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Christopher E. Lalonde

Release date: January 21, 2015



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Is the injury gap closing between the Aboriginal and general populations of British Columbia?

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Abstract

Background

Evidence from various jurisdictions has shown higher rates of injury for Aboriginal compared with non-Aboriginal populations. This study provides an overview of trends in hospitalization injury rates between the Aboriginal and total populations of one Canadian province, British Columbia.

Data and methods

Hospital discharge records from 1986 through 2010 were obtained from linked health care databases maintained by Population Data BC. Crude rates and standardized relative risks of hospitalization due to injury among Aboriginal people, relative to the total population of British Columbia, were calculated. Changes over time among males and females were compared for various types and causes of injury.

Results

Throughout more than two decades, standardized risks of hospitalization for injury decreased among the Aboriginal and total populations of British Columbia. Larger decreases among the Aboriginal population than among the total population suggest that the gaps are closing. Downward trends in rates were found for most injury categories, and for males and females.

Interpretation

The findings indicate narrowing of the gap in injury rates between the total population of British Columbia and the province's Aboriginal population.

Keywords

Aboriginal, databases, health services, hospitalization, indigenous, injury, medical record linkage

Authors

M. Anne George (ageorge@mail.ubc.ca) and Mariana Brussoni are with the University of British Columbia and the Child and Family Research Institute in Vancouver, British Columbia. Andrew Jin is an epidemiology research consultant. Christopher E. Lalonde is with the University of Victoria, Victoria, British Columbia.

Higher injury mortality and morbidity rates have been documented for indigenous peoples than for the general population in Australia,^{1,2} New Zealand,³ and the United States.⁴ Similarly, Canadian studies indicate disparities at national⁵⁻⁷ and regional levels, including the provinces of Ontario⁸ and British Columbia,⁹⁻¹² and for children in Newfoundland and Labrador¹³ and in Alberta.¹⁴

Differences between Aboriginal and non-Aboriginal populations have also been reported for both the type and outcome of injuries. In British Columbia, rates of potential years of life lost among Status Indians (persons registered under the Indian Act of Canada) were two or three times higher for suicide, homicide, and deaths from motor vehicle accidents, compared with other residents of the province.¹⁵ In Alberta, severe trauma was found to be higher for Aboriginal (all indigenous peoples: First Nations, Métis and Inuit) than for non-Aboriginal people.¹⁶ A review of motor vehicle accidents found that the rate of crashes among Aboriginal populations was twice that of the general Canadian population.¹⁷ Consistent with non-indigenous populations,¹⁸ male gender was associated with higher morbidity and mortality rates in Aboriginal communities.^{7,13,19}

However, declining injury mortality rates have been reported for the Canadian population overall during the 2001-to-2007 period,¹⁹ and for First Nations people from 1979 to 1993.²⁰ Among Aboriginal people in British Columbia, mortality rates from

motor vehicle accidents dropped steadily between 1993 and 2006.¹²

Previous research in Canada has measured the incidence of hospitalizations^{5,8,13,21} and deaths¹³ due to injuries among residents of Indian reserves^{8,13} and in areas where a high percentage of the population self-identified as Aboriginal in the census.^{5,21} These findings are difficult to generalize because not every resident of the target areas is Aboriginal, and the experience of Aboriginal people outside the target areas is excluded. A study that measured potential years of life lost due to various categories of injury was able to avoid this shortcoming by linking census records to provincial death registry records for a cohort who self-identified as Aboriginal in the 1991 Census.²²

Most studies that have made age- and gender-standardized comparisons between the Aboriginal and total populations of Canada or a province^{5,13-17,19-21} leave open the question of how much of the disparity in injury rates was due to a larger percentage of Aboriginal people

residing in northern, rural or remote locations. In fact, one comparison of injury hospitalization rates between residents of Indian reserves and (mostly non-Aboriginal) residents of other small communities in northern Ontario found smaller disparities than did other research.⁸

Apart from earlier research conducted by the authors of the present analysis,⁹⁻¹¹ one previous study of premature deaths among Status Indians in British Columbia¹⁵ used the province's universal health care insurance program²³ as a population registry, and identified Aboriginal people (in the population and among deaths) by record linkage, based on a combination of insurance premium group, Indian status, and birth and death record notations. The current analysis applies that method, with two improvements. First, the focus is on hospitalizations, which represent a broader range of injuries than do deaths. Second, rates of hospitalization for injury in the Aboriginal and total populations of British Columbia are standardized not only by age and gender, but also by region of the province, thereby accounting for the effects of northern location and degree of urbanization.

This update of disparities in injury hospitalization rates between Aboriginal people and the total population of British Columbia by gender and by type and cause of injury extends across a longer period than did previous research.

Methods

The University of British Columbia Behavioural Research Ethics Board reviewed and approved the methods used in this analysis. The Data Steward representing the BC Ministry of Health Services approved the data access request. Existing databases, permanently linked by BC Personal Health Number, maintained by Population Data BC (<https://www.popdata.bc.ca/data>), were used for this study. Population Data BC made the client records anonymous before the analysis.

One-day extracts of the consolidated registration and premium billing files of the provincial health care insurance

program—the Medical Services Plan (MSP) of B.C.—at the midpoints of fiscal years 1985/1986 to 2010/2011²⁴ were obtained. The MSP is the best available registry of the province's population. For instance, based on the MSP, in fiscal year 2006/2007, the provincial population totalled 4,266,070, which amounted to 103.7% of the number (4,113,487) recorded by the 2006 Census of Canada. The slight excess may be attributable to persons who were deceased or no longer resident in the province, but who had yet to be removed from the insurance registry.

“Aboriginal” was considered to be individuals with:

- membership in MSP Premium Group 21 (insurance premiums paid by First Nations and Inuit Health Program, Health Canada, for reason of Indian status), or
- one or both parents with Indian status or resident on an Indian Reserve, as indicated on the linked Vital Statistics birth record, or
- Indian status or resident of a reserve, as indicated on the linked Vital Statistics death record.

