

# First Peoples lost: Determining the state of status First Nations mortality in Canada using administrative data

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*Abstract.* We present the most comprehensive set of estimates to date for status First Nations mortality in Canada. We use administrative data from Indigenous and Northern Affairs Canada to establish a set of stylized facts regarding status First Nations mortality rates. Between 2010 to 2013, the mortality rates of status First Nations men and boys are highest in nearly all age groups of status First Nations considered, with the exception of status girls between the ages of 10 to 14. On reserve, status boys between the ages of 15 to 19 have mortality rates nearly four times that in the general population, while status girls between the ages of 15 to 19 have mortality rates five times that in the general population. We demonstrate substantial regional variation in mortality rates. Finally, we document that there has been no improvement in mortality among status women and girls living on reserve in the last 30 years and relative mortality rates for all status people on reserve has not changed in 40 years.

*Résumé.* *Premières Nations perdues : évaluation du taux de mortalité des membres des Premières Nations inscrits au Canada basée sur des données administratives.* Nous présentons l'ensemble de données le plus complet relativement à la mortalité des membres des Premières Nations inscrits au Canada. Nous avons utilisé les données administratives des Affaires autochtones et du Nord Canada pour établir un ensemble de faits stylisés concernant le taux de mortalité des membres des Premières Nations inscrits. Entre 2010 et 2013, les taux de mortalité parmi les hommes et jeunes garçons membres des Premières Nations inscrits étaient les plus élevés dans presque tous les groupes d'âge visés, à l'exception des filles membres des Premières Nations inscrits âgées de 10 à 14 ans. Dans les réserves, les taux de mortalité concernant les jeunes hommes membres des Premières Nations inscrits âgés de 15 à 19 ans sont presque quatre fois supérieurs à

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We would like to thank two anonymous referees for invaluable feedback. We would also like to thank Siwan Anderson, Patrick Button, Pascal Courty, David Green, Robert L. A. Hancock, Stephen Hume, Anke Kessler, Eric McGregor, Kevin Milligan, David Scoones, Manisha Shah, Erin O'Sullivan, Steven Stillman, Jacqueline Quinless and all those who commented on this work along the way. We would also like to thank Statistics Canada's Research Data Centre staff and the former Indigenous and Northern Affairs Canada for the access they granted to the data. Any errors or omissions are ours alone.

ceux de la population générale; ces taux de mortalité sont presque cinq fois supérieurs à ceux de la population générale pour les filles membres des Premières Nations inscrits âgées de 15 à 19 ans. Nous montrons des disparités régionales importantes concernant les taux de mortalité. Enfin, nous expliquons qu'en matière de mortalité, il n'y a pas eu d'amélioration pour les femmes et les jeunes filles membres des Premières Nations inscrits vivant dans des réserves au cours des 30 dernières années, et que les taux de mortalité relatifs pour tous les membres des Premières Nations inscrits n'ont pas évolué depuis 40 ans.

JEL classification: J15, J16, I15, I14

## 1. Introduction

**A**VOIDING AN EARLY death is one of the greatest advantages of being born in a wealthy country (Deaton 2013). However, this advantage is not shared equally. In Canada, there is evidence of substantial health disparities between First Nations peoples and the general population, but existing statistics are at best sparse (Truth and Reconciliation Commission of Canada [TRC] 2015, p. 161). In this work, we provide the most comprehensive analysis to date of the patterns and trends in mortality rates for the largest First Nation's population in Canada—status First Nations individuals.<sup>1</sup> We do this by using administrative data from Indigenous and Northern Affairs Canada (INAC)<sup>2</sup> from 1974 to 2013, which, to our knowledge, is the most complete and consistent source of First Nations vital statistics data available. Our goal in this work is to provide a benchmark set of stylized facts on status First Nations mortality in Canada that can be used for future academic and policy research. This work was conducted in response to the recent calls in Canada for reconciliation between Indigenous and non-Indigenous people by the Truth and Reconciliation Commission of Canada: the commission called for all Canadians to contribute to the process of reconciliation and called for the establishment of comprehensive measures of well-being for Indigenous peoples (TRC 2015, p. 161). The commission also called for cooperation between the federal government and Indigenous groups to “establish measurable goals to identify and close the gaps in health outcomes between Indigenous and non-Indigenous communities and to publish annual progress reports and assess long-term trends” (TRC 2015, p. 322). It is our hope that this work helps to establish a foundation for the dialogue and that it takes a step towards establishing comprehensive measures of well-being for Indigenous peoples.

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1 “Status First Nations” are individuals who are governed explicitly under the *Indian Act* as “Indians.” “Indian status” is determined through genetic relation to the First Peoples classified by the federal government as “Indians.”

2 With the dissolution in August 2017 of the former Indigