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# Sex differences in suicide mortality in Newfoundland and Labrador: An observational study with medical examiner data from 1997 to 2016

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## ABSTRACT

### Background

Globally, the suicide rate is two times higher for males than for females. Previous studies in Newfoundland and Labrador did not examine age-specific rates by sex. The objectives of this study were to determine suicide rates by sex and age group and to compare the demographic and clinical characteristics of males and females who died by suicide.

### Data and methods

This observational study analyzed a routinely collected dataset based on all medical examiner-determined suicide deaths among people aged 10 years and older in Newfoundland and Labrador, Canada, between 1997 and 2016. Age-standardized and age-specific suicide rates and rate ratios were calculated based on the number of deaths during the period, and descriptive statistics were used to compare demographic and clinical characteristics between males and females.

### Results

The age-standardized suicide rate was 4.6 times higher among males than females and was higher for males in most age groups. Rates were highest in the young adult age groups for males (20 to 24 years) and females (35 to 39 years). Males who died by suicide were more likely to be from a rural community and to have died by firearm; females were more likely to die by self-poisoning and to have had a mental illness or substance use history.

### Interpretation

The results are broadly consistent with previous research, though this is the first study to report age-specific suicide rates among females across the life course in Newfoundland and Labrador. The results underscore the need to design public health and clinical interventions that account for sex differences in suicide risks.

### Keywords

Suicide; sex differences; population health; epidemiology; routinely collected health data; coroners and medical examiners; Newfoundland and Labrador.

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Globally, the suicide rate is two times higher for males than for females,<sup>1</sup> though this disparity varies by region and country.<sup>1,2</sup> In Canada, the suicide rate was three times higher among males than females in 2019 (18.5 versus 5.9 suicide deaths per 100,000), and males accounted for 76% of all suicide deaths.<sup>3</sup> Among provinces and territories, the average male-to-female rate ratios (RRs) ranged from 2.6 to 6.7 during the 2000-to-2019 period and were highest in Nunavut and the Atlantic provinces.<sup>4</sup> In Newfoundland and Labrador, previous studies found that 83% of suicide deaths were among males, and the male-to-female ratio was 4.8 and 4.9 to 1.<sup>5,6</sup>

In general, sex differences in suicide in Newfoundland and Labrador<sup>5-8</sup> appear to be similar to those in Canada<sup>9,10</sup> and other high-income countries.<sup>1</sup> However, the epidemiology of suicide in Newfoundland and Labrador is distinguished from national<sup>9</sup> and global<sup>1</sup> suicide rate declines by rate increases among males and females between 1981 and 2018.<sup>5</sup> Given this trend, it is important to understand the patterns of suicide mortality in subpopulations further to inform targeted interventions.

Disaggregating mortality data by multiple demographic factors is challenging with small populations, as in Newfoundland and Labrador, and with “rare” outcomes like suicide.<sup>11</sup> Such analyses often produce small cell counts and unstable rate estimates with wide confidence intervals. Aggregating subgroups into broad categories or pooling data from multiple years are strategies that can help address these challenges.<sup>5,6,8,12</sup>

Previous studies in Newfoundland and Labrador used wide age bands to examine suicide rates for males by geography, over time.<sup>5,8</sup> However, this approach obscured possible rate differences for specific developmental subgroups such as young adults (20 to 24 years) and older seniors (75 years and older). Age-specific rates for females were not reported in previous studies in the province,<sup>5,6,8,12</sup> with one exception for youth.<sup>7</sup> The present study was conducted to address these limitations and to examine the sex differences in suicide rates and characteristics further. The objectives of this study were to describe the overall and age-specific rates of suicide by sex and to compare the demographic and clinical characteristics of males and females who died by suicide.

## Methods

This observational study examined data on males and females aged 10 years and older who died by suicide in Newfoundland and Labrador, Canada. This study was approved by the Newfoundland and Labrador Health Research Ethics Board (#2018.125).

### Data source

The primary data source was the Newfoundland and Labrador Centre for Health Information (NLCHI) Suicide Database. This database includes information on all medical examiner-confirmed suicide deaths that occurred in the province between January 1, 1997, and December 31, 2016. Data were derived

from a review of files from the provincial Office of the Chief Medical Examiner, which contain materials collected through medicolegal death investigations, including police reports, autopsy and toxicology results, and medical records. Information was extracted via a standardized chart review procedure by NLCHI epidemiologists, then linked at the record level to three administrative datasets: annual mortality files, the provincial health care client registry, and the Postal Code Conversion File. The database includes information on demographics, circumstances surrounding death, recent social factors, and medical history. The variable “sex” was defined as sex assigned at birth and was reported for all deaths; the data source did not include information about gender. Additional details about the data source were reported in previous studies.<sup>6,12</sup>

### Statistical analysis

This study analyzed data on provincial residents who died by suicide. Age-standardized and age-specific suicide mortality rates per 100,000 population were calculated based on the number of deaths during the 1997-to-2016 period. Population data for the rate calculations were derived from census, intercensal, and postcensal estimates from Statistics Canada.<sup>13</sup> The provincial population counts for each year in the 20-year study period were stratified by sex and five-year age groups, then pooled to create cumulative person-year denominators for each stratum. As in other studies,<sup>8,9,14</sup> 10 years old was the lower threshold for count and population data because suicide deaths among children aged 9 and younger are rare. Pooled rather than annual incidence was calculated to reduce the number of strata with small counts and to increase the stability of the rates.<sup>15</sup> Age-standardized suicide mortality rates and 95% confidence intervals (CIs) were computed with the direct method using the 2011 Canadian standard population.<sup>16</sup> To compare rates, incidence rate ratios (IRRs) and 95% CIs were calculated by sex and five-year age groups using the rate among males as the reference. Rates were considered to be significantly different if the IRR CIs did not include one.

Descriptive statistics, including counts and proportions, were used to examine demographic and clinical characteristics. Males and females were compared using t-tests for continuous variables and chi-squared tests for categorical variables. Statistical significance was determined with a p-value of 0.05, and effect size was reported using Cramér's *V*. Post hoc differences were assessed via the inspection of standardized residuals. A Bonferroni adjustment was also used where applicable.<sup>17</sup> Analyses were conducted with Stata version 13.1 and SPSS 21.0.

## Results

Between 1997 and 2016, 972 residents of Newfoundland and Labrador died by suicide. Males accounted for 81.6% (n = 793) of all suicide deaths. The average age of males was 42.9 years (range 12 to 89 years); females were slightly younger (40.3

**Table 1**  
Crude and age-standardized suicide rates per 100,000 population by sex in Newfoundland and Labrador, 1997 to 2016

Sex	Suicide deaths		Crude rate	Age-standardized rate	95% Confidence interval	
	number	Person-years			Lower	Upper
All	972	9,394,671	10.3	10.4	9.7	11.0
Female	179	4,781,396	3.7	3.7	3.2	4.3
Male	793	4,613,275	17.2	17.2	16.0	18.4

Note: Confidence intervals are per 100,000 population.