According to these criteria, in fiscal year 2006/2007, 148,458 British Columbia residents were “Aboriginal,” which is 75.8% of the number (196,070) who identified as “an Aboriginal person, that is, North American Indian, Métis or Inuit (Eskimo)” in the 2006 Census. The definition of “Aboriginal” in this analysis is largely based on membership in MSP Premium Group 21, eligibility for which requires legally recognized Indian status, as defined by the Indian Act of Canada, and so primarily captures Registered Indians. This definition was used for the numerator (hospitalizations) and the denominator (population).

Statistics Canada defines the Aboriginal population somewhat differently. The 2011 National Household Survey defines the Aboriginal population as those who identify as First Nations, Métis or Inuit and/or report being a Registered or Treaty Indian (that is, registered under the Indian Act of Canada)

and/or report being a member of a First Nation or Indian band.

Population counts were calculated by year, gender, five-year age group, Aboriginal status, and Health Service Delivery Area (HSDA) (of which there are 16 in British Columbia).

Hospitalization counts were based on discharge summary records for hospital separations in British Columbia from January 1, 1986 to March 31, 2010.²⁵ Hospitalization was considered to be “due to injury” if the level of care was “acute” or “rehabilitation,” and the most responsible diagnosis on the discharge record was an International Classification of Diseases Revision 9 (ICD-9) code in the 800 to 999 range, or an ICD-10 code in the S00 to T98 range. Injury hospitalizations were classified by type (trauma, poisoning, burn or other), based on most responsible diagnosis codes. Beginning April 1, 1991, hospitalizations were also classified by intention and external cause, based on the first occurrence of a supplemental injury diagnosis code (ICD-9 codes E800 through E999, or ICD-10 codes V01 through Y98) (Appendix Table A).

Injury hospitalizations were tabulated by injury type, injury intention and external cause category, calendar year of discharge, gender, five-year age group, Aboriginal status, and HSDA of residence. The crude rate of injury hospitalization was calculated as the number of separations divided by the person-years of observation (the sum of the annual population counts times the fraction of each year included in the observation period). The crude rate was considered to be a binomial proportion; standard errors and 95% confidence intervals were estimated accordingly. Standardized Relative Risk (SRR) of hospitalization was calculated relative to the risk among the combined total population of British Columbia during the specified observation period (95,071,843 from 1986 to 2010, or 78,256,306 from 1991 to 2010), using the indirect standardization method,²⁶ standardizing by gender, five-year age group, and HSDA.

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Cumulative change in SRR over time was assessed as the relative change between the first and last years of the observation period: $(SRR_2/SRR_1) - 1$. To facilitate comparisons, relative change over a period of multiple years was converted to an annualized change:

$$\left(\frac{SRR_2}{SRR_1} \right)^{1/(t_2-t_1)} - 1$$

Trend of SRR was assessed by time series analysis, using the Forecasting procedure of IBM SPSS Statistics 19.²⁷ The procedure automatically identifies the best-fitting Autoregressive Integrated Moving Average (ARIMA) or exponential smoothing model for the dependent variable series and produces forecasts with confidence intervals (CI). SRR was forecast to 2014; the forecast change was calculated relative to SRR in 2010.

Results

Crude rates and SRRs of hospitalizations due to injuries from 1986 to 2010, standardized by five-year age group, gender and HSDA, are shown for the Aboriginal population in Table 1, and for the total population of British Columbia in Table 2. The reference population is the combined total population of British Columbia during the entire period (1986 to 2010). Thus, for the total population of British Columbia, the SRR in a particular year can be higher or lower than one, but the average of the SRRs over all the years will be one.

In every year from 1986 to 2010, the Aboriginal population had a higher crude rate and a higher SRR of injury hospitalization (Table 1) than did the total British Columbia population (Table 2). However, throughout the period, reductions in crude rates and SSRs were sustained and substantial among both populations. Because the data were standardized by age, gender and HSDA, these were real reductions and were not attributable to demographic changes or to geographic redistribution of the population over time.

Crude rates and SSRs of hospitalization due to injury in the first and last years of the period are presented for the Aboriginal population in Table 3, and for the total British Columbia population in Table 4. Males had higher crude rates of injury hospitalization than did females, although reductions in crude rates were substantial for both genders and for both

the Aboriginal and total populations. In 1986, Aboriginal females had a higher SRR of injury hospitalization (relative to females in the reference population) than did Aboriginal males (relative to males in the reference population), but by 2010, this gender disparity had practically disappeared (Table 3).

Table 1
Hospital separations due to injury, by calendar year, Aboriginal population, British Columbia, 1986 to 2010[†]

Year	Person-years [‡]	Observed [§]	Expected ^{††}	Crude rate (per 10,000 person-years)			Standardized Relative Risk ^{‡‡}		
				95% confidence interval			95% confidence interval		
				from	to	from	to	from	to
1986	93,384	3,279	975	351	340	363	3.36	3.16	3.58
1987	96,252	3,259	1,007	339	327	350	3.24	3.04	3.44
1988	99,507	3,244	1,044	326	315	337	3.11	2.93	3.30
1989	102,607	3,375	1,077	329	318	340	3.13	2.95	3.33
1990	104,866	3,264	1,096	311	301	322	2.98	2.81	3.16
1991	108,471	3,162	1,131	292	282	302	2.80	2.64	2.96
1992	111,758	3,231	1,165	289	279	299	2.77	2.62	2.94
1993	116,061	3,094	1,209	267	257	276	2.56	2.42	2.71
1994	119,614	2,995	1,239	250	242	259	2.42	2.29	2.55
1995	122,026	2,881	1,255	236	228	245	2.30	2.17	2.42
1996	124,891	2,755	1,285	221	213	229	2.14	2.03	2.26
1997	126,909	2,771	1,309	218	210	227	2.12	2.01	2.23
1998	128,332	2,650	1,323	206	199	214	2.00	1.90	2.11
1999	128,945	2,506	1,330	194	187	202	1.88	1.79	1.99
2000	130,683	2,581	1,345	198	190	205	1.92	1.82	2.02
2001	133,025	2,416	1,369	182	175	189	1.76	1.67	1.86
2002	135,727	2,262	1,397	167	160	174	1.62	1.54	1.71
2003	139,955	2,242	1,445	160	154	167	1.55	1.47	1.63
2004	142,881	2,254	1,477	158	151	164	1.53	1.45	1.60
2005	145,834	2,205	1,511	151	145	158	1.46	1.39	1.53
2006	148,458	2,213	1,542	149	143	155	1.44	1.37	1.51
2007	151,609	2,390	1,576	158	151	164	1.52	1.44	1.59
2008	154,876	2,218	1,610	143	137	149	1.38	1.31	1.45
2009	158,252	2,186	1,648	138	132	144	1.33	1.26	1.39
2010	39,871	493	417	124	113	135	1.18	1.08	1.30

