases were 18.5 per 1000 (CI 18.3, 18.7) for females and 20.8 per 1000 (CI 20.6, 21.0) for males. These mortality rates were significantly higher than in the general population (5.7 per 1000 [CI 5.7, 5.8] among non-SRD females and 6.5 per 1000 [CI 6.5, 6.6] among non-SRD males). Therefore, the all-cause adjusted MRR was 3.2 for both sexes. Figure 3 presents adjusted MRR by specific cause of death and sex between 1 April 2003 and 31 March 2017. There was an excess of mortality among individuals with SRD compared to the general population for all causes of death. Males with SRD were more likely than non-SRD males to die of diseases of the digestive system (MRR 7.2), followed by other specific causes of death (e.g. diseases of the blood and the blood-forming organs, certain immune disorders, diseases of the skin, the subcutaneous tissue, the musculoskeletal system and connective tissues, diseases of the genitourinary system, symptoms, signs and abnormal clinical findings not classified elsewhere) (MRR 7.1) and external causes (e.g. injuries, poisonings) (MRR 5.5). Females with SRD were more likely than non-SRD females to die from external causes, such as suicide (MRR 7.7) followed by diseases of the digestive system (MRR 6.2) and other causes (MRR 5.0).

Discussion

This study measured annual and cumulative prevalence rates of diagnosed SRDs, as well as mortality rates, in a complete population under universal health care using indicators based on ICD coding.

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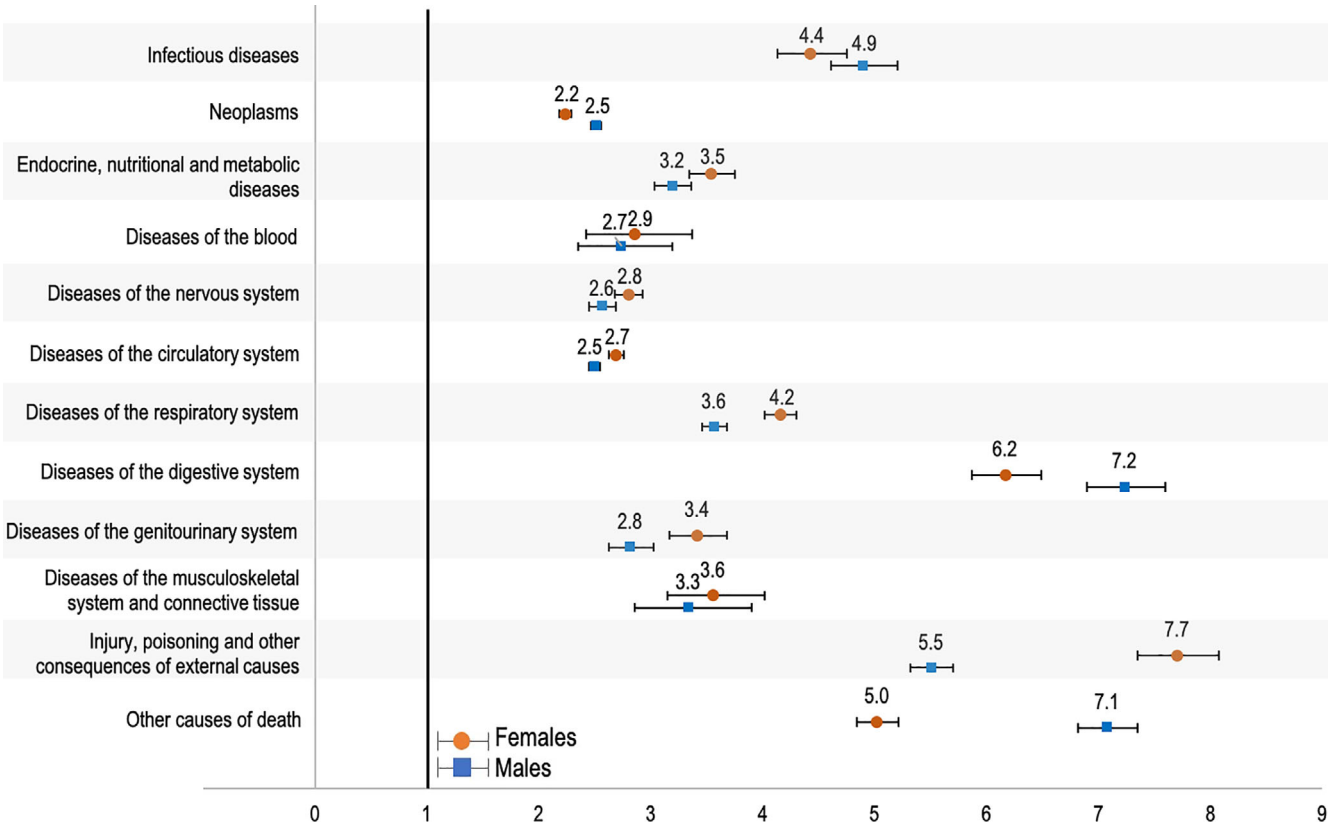


Figure 3. *Age-adjusted mortality rate ratios (substance-related disorder: non-substance-related disorder) by cause of death and sex, 1 April 2003 to 31 March 2017, Quebec.*

Discrepancies in findings between epidemiological surveys and administrative health databases can happen for several reasons, such as the failure to detect SRD or a reluctance to use available medical services, but may also indicate a system-wide failure in providing care to individuals with SRD. Administrative data also provide crucial information on the minimal levels of necessary services given that they only capture a portion of SRD, and most probably the severe or recurrent cases. Reassuringly, QICDSS results for the annual prevalence of diagnosed SUD are similar to those from epidemiological surveys that report on treated individuals with SUD [29].