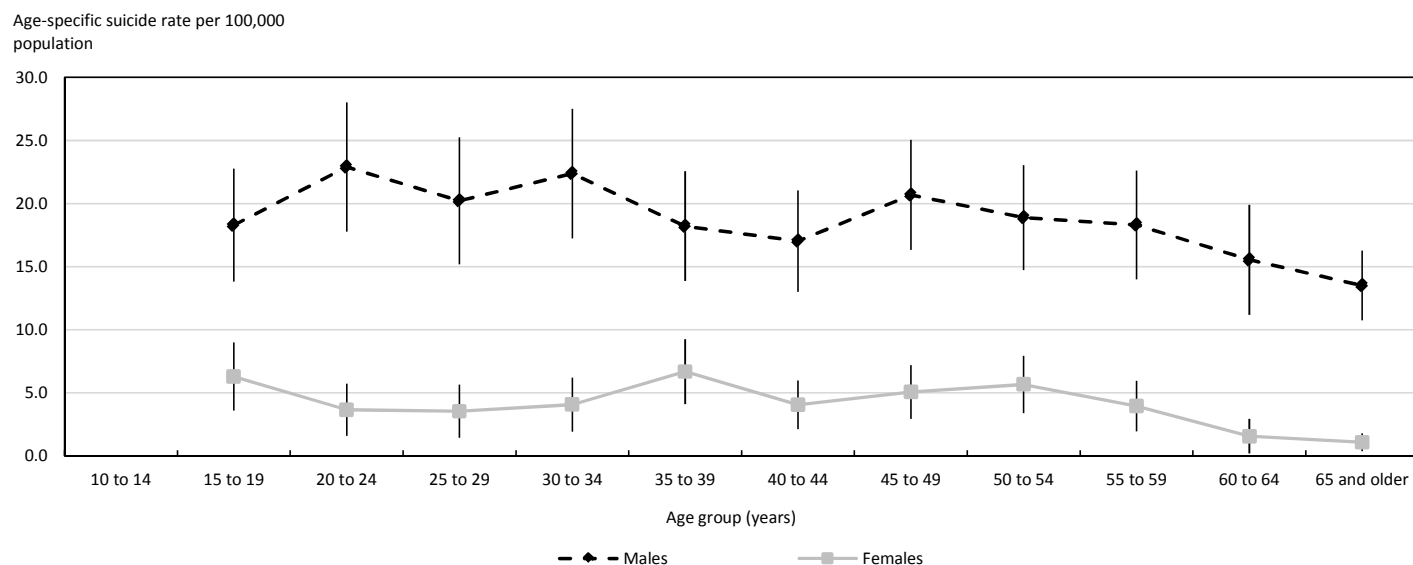
Source: Newfoundland and Labrador Centre for Health Information Suicide Database.

years old; range 13 to 93 years;  $t = 1.90$ ,  $p = 0.045$ ). The age-standardized suicide rate (Table 1) was 4.6 (95% CI: 3.9 to 5.4) times higher among males than females. Age-specific suicide rates for males were highest in the 20- to 24-year-old age group; among females, the suicide rate was highest in the 35- to 39-year-old age group (Figure 1). Suicide rates declined with age for both males and females. Age-specific rates were significantly higher among males than females in all age groups except among 10- to 14-year-olds (Figure 1; Table 2). The suicide rate in the 10- to 14-year-old age group for both sexes combined was 1.32 deaths per 100,000 (95% CI: 0.4 to 2.2); sex-specific rates for this age group were suppressed because of small cell counts. Age-specific IRRs ranged from 1.58 to 12.25 times higher among males than females (Table 2).

The demographic and clinical characteristics of people who died by suicide varied by sex, though effect sizes were small for most significant variables, except suicide method, which had a

moderate effect size (Table 3). Males were significantly more likely to have been employed, have been retired, or have resided in a rural community than females when they died (Table 3). Hanging, strangulation and suffocation was the method in half of all suicide deaths for both sexes; males were significantly more likely to use firearms, and females were more likely to have been living alone and to have died by self-poisoning (Table 3). Alcohol toxicology screening was completed in 777 cases (79.9%); of those, 362 people (46.6%) had alcohol in their blood at the time of death. Of those who had any alcohol in their system, males had a higher average blood alcohol level ( $M = 26.83$  mmol/L, standard deviation [SD] = 20.76) than females ( $M = 20.79$  mmol/L, SD = 18.03); however, the difference was not significant. Males and females also differed on some, but not all, other clinical factors (Table 3).