[†] during observation period: January 1, 1986 to March 31, 2010

[‡] annual population count multiplied by fraction of year included in observation period

[§] observed number of hospital separations (acute or rehabilitation care)

^{††} expected number, indirectly standardized, based on age, gender and HSDA rates in total British Columbia population during entire observation period

^{‡‡} compared with total British Columbia population during same period = Observed/Expected

Sources: Population Data BC; Medical Services Plan of B.C.

In almost every major injury category, the Aboriginal population had a higher crude rate and a higher SRR of injury hospitalization than did the total population. However, since 1986 (or 1991 for injuries categorized by intent and external cause), reductions in crude rates and in SRRs were substantial in both populations (Tables 3 and 4).

Table 5 presents relative changes in SRRs of injury hospitalization between 1986 and 2010 among the Aboriginal and total British Columbia populations by gender and by major category of injury

type. The SRR of hospitalization for all injury types combined fell 64.8% (annualized change of -4.3%; 95% CI: -4.7% to -3.8%) among the Aboriginal population and 52.6% (annualized change of -3.1%; 95% CI -3.1% to -3.0%) among the total population, a disparity that was statistically significant ($p < 0.001$, two-sided). For Aboriginal males, the decrease was 63.2%, compared with a 57.0% decrease for British Columbia males overall ($p = 0.048$, two-sided). Among females, the corresponding declines were 67.1% and 47.0% ($p < 0.001$, two-sided).

For trauma, the largest injury type category, the SSR of hospitalization fell 69.1% among the Aboriginal population and 55.5% among the total population ($p < 0.001$, two-sided). The 65.9% decrease among Aboriginal males was not statistically different from the 60.6% decline among males overall ($p = 0.103$, two-sided). By contrast, the 73.4% decrease in the SRR of hospitalization for trauma among Aboriginal females was significantly greater than the 48.7% decrease among females in the total population ($p < 0.001$, two-sided). For the other injury type categories (poisoning, burn, and other) no materially or statistically significant disparities emerged between the Aboriginal and total populations with respect to relative changes in the SRR of hospitalization.

Table 6 presents relative changes in SRRs of injury hospitalization between 1991 and 2010 among the Aboriginal and total British Columbia populations by gender and by major category of injury cause. The SSR of injury hospitalization for all unintentional causes combined decreased 59.9% (annualized change of -4.7%; 95% CI: -5.4% to -4.0%) among the Aboriginal population, compared with a 49.3% decrease (annualized change of -3.5%; 95% CI: -3.6% to -3.4%) among the total population, a statistically significant difference ($p = 0.001$, two-sided). Among Aboriginal males, the SSR for all unintentional causes combined fell 58.7%, which was statistically similar to the 53.7% drop among males in the total population ($p = 0.204$, two-sided). By contrast, the 61.8% decline among Aboriginal females was significantly greater than the 43.8% decrease among females in the total population ($p < 0.001$, two-sided).

For unintentional transportation vehicle collisions, the SRR of injury hospitalization fell 84.1% among the Aboriginal population, compared with a 68.7% decrease among the total population ($p < 0.001$, two-sided). The decrease among Aboriginal males was 83.2%, compared with 69.3% among males in the total population ($p = 0.001$, two-sided). Similarly, the 86.1% decrease

Table 2
Hospital separations due to injury, by calendar year, British Columbia, 1986 to 2010†

Year	Person-years‡	Observed§	Expected¶	Crude rate (per 10,000 person-years)			Standardized Relative Risk**		
				95% confidence interval			95% confidence interval		
				from	to		from	to	
1986	3,088,792	42,700	30,021	138	137	140	1.42	1.41	1.44
1987	3,121,318	44,380	30,457	142	141	144	1.46	1.44	1.47
1988	3,165,022	43,717	30,809	138	137	139	1.42	1.40	1.43
1989	3,245,277	42,462	31,532	131	130	132	1.35	1.33	1.36
1990	3,339,763	43,202	32,400	129	128	131	1.33	1.32	1.35
1991	3,421,459	42,411	33,213	124	123	125	1.28	1.26	1.29
1992	3,515,345	42,726	34,151	122	120	123	1.25	1.24	1.26
1993	3,649,925	43,573	35,443	119	118	120	1.23	1.22	1.24
1994	3,771,519	42,187	36,700	112	111	113	1.15	1.14	1.16
1995	3,856,183	41,109	37,592	107	106	108	1.09	1.08	1.10
1996	3,959,300	39,830	38,699	101	100	102	1.03	1.02	1.04
1997	4,040,687	39,769	39,594	98	97	99	1.00	0.99	1.01
1998	4,087,714	38,336	40,201	94	93	95	0.95	0.94	0.96
1999	4,115,601	38,021	40,689	92	91	93	0.93	0.93	0.94
2000	4,114,815	38,016	40,829	92	91	93	0.93	0.92	0.94
2001	4,160,615	35,417	41,424	85	84	86	0.85	0.85	0.86
2002	4,211,443	33,853	42,155	80	80	81	0.80	0.80	0.81
2003	4,285,095	33,967	43,061	79	78	80	0.79	0.78	0.80
2004	4,335,962	34,734	43,718	80	79	81	0.79	0.79	0.80
2005	4,383,639	34,736	44,397	79	78	80	0.78	0.78	0.79
2006	4,414,528	35,557	44,939	81	80	81	0.79	0.78	0.80
2007	4,476,436	35,174	45,786	79	78	79	0.77	0.76	0.78
2008	4,546,001	35,417	46,663	78	77	79	0.76	0.75	0.77
2009	4,607,365	34,989	47,465	76	75	77	0.74	0.73	0.74
2010	1,158,039	8,068	11,970	70	68	71	0.67	0.66	0.69