As in epidemiological surveys, the QICDSS found a higher rate of almost all SRD in males [10,30]. This is consistent with substance use being more culturally acceptable in men [31], who also tend to express psychological distress through externalised behaviours, such as substance misuse [32]. Physicians are also more likely to diagnose a SRD in males, while women are more likely to be diagnosed with an anxiety or mood disorder [33]. In contrast to SUDs, we are unable to compare rates for acute intoxication or substance-induced disorders, as these are not covered by any survey in Quebec or elsewhere in Canada [6,34,35].

In the case of alcohol use disorders, our findings that those aged over 65 years, especially males, had the highest prevalence rate are in contrast to the CCHS results where 15–24-year-olds had the highest rate [36]. Higher alcohol use among older individuals may be due to a cohort effect, with 'baby boomers' now turning 65 years old [37]. In addition, older adults are generally more likely to use health services than other age groups [38]. Individuals may wait decades until an alcohol-related disorder become sufficiently severe to seek help. Similarly, doctors may detect an alcohol-related disorder later in life when the patient presents with physical complications [39,40].

On the other hand, our data did confirm that 18–24-year-olds were more likely to present to emergency departments for acute disorders such as intoxication while underutilising ambulatory care [41]. This may be due to the normalisation of excessive alcohol drinking in this group and a consequent reluctance to seek help [42]. They also tend to have lower professional and familial responsibilities, so alcohol-related harms are less apparent [43,44].

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In contrast to alcohol, and in keeping with epidemiological surveys, rates of other drug use disorders were highest among young adults [45]. Whereas alcohol is socially accepted and easily accessible, the use of other substances may be restricted to individuals who are more inclined to experimentation and risk-taking traits, which are commoner in young adults [46]. Also, the health consequences of some drugs such as bloodborne viruses or psychosis may develop sooner in life than those of alcohol [47,48].

Higher MRRs were found for all causes of death among individuals with SRD, which is consistent with findings from Nordic registers [11,49,50], and possibly explained by their greater risk of comorbid physical diseases directly (e.g. alcoholic liver cirrhosis) or indirectly (e.g. HIV/AIDS or hepatitis C virus) attributable to the relevant substance [51]. The highest MRR for males with SRD was for diseases of the digestive system, which differs from Danish registry data where the highest MRRs were for external causes, followed by infectious diseases and only then by diseases of the digestive system [11]. One explanation is that our SRD case definition included both physical and psychological disorders while the Danish definition of SRD was restricted to the latter. Another is that males in the QICDSS had a higher rate of alcohol-related than other drug-related disorders and alcohol is a known aetiological factor for liver cirrhosis and chronic pancreatitis [52]. For females, the highest MRRs were for external causes, such as suicide, poisoning and injuries, followed by gastro-intestinal and infectious diseases in the QICDSS is consistent with the pattern found in the Danish registries [11].

Limitations

Administrative health databases were not designed for research purposes [53], although recording bias is minimised through financial incentives to ensure data quality [54]. They also lack data on socio-economic status or ethnicity. In addition, only the primary diagnosis is recorded in the physician's claim database and so if SRD was not the main reason for consultation, this diagnosis will not be recorded. It is impossible to examine the original physician records for further information on secondary diagnoses or to confirm the validity of the ICD codes in the QICDSS because data are de-identified for confidentiality and privacy reasons. Furthermore, the QICDSS databases only identify individuals who have seen a physician and not people seen in addiction rehabilitation centres, local community service centres or private psychosocial clinics [55]. Nonetheless, an individual with a SRD has a high probability of eventually using medical services given their diverse health consequences [56,57]. Cumulative prevalence rates may therefore capture most cases in the long term. These data can only measure the rates of treated illness not the overall prevalence in the community. Furthermore, coding accuracy can be affected by clerical errors, limited coding options, diagnostic misclassification or omission [53,58].

Conclusion

This study demonstrated the importance of administrative databanks in health services planning for SRD by providing estimates such as treated prevalence and mortality rates given that nine individuals per 1000 were diagnosed with SRD annually and their excess consequent all-cause mortality. Developing a surveillance system on SRD can guide health services planning and manage the burden associated with these conditions although it is important that data are regularly updated. A time frame of 1-year lag between data collection and availability seems adequate when dealing with temporally stable phenomena, such as the annual prevalence rate of SRD in Quebec. However, continuous monitoring without a time lag becomes necessary to respond quickly to health crises, such as sudden surges of fatalities from new substances appearing on the market. While this study was mostly descriptive, these indicators could be used in regression models to further investigate possible predictors of health outcomes such as frequency of contacts or psychiatric comorbidities. We plan to extend this method to other Canadian provinces as a prelude to nationwide adoption by the Public Health Agency of Canada and this may also be applicable to countries with similar linked administrative data.

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Conflict of Interest

The authors have no conflicts of interest.

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Ethical Standards

This study has been approved by Quebec Public Health Ethics Committee and the Access of Information Commission of Quebec. It has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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