**Figure 1**  
Age-specific suicide rates per 100,000 population by sex and age group in Newfoundland and Labrador, 1997 to 2016



Note: Age 10 to 14 - Data Suppressed because the age-specific rate was based on five suicide deaths or less.

Source: Newfoundland and Labrador Centre for Health Information Suicide Database.

**Table 2**  
**Incidence rate ratios for suicide rates by age group for males compared with females in Newfoundland and Labrador, 1997 to 2016**

Age group (years)	Both sexes		
	95% Confidence interval		
	IRR	Lower	Upper
10 to 14	1.58	0.31	10.19
15 to 19	2.90	1.75	5.00
20 to 24	6.25	3.38	12.61
25 to 29	5.70	2.97	12.00
30 to 34	5.49	3.07	10.53
35 to 39	2.72	1.70	4.45
40 to 44	4.20	2.44	7.61
45 to 49	4.07	2.53	6.83
50 to 54	3.33	2.09	5.50
55 to 59	4.62	2.62	8.70
60 to 64	9.85	3.94	31.67
65 and older	12.25	6.18	27.63

**Notes:** IRR = incidence rate ratio (male/female); IRR from age group "15 to 19" to age group "65 and older" indicate a statistically significant ratio where 95% CIs do not overlap  
1. Age group 10 to 14 years by sex were based on five suicide deaths or less per strata.

**Source:** Newfoundland and Labrador Centre for Health Information Suicide Database.

## Discussion

The results of this study are broadly consistent with previous research from the province<sup>5-8</sup> and Canada<sup>9,10,18</sup> that has shown a substantial sex differential in suicide mortality rates. The age-standardized suicide rate was higher among males than females overall and in all age groups except for 10- to 14-year-olds; the male-to-female RR was higher than the national ratio (RR 4.6 versus 3.13).<sup>3</sup> Rates were highest in younger age groups for both males (20 to 24 years) and females (35 to 39 years) and declined for both sexes after age 40. These peaks differ from the national age-specific patterns, where rates in a previous study were highest among males and females aged 45 to 64 years old.<sup>9</sup> However, this difference may be partially related to the narrower age strata in this analysis and the use of pooled data from a large period.

The demographic and clinical profile differed somewhat between the sexes in this study, although the association was weak or moderate for many variables. Males were more likely to be from a rural community, to be employed or retired, to have died by firearm, and to have experienced legal problems; females were more likely to have been living alone, died by self-poisoning, and had a prior mental illness or substance use history. The prevalence of prior suicide attempts, psychiatric diagnosis, and substance use problems was significantly higher for females than males. A study with coroner data from Montréal found a similar prevalence of suicide attempts and mental disorders for both females (69.7%) and males (60.1%),<sup>19</sup> whereas psychological autopsy studies reported a substantially higher prevalence (greater than 85%).<sup>20,21</sup>

The relatively low prevalence of mental illness among people who died by suicide in Newfoundland and Labrador was likely related to the under-capture of mental health history in medicolegal investigations.<sup>19,22</sup> Given that medical records are a primary source of clinical data in these investigations, missing information about mental health may disproportionately impact rural residents and males because of barriers to care and stigma associated with seeking help in rural communities.<sup>23,24</sup>

## Strengths and limitations

One of the strengths of this study was that it used a comprehensive dataset with all deaths determined to be suicide by the provincial medical examiner over a 20-year period. Suicide deaths are subject to misclassification in medicolegal investigations, though undercounting may be more common in vital statistics than in coroner or medical examiner data.<sup>6,7,25</sup> Still, some suicide deaths, especially those resulting from poisoning, may have been classified as unintentional<sup>26</sup> or undetermined because of a lack of clarity about intent and therefore were not included in the database.<sup>27</sup> As poisoning was the most prevalent method for females in the province,<sup>5</sup> rates for females may have been underestimated, and disparities relative to males may have been overestimated.<sup>28</sup>