† during observation period: January 1, 1986 to March 31, 2010

‡ annual population count multiplied by fraction of year included in observation period

§ observed number of hospital separations (acute or rehabilitation care)

¶ expected number, indirectly standardized, based on age, gender and HSDA rates in total British Columbia population during entire observation period

** compared with total British Columbia population during same observation period = Observed/Expected

Sources: Population Data BC; Medical Services Plan of B.C.

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Table 3
Hospital separations due to injury, by calendar year and injury category, Aboriginal population, British Columbia, 1986 or 1991 to 2010

Injury category	Person-years [†]	Observed [‡]	Expected [§]	Crude rate (per 10,000 person-years)			Standardized Relative Risk ^{††}		
				95% confidence interval			95% confidence interval		
				from	to		from	to	
All injuries									
Total									
1986	93,384	3,279	975	351	340	363	3.36	3.16	3.58
2010	39,871	493	417	124	113	135	1.18	1.08	1.30
Male									
1986	44,432	1,738	559	391	374	410	3.11	2.86	3.38
2010	19,739	275	240	139	124	157	1.14	1.01	1.30
Female									
1986	47,767	1,473	387	308	293	324	3.81	3.45	4.20
2010	20,052	218	174	109	95	124	1.25	1.08	1.45
Trauma									
1986	93,384	2,465	702	264	254	274	3.51	3.26	3.78
2010	39,871	320	295	80	72	90	1.09	0.97	1.22
Poisoning									
1986	93,384	466	112	50	46	55	4.17	3.46	5.02
2010	39,871	77	42	19	15	24	1.81	1.34	2.46
Burn									
1986	93,384	83	20	8.9	7.2	11	4.23	2.71	6.67
2010	39,871	10	8	2.5	1.3	4.7	1.26	0.62	2.70
Other injury type									
1986	93,384	265	141	28	25	32	1.88	1.59	2.22
2010	39,871	86	71	22	17	27	1.20	0.95	1.52
Unintentional injury									
1991	81,353	1,802	628	222	212	232	2.87	2.66	3.10
2010	39,871	370	322	93	84	103	1.15	1.03	1.28
Transport vehicle (unintentional)									
1991	81,353	545	152	67	62	73	3.60	3.07	4.22
2010	39,871	40	70	10	7	14	0.57	0.45	0.72
Medical/Surgical mishap									
1991	81,353	221	117	27	24	31	1.89	1.57	2.26
2010	39,871	83	67	21	17	26	1.24	0.98	1.58
Fall (unintentional)									
1991	81,353	590	205	73	67	79	2.88	2.51	3.30
2010	39,871	164	112	41	35	48	1.47	1.22	1.77
Self-inflicted injury									
1991	81,353	285	60	35	31	39	4.74	3.68	6.11
2010	39,871	46	25	12	9	15	1.81	1.22	2.68
Poisoning (self-inflicted)									
1991	81,353	226	53	28	24	32	4.29	3.27	5.64
2010	39,871	40	22	10	7	14	1.78	1.18	2.72
Intentionally inflicted by another									
1991	81,353	282	43	35	31	39	6.54	4.85	8.84
2010	39,871	60	19	15	12	19	3.23	2.04	5.15

[†] annual population count multiplied by fraction of year included in observation period

[‡] observed number of hospital separations (acute or rehabilitation care)

[§] expected number, indirectly standardized, based on age, gender and HSDA rates in total British Columbia population during entire observation period

^{††} compared with total British Columbia population during same observation period = Observed/Expected

Sources: Population Data BC; Medical Services Plan of B.C.

Table 4
Hospital separations due to injury, by calendar year and injury category, British Columbia, 1986 or 1991 to 2010

Injury category	Person-years [†]	Observed [‡]	Expected [§]	Crude rate (per 10,000 person-years)			Standardized Relative Risk ^{††}		
				95% confidence interval			95% confidence interval		
				from	to		from	to	
All injuries									
Total									
1986	3,088,792	42,700	30,021	138.0	137.0	140.0	1.42	1.41	1.44
2010	115,804	8,068	11,970	70.0	68.0	71.0	0.67	0.66	0.69
Male									
1986	1,505,513	24,126	16,293	160.0	158.0	162.0	1.48	1.46	1.50
2010	573,085	4,041	6,353	71.0	68.0	73.0	0.64	0.62	0.65
Female									
1986	1,555,243	17,561	12,976	113.0	111.0	115.0	1.35	1.33	1.38
2010	584,475	4,024	5,605	69.0	67.0	71.0	0.72	0.70	0.74
Trauma									
1986	3,088,792	31,424	20,865	102.0	101.0	103.0	1.51	1.49	1.53
2010	1,158,039	5,515	8,229	48.0	46.0	49.0	0.67	0.66	0.68
Poisoning									
1986	3,088,792	3,529	2,631	11.4	11.1	11.8	1.34	1.29	1.39
2010	1,158,039	626	930	5.4	5.0	5.8	0.67	0.63	0.72
Burn									
1986	3,088,792	806	449	2.6	2.4	2.8	1.80	1.64	1.97
2010	1,158,039	66	146	0.6	0.4	0.7	0.45	0.38	0.53
Other injury type									
1986	3,088,792	6,941	6,077	22.0	22.0	23.0	1.14	1.11	1.17
2010	1,158,039	1,861	2,665	16.0	15.0	17.0	0.70	0.67	0.73
Unintentional injury									
1991	2,566,094	29,015	20,142	113.0	112.0	114.0	1.44	1.42	1.46
2010	1,158,039	7,304	9,998	63.0	62.0	65.0	0.73	0.72	0.74
Transport vehicle (unintentional)									
1991	2,566,094	5,943	3,567	23.2	22.6	23.8	1.67	1.61	1.72
2010	1,158,039	813	1,560	7.0	6.6	7.5	0.52	0.50	0.55
Medical/Surgical mishap									
1991	2,566,094	6,678	4,940	26.0	25.0	27.0	1.35	1.31	1.39
2010	1,158,039	1,848	2,551	16.0	15.0	17.0	0.72	0.70	0.75
Falls (unintentional)									
1991	2,566,094	10,109	7,894	39.0	39.0	40.0	1.28	1.25	1.31
2010	1,158,039	3,561	4,268	31.0	30.0	32.0	0.83	0.81	0.86
Self-inflicted injury									
1991	2,566,094	1,770	1,293	6.9	6.6	7.2	1.37	1.30	1.45
2010	1,158,039	354	544	3.1	2.8	3.4	0.65	0.60	0.71
Poisoning (self-inflicted)									
1991	2,566,094	1,532	1,150	6.0	5.7	6.3	1.33	1.26	1.41
2010	1,158,039	322	485	2.8	2.5	3.1	0.66	0.61	0.73
Intentionally inflicted by another									
1991	2,566,094	1,243	918	4.8	4.6	5.1	1.35	1.27	1.44
2010	1,158,039	308	383	2.7	2.4	3.0	0.80	0.73	0.89

[†] annual population count multiplied by fraction of year included in observation period[‡] observed number of hospital separations (acute or rehabilitation care)[§] expected number, indirectly standardized, based on age, gender and HSDA rates in total British Columbia population during entire period^{††} compared with total British Columbia population during same observation period = Observed/Expected**Sources:** Population Data BC; Medical Services Plan of B.C.

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Table 5
Standardized Relative Risks (SRR) of hospitalization due to injury, by gender and injury type, Aboriginal and total population, British Columbia, 1986 to 2010

Population, gender, injury type	SRR		1986 to 2010 % change	p [†]	Annual % change			Forecast SRR 2014	2010 to 2014 % change	Annual % change		
	1986	2010			95% confidence interval		95% confidence interval					
					from	to			from	to		
Aboriginal												
Total												
All injuries	3.36	1.18	-64.8	0.000	-4.3	-4.7	-3.8	0.82	-30.7	-8.8	-19.1	-1.1
Trauma	3.51	1.09	-69.1	0.000	-4.8	-5.3	-4.2	0.68	-37.2	-11.0	-26.9	-0.8
Poisoning	4.17	1.81	-56.5	0.437	-3.4	-4.8	-2.0	1.62	-10.9	-2.8	-10.0	3.0
Burn	4.23	1.26	-70.2	0.697	-4.9	-8.1	-1.6	1.06	-15.7	-4.2	-36.3	11.1
Other injury type	1.88	1.20	-35.9	0.748	-1.8	-3.0	-0.7	1.28	6.0	1.5	-8.0	8.9
Male												
All injuries	3.11	1.14	-63.2	0.048	-4.1	-4.7	-3.5	1.07	-6.9	-1.8	-10.6	5.2
Trauma	3.15	1.08	-65.9	0.103	-4.4	-5.1	-3.7	0.73	-32.2	-9.3	-28.0	2.1
Poisoning	4.11	1.40	-65.9	0.382	-4.4	-6.7	-2.1	1.32	-5.8	-1.5	-17.0	9.0
Burn	3.70	1.38	-62.8	0.442	-4.0	-7.8	-0.1	1.05	-23.6	-6.5	-52.5	10.2
Other injury type	2.09	1.35	-35.1	0.884	-1.8	-3.5	-0.1	1.11	-18.1	-4.9	-16.9	3.8
Female												
All injuries	3.81	1.25	-67.1	0.000	-4.5	-5.2	-3.8	0.83	-34.0	-9.9	-22.6	-1.0
Trauma	4.21	1.12	-73.4	0.000	-5.4	-6.3	-4.5	0.61	-46.0	-14.3	-51.3	0.6
Poisoning	4.28	2.08	-51.3	0.628	-3.0	-4.8	-1.1	1.79	-13.9	-3.7	-11.6	2.7
Burn	6.00	0.95	-84.2	0.601	-7.4	-13.4	-1.0	0.75	-21.3	-5.8	..	24.3
Other injury type	1.78	1.07	-39.8	0.963	-2.1	-3.7	-0.4	1.11	3.9	1.0	-13.3	10.9
Total British Columbia												
Total												
All injuries	1.42	0.67	-52.6	...	-3.1	-3.1	-3.0	0.55	-18.5	-5.0	-10.8	-0.1
Trauma	1.51	0.67	-55.5	...	-3.3	-3.4	-3.2	0.53	-20.8	-5.7	-12.0	-0.4
Poisoning	1.34	0.67	-49.8	...	-2.8	-3.1	-2.5	0.56	-16.6	-4.4	-14.3	3.1
Burn	1.80	0.45	-74.8	...	-5.6	-6.3	-4.8	0.37	-19.2	-5.2	-41.5	10.6
Other injury type	1.14	0.70	-38.9	...	-2.0	-2.2	-1.8	0.62	-10.6	-2.8	-14.0	5.6
Male												
All injuries	1.48	0.64	-57.0	...	-3.5	-3.6	-3.3	0.50	-22.1	-6.1	-13.4	-0.1
Trauma	1.57	0.62	-60.6	...	-3.8	-3.9	-3.7	0.46	-25.6	-7.1	-16.5	0.0
Poisoning	1.38	0.61	-55.7	...	-3.3	-3.8	-2.9	0.48	-21.0	-5.7	-15.5	1.7
Burn	1.83	0.46	-74.8	...	-5.6	-6.4	-4.7	0.35	-24.7	-6.9	..	10.9
Other injury type	1.14	0.71	-37.1	...	-1.9	-2.2	-1.7	0.64	-9.8	-2.6	-14.0	5.8
Female												
All injuries	1.35	0.72	-47.0	...	-2.6	-2.7	-2.5	0.61	-14.8	-3.9	-9.2	0.6
Trauma	1.43	0.73	-48.7	...	-2.7	-2.9	-2.6	0.62	-15.8	-4.2	-9.1	0.0
Poisoning	1.31	0.71	-45.4	...	-2.5	-2.9	-2.1	0.62	-13.9	-3.7	-16.1	5.2
Burn	1.74	0.43	-75.5	...	-5.7	-7.1	-4.3	0.52	23.1	5.3	-22.3	20.4
Other injury type	1.14	0.68	-40.4	...	-2.1	-2.4	-1.9	0.60	-11.3	-3.0	-15.9	6.2