Another strength of this study is that it used pooled data to overcome challenges related to determining incidence rates with low frequency outcomes in small populations, allowing for

**Table 3**  
**Demographic and clinical characteristics of males and females who died by suicide in Newfoundland and Labrador, 1997 to 2016**

Variable	Total (n = 972)		Male (n = 793)		Female (n = 179)		$\chi^2$	p-value	Cramér's V
	number	percent	number	percent	number	percent			
<b>Age group (years)</b>	...	...	...	...	...	...	17.2	0.004	0.133
10 to 19	93	9.6	69	8.7	24	13.4	3.7	0.053	...
20 to 29	162	16.7	139	17.5	23	12.8	2.3	0.129	...
30 to 39	180	18.5	140	17.7	40	22.3	2.1	0.144	...
40 to 49	195	20.1	156	19.7	39	21.8	0.4	0.523	...
50 to 59	187	19.2	148	18.7	39	21.8	0.9	0.338	...
60 and older	155	15.9	141	17.8	14	7.8	10.8	0.001	...
<b>Marital status (% married or common law)</b>	299	30.8	252	31.8	47	26.3	2.1	0.148	0.046
<b>Living alone</b>	189	19.4	144	18.2	45	25.1	4.5	0.033	0.068
<b>Employment status</b>	...	...	...	...	...	...	35.2	<0.001	0.19
Student	69	7.1	49	6.2	20	11.2	5.5	0.019	...
Employed	296	30.5	258	32.5	38	21.2	8.8	0.003	...
Unemployed	304	31.3	249	31.4	55	30.7	0.0	0.861	...
Retired	116	11.9	106	13.4	10	5.6	8.4	0.004	...
Not reported	187	19.2	131	16.5	56	31.3	20.5	<0.001	...
<b>Rural or urban status (% rural)</b>	600	65.3	503	67.4	97	56.1	8.0	0.005	0.093
<b>Suicide note</b>	306	31.5	234	29.5	72	40.2	7.8	0.005	0.089
<b>Method</b>	...	...	...	...	...	...	93.7	<0.001	0.311
Self-poisoning	183	18.8	110	13.9	73	40.8	69.2	<0.001	...
Firearms	219	22.5	213	26.9	6	3.4	46.2	<0.001	...
Hanging, strangulation, suffocation	469	48.3	391	49.3	78	43.6	2.0	0.162	...
Other <sup>a</sup>	101	10.4	79	10.0	22	12.3	0.9	0.356	...
<b>Any alcohol at time of death</b>	...	...	...	...	...	...	6.0	0.05	0.078
Alcohol in system	362	37.2	308	38.8	54	30.2	4.7	0.03	...
No alcohol in system	415	42.7	335	42.2	80	44.7	0.4	0.55	...
Not tested	195	20.1	150	18.9	45	25.1	3.5	0.06	...
<b>Legally intoxicated at time of death<sup>b</sup></b>	...	...	...	...	...	...	7.5	0.023	0.088
Legally intoxicated	206	21.2	180	22.7	26	14.5	5.8	0.016	...
Not legally intoxicated	571	58.7	463	58.4	108	60.3	0.2	0.632	...
Not tested	195	20.1	150	18.9	45	25.1	3.5	0.06	...
<b>Clinical characteristics</b>									
Trouble with the law	118	12.1	111	14.0	7	3.9	13.9	<0.001	0.12
Financial problems	87	9	73	9.2	14	7.8	0.3	0.558	0.019
Marital or relationship problems	262	27	216	27.2	46	25.7	0.2	0.675	0.013
Interpersonal conflict	76	7.8	61	7.7	15	8.4	0.1	0.757	0.01
Recent heavy drinking	214	22	184	23.2	30	16.8	3.5	0.06	0.06
Family history of suicide loss	44	4.5	36	4.5	8	4.5	0.0	0.967	0.001
Suicidal thoughts or talk	389	40	312	39.3	77	43	0.8	0.365	0.029
Past suicide attempt	278	28.6	202	25.5	76	42.5	20.6	<0.001	0.146
Psychiatric disorder	571	58.7	437	55.1	134	74.9	23.5	<0.001	0.156
History of alcohol abuse	39	4	28	3.5	11	6.1	2.6	0.107	0.052
History of substance abuse	98	10.1	72	9.1	26	14.5	4.8	0.029	0.07
Psychiatric drugs in medical chart	369	38	261	32.9	10	60.3	46.6	<0.001	0.219
Pain	31	3.2	23	2.9	8	4.5	1.2	0.281	0.035
Chronic disease or condition	212	21.8	174	21.9	38	21.2	0.0	0.835	0.007