[†] probability (2-sided, z-test) that Ln((SRR 2010)/(SRR 1986)) Aboriginal = Ln((SRR 2010)/(SRR 1986)) BC

.. not available for specific reference period

... not applicable

Sources: Population Data BC; Medical Services Plan of B.C.

Table 6
Standardized Relative Risks (SRR) of hospitalization due to injury, by gender and injury cause, Aboriginal and total population, British Columbia, 1991 to 2010

Population, gender, injury cause	SRR		1991 to 2010 % change	p†	Annual % change			Forecast SRR 2014	2010 to 2014 % change	Annual % change		
	1991	2010			95% confidence interval		95% confidence interval					
					from	to			from	to		
Aboriginal												
Total												
Unintentional injury	2.87	1.15	-59.9	0.001	-4.7	-5.4	-4.0	0.79	-31.5	-9.0	-22.7	0.3
Transport vehicle	3.60	0.57	-84.1	0.000	-9.2	-10.6	-7.9	-0.07	9.6
Medical/Surgical mishap	1.89	1.24	-34.1	0.181	-2.2	-3.7	-0.6	1.09	-12.3	-3.2	-9.5	2.0
Fall	2.88	1.47	-49.0	0.039	-3.5	-4.6	-2.3	1.17	-20.2	-5.5	-20.2	4.4
Self-inflicted injury	4.74	1.81	-61.9	0.358	-5.0	-7.2	-2.6	1.50	-16.8	-4.5	-15.0	3.4
Poisoning	4.29	1.78	-58.5	0.479	-4.5	-7.0	-2.0	1.59	-10.8	-2.8	-12.8	4.8
Intentionally inflicted by another	6.54	3.23	-50.7	0.516	-3.6	-6.4	-0.9	3.55	10.1	2.4	-7.5	10.1
Male												
Unintentional injury	2.77	1.14	-58.7	0.204	-4.5	-5.4	-3.7	1.16	1.5	0.4	-7.2	6.6
Transport vehicle	3.58	0.60	-83.2	0.001	-8.9	-10.6	-7.3	0.66	9.7	2.3	-50.2	20.9
Medical/Surgical mishap	1.49	1.44	-3.2	0.011	-0.2	-2.4	2.1	1.39	-3.7	-1.0	-11.5	7.0
Fall	2.64	1.62	-38.9	0.969	-2.6	-4.2	-0.9	1.40	-13.4	-3.5	-16.7	5.8
Self-inflicted injury	3.87	1.83	-52.7	0.844	-3.9	-7.8	0.3	1.40	-23.4	-6.5	-26.8	5.6
Poisoning	2.61	1.60	-38.6	0.528	-2.5	-7.1	2.2	1.63	2.1	0.5	-24.3	14.4
Intentionally inflicted by another	5.50	2.64	-51.9	0.377	-3.8	-6.8	-0.7	2.04	-22.7	-6.2	-48.7	10.2
Female												
Unintentional injury	3.06	1.17	-61.8	0.000	-4.9	-6.0	-3.9	0.77	-34.0	-9.9	-27.1	0.9
Transport vehicle	3.63	0.51	-86.1	0.001	-9.9	-12.1	-7.5	0.14	-72.6	-27.6	..	2.8
Medical/Surgical mishap	2.27	1.07	-53.0	0.597	-3.9	-6.0	-1.8	1.09	1.7	0.4	-9.3	7.9
Fall	3.21	1.35	-57.9	0.005	-4.5	-6.1	-2.8	0.96	-29.0	-8.2	-35.0	5.6
Self-inflicted injury	5.15	1.79	-65.2	0.224	-5.4	-8.2	-2.5	1.55	-13.3	-3.5	-17.9	6.4
Poisoning	4.96	1.86	-62.4	0.293	-5.0	-7.9	-2.0	1.58	-15.1	-4.0	-18.5	5.9
Intentionally inflicted by another	10.86	5.76	-47.0	0.814	-3.3	-9.4	3.3	5.27	-8.5	-2.2	-18.6	8.6
Total British Columbia												
Unintentional injury	1.44	0.73	-49.3	...	-3.5	-3.6	-3.4	0.58	-20.5	-5.6	-11.8	-0.4
Transport vehicle	1.67	0.52	-68.7	...	-5.9	-6.2	-5.6	0.28	-46.2	-14.4	-53.7	0.7
Medical/Surgical mishap	1.35	0.72	-46.4	...	-3.2	-3.5	-3.0	0.59	-18.2	-4.9	-16.1	3.3
Fall	1.28	0.83	-34.8	...	-2.2	-2.4	-2.0	0.74	-11.3	-2.9	-6.8	0.5
Self-inflicted injury	1.37	0.65	-52.4	...	-3.8	-4.3	-3.3	0.49	-25.5	-7.1	-13.3	-1.9
Poisoning	1.33	0.66	-50.2	...	-3.6	-4.1	-3.1	0.51	-22.9	-6.3	-12.3	-1.3
Intentionally inflicted by another	1.35	0.80	-40.7	...	-2.7	-3.3	-2.1	0.69	-14.4	-3.8	-12.9	3.2
Male												
Unintentional injury	1.50	0.70	-53.7	...	-4.0	-4.1	-3.8	0.53	-24.4	-6.7	-14.8	-0.4
Transport vehicle	1.63	0.50	-69.3	...	-6.0	-6.4	-5.7	0.26	-47.5	-14.9	..	2.5
Medical/Surgical mishap	1.37	0.75	-45.3	...	-3.1	-3.5	-2.8	0.62	-17.5	-4.7	-16.0	3.6
Fall	1.32	0.81	-38.5	...	-2.5	-2.8	-2.2	0.71	-13.2	-3.5	-9.0	1.3
Self-inflicted injury	1.37	0.60	-56.4	...	-4.3	-5.1	-3.4	0.45	-24.6	-6.8	-14.0	-0.9
Poisoning	1.28	0.59	-54.4	...	-4.0	-5.0	-3.1	0.50	-14.6	-3.9	-11.6	2.3
Intentionally inflicted by another	1.25	0.79	-36.5	...	-2.4	-3.0	-1.7	0.70	-12.1	-3.2	-12.3	4.0
Female												
Unintentional injury	1.37	0.77	-43.8	...	-3.0	-3.2	-2.8	0.64	-16.4	-4.4	-9.8	0.3
Transport vehicle	1.72	0.56	-67.7	...	-5.8	-6.3	-5.3	0.31	-44.0	-13.5	-42.5	0.2
Medical/Surgical mishap	1.33	0.70	-47.4	...	-3.3	-3.7	-3.0	0.57	-19.0	-5.1	-17.7	3.8
Fall	1.25	0.85	-31.7	...	-2.0	-2.2	-1.7	0.77	-9.8	-2.5	-6.3	0.8
Self-inflicted injury	1.37	0.68	-50.0	...	-3.6	-4.2	-2.9	0.51	-26.0	-7.2	-14.7	-1.3
Poisoning	1.35	0.70	-48.0	...	-3.4	-4.0	-2.7	0.52	-26.3	-7.4	-14.5	-1.6
Intentionally inflicted by another	1.85	0.84	-54.5	...	-4.1	-5.6	-2.5	0.94	11.8	2.8	-15.4	14.6

† probability (2-sided, z-test) that $\ln((\text{SRR}_{2010})/(\text{SRR}_{1991}))$ Aboriginal = $\ln((\text{SRR}_{2010})/(\text{SRR}_{1991}))$ BC

.. not available for specific reference period

... not applicable

Sources: Population Data BC; Medical Services Plan of B.C.

among Aboriginal females substantially exceeded the 67.7% decrease among females in the total population ($p = 0.001$, two-sided).

The decline in the SRR of injury hospitalization for unintentional falls among the Aboriginal population was 49.0%, compared with 34.8% among the population overall ($p = 0.039$, two-sided). Among Aboriginal males, the decrease was 38.9%, similar to the 38.5% decrease among males in the total population ($p = 0.969$, two-sided). However, among Aboriginal females, the 57.9% drop surpassed the 31.7% decrease among females overall ($p = 0.005$, two-sided).

The pattern differed for medical/surgical mishaps. Between 1991 and 2010, the SRR of hospitalization among the Aboriginal population fell 34.1%, compared with a 46.4% drop among the total population ($p = 0.181$, two-sided). For Aboriginal males, the decrease was 3.2%, far less than the 45.3% decrease for males overall ($p = 0.011$, two-sided). For Aboriginal females, the 53.9% decline was statistically similar to the 47.4% drop for females overall ($p = 0.597$, two-sided).

No materially or statistically significant disparities in relative changes in the SRR of hospitalization for the other causes of injury (self-inflicted, self-inflicted poisoning, and intentionally inflicted by another) emerged between the Aboriginal and total populations.

The steeper declines in SRRs of injury hospitalization for the Aboriginal population narrowed the gap between them and the total population. This reflects relatively rapid improvements in the categories of trauma (females), unintentional transportation vehicle collisions (both genders), and unintentional falls (females).

Forecasts of SSRs to 2014 in Tables 5 and 6 derived from time series modeling suggest considerable declines in SRRs of hospitalization for all injuries combined and for most categories of injury among all British Columbia residents, but especially among the Aboriginal population. Nonetheless, the 95% confidence intervals of the forecasts are wide.

The results of these analyses show considerable improvement over the past two decades in SRRs of injury hospitalization for both the Aboriginal and total populations of British Columbia. SSRs of hospitalization in the major injury categories declined more rapidly for the Aboriginal population, thereby narrowing the gaps relative to the total population of the province, and suggesting the possibility of closing the gaps in the future. As well, decreases were greater for Aboriginal females than for Aboriginal males, narrowing the gender disparities.

Discussion and limitations

Studies in Canada⁸⁻¹⁵ and in other countries¹⁻⁴ have noted differences in injury morbidity and mortality rates between Aboriginal and general populations. The results of this analysis of hospitalizations attributable to injury show a similar disparity and are consistent with reports of declining unintentional injury rates among the general population of Canada during the 2001-to-2007 period,¹⁷ among Aboriginal peoples throughout the 1990s,¹⁸ and among Aboriginal children during the 2001-to-2006 period.²⁰ The results are also consistent with trends reported in other indicators; for example, the gap between Aboriginal and non-Aboriginal infant mortality rates in rural areas of British Columbia narrowed substantially from 1981 to 2000.²⁸

The divergent pattern that prevailed for “medical or surgical mishaps” is difficult to interpret. Aboriginal people are at higher risk of such mishaps, and owing to persistently high risk among Aboriginal males, the gap with the general population is not narrowing. This might reflect the nature of the injuries and complexity of care. It is also possible that improved access to medical care actually increases risk in this category. These questions require further research.

The findings of this analysis should be interpreted in the light of several limitations. The counts do not pertain to “injuries,” but to “hospitalizations due

What is already known about this subject?

- Evidence from various jurisdictions has shown higher rates of injury for Aboriginal compared with non-Aboriginal populations.
- Age- and gender-standardized comparisons between the Aboriginal population and the total population of Canada or a province raise the question of how much of the disparity in injury rates is due to a larger percentage of Aboriginal people residing in northern, rural or remote locations.
- A study of premature deaths among Status Indians in British Columbia used the province’s universal health care insurance program to identify Aboriginal people by record linkage, based on a combination of insurance premium group, Indian status, and birth and death record notations.

What does this study add?

- Using that method, the current analysis provides an overview of trends in hospitalization rates for injury among the Aboriginal and total population of British Columbia from 1986 through 2010.
- Rates of hospitalization for injury were standardized by age, gender and region of the province, thereby accounting for the effects of northern location and urbanization.
- Over more than two decades, standardized risks of hospitalization for injury decreased among the Aboriginal and the total population of British Columbia.
- Larger decreases among the Aboriginal population suggest that gaps are closing.

to injury”. Hospitalizations are part of a larger picture—they are a type of health care use, indicative of injury burden, but influenced by the availability of beds, outpatient and community care options, and patterns of medical practice. These factors vary by region of the province, and the Aboriginal and total populations of British Columbia differ in their proportional distributions among the regions. Although SSRs were standardized by HSDA, thereby compensating for the effects of regional factors, it is possible that conditions in specific HSDAs may affect Aboriginal people differently from the general population. In addition, hospitalizations do not include all injuries; they represent more severe injuries, but extreme cases resulting in immediate death would not involve hospitalization. Also, some injuries may require more than one hospitalization, due to severity, complications, or unavailability of specialized treatment locally.

The definition of “Aboriginal” in this study is quite restrictive, as it is largely based on membership in MSP Premium Group 21, which requires legally recognized Indian status. An amendment to the Indian Act in 1985 (federal bill C-31, *Act to Amend the Indian Act*²⁹) brought many people who formerly were not classified as Registered Indians into Registered Indian population counts. The effects of this amendment would have been continuous and cumulative throughout the period covered in this analysis (1986 to 2010) and could have influenced the trend in the risk of injury hospitalization. However, this is not bias, but the reality of how the Aboriginal population is changing over time. Subsequent changes in 2011 (federal Bill C-3, *Gender Equity in Indian Registration Act*³⁰) would not have affected the results of this study.

No standard definition of “Aboriginal” exists for the purposes of inclusion in statistical analyses. An alternative method of identifying the Aboriginal population would have been to use the federal Indian Status Registry, but because of privacy issues, it was not possible to obtain access to it. An advantage of the definition of “Aboriginal” employed here is that it is more likely to include children eligible for Indian status because of their parents’ status, but who have yet to apply for registration—MSP Premium Group 21 includes family accounts if the primary registrant declares Indian status. And while some people eligible to join MSP Premium Group 21 might not do so if another party pays their premiums (for example, an employer), this is not common. Moreover, for this analysis, linked birth and death certificates were checked for notations of Indian status. A study by the BC Vital Statistics Agency that used the same method, but with the addition of people found only in the Indian Status Registry, counted 151,783 Aboriginal persons in British Columbia in 2002,²² compared with the 135,076 on which the present analysis is based.

An overly inclusive definition that counted as “Aboriginal” many persons who were not so might introduce a bias toward the null hypothesis in comparisons with the total population. The restrictive definition was used here to protect the internal validity of the analysis. Moreover, the definition is not so restrictive that it threatens the ability to generalize these findings to a more broadly defined Aboriginal population. For the present study, because the same definition was consistently applied when counting the numerator (hospitalizations) and the denominator (the population), the calculated rates contain no bias.

Conclusion

According to the results of this study, over the past two decades, rates of injury hospitalization declined among the Aboriginal and total populations of British Columbia, and disparities between the two populations narrowed. The SRR of injury hospitalization decreased considerably for both populations, but particularly, for the Aboriginal population, which suggests the possibility of closing the gaps in the future. As well, greater decreases for Aboriginal females than for Aboriginal males reduced gender disparities. Although not without limitations, this analysis covers a longer time span than previous research and employs improved methods of measurement. ■

Acknowledgments

This work was funded by the Canadian Institutes of Health Research, Institute of Aboriginal Peoples Health [grant number AHR # 81043]. Salary support for authors was provided by the Child & Family Research Institute and by the British Columbia Region, First Nations and Inuit Health, Health Canada. The authors thank Anna Low, Sherylyn Arabsky and Kelly Alke of Population Data BC for assistance with data access and linkage. They also thank Dr. Rod McCormick for his contributions to the study design.

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Appendix

Table A

Injury categories derived from International Classification of Diseases (ICD) codes

Injury category	ICD-9 codes	ICD-10 codes
Injury types		
All	800-999	S00-S99, T00-T98
Trauma	800-908, 910-939, 950-959	S00-S99, T00-T19, T79, T90-T94
Poisoning	909.0, 909.1, 960-989	T36-T65, T96-T97
Burn	940-949	T20-T32, T95
Other	909.2-909.9, 990-999	T33-T35, T66-T78, T80-T88, T98
Injury causes		
Unintentional	E800-E928, E930-E949	V01-X59, Y40-Y84
Transport vehicle	E800-E807, E810-E829, E831, E833-E838, E840-E848	V01-V89, V91, V93-V99
Medical/Surgical mishap	E870-E876, E878-E879, E930-E949	Y40-Y84
Fall	E880-E888	W00-W19
Self-inflicted	E950-E958	X60-X84
Poisoning	E950-E952	X60-X69
Inflicted by another	E960-E968	X85-Y09