... not applicable

<sup>a</sup> Other methods include jumping from a high place; cutting or piercing; burns, smoke or fire; motor vehicle; electrocution; drowning; and poisoning with a liquid substance.

<sup>b</sup> Over the legal limit of 17.36 mmol/L or 0.08% blood alcohol content.

Source: Newfoundland and Labrador Centre for Health Information Suicide Database.

stratified analyses by sex and age group. This helped to identify elevated rates among females aged 15 to 19 years and 35 to 39 years. However, pooling the data also meant that variations in rates and characteristics that may have occurred over time were obscured, and this is a limitation. It remains unclear how age-specific suicide rates among females changed between 1997 and 2016 as this study did not assess time trends and another recent study did not report rates for females by age group because of small cell counts.<sup>5</sup>

Lastly, some demographic factors such as gender identity and sexual orientation were not included in the dataset, and some available variables had a high proportion of missing data. Previous Canadian studies have noted that coroner and medical examiner reports have a relatively complete capture of factors related to demographics and circumstances of death but under-capture social factors, health service use, and mental health history.<sup>19,22</sup> Variables in the NLCHI dataset also had limited definitions. Developing a standardized approach to recording

information during the death investigation process and coding information during database development may improve data coverage and quality.<sup>19,22</sup>

### **Implications for public health and clinical approaches to suicide prevention**

The results of this study point to a need for public health and clinical interventions that account for sex differences in suicide risk factors and antecedents. Applying a sex- and gender-based analysis to health policy and service planning may help create more responsive and inclusive approaches to suicide prevention.<sup>29,30</sup>

For example, targeting risks associated with postpartum depression and anxiety and strengthening perinatal mental health care and social support<sup>31,32</sup> may help prevent suicide among females in some reproductive age groups. Similarly, the elevated risk among males aged 20 to 24 years and females aged 15 to 19 years may be reduced with early interventions to recognize and treat mood and psychotic disorders when adolescents present for clinical care.<sup>14</sup> Older males, especially those in rural communities, may also benefit from increased access to mental health services through virtual care<sup>33</sup> to reduce risks associated with under-recognized mental illness.

### **Future directions for research**

Coroner and medical examiner records are a valuable data source for suicide surveillance.<sup>22,26</sup> Establishing a standardized minimum dataset<sup>26</sup> at the national level will help overcome some of the methodological limitations in this study and support

comparisons across jurisdictions. Future research should also link medicolegal mortality data with administrative health and social datasets and use study designs with comparison groups. These steps would strengthen context-specific evidence related to service use, mental illness and chronic disease among people who died by suicide. Further disaggregating suicide rates by geography, demographics and circumstances of death may also help uncover more specific differences between subgroups and inform targeted interventions.

### **Conclusion**

This study examined suicide mortality rates by sex and age group and compared the demographic and clinical characteristics of males and females who died by suicide in Newfoundland and Labrador. Suicide rates peaked in younger age groups for both males and females. This is a novel finding given that this is one of the only studies to report age-specific suicide rates across the lifespan for females in the province. Integrating sex- and gender-based analysis into suicide prevention may help improve public health and clinical interventions based on the distinct risk patterns for males and females.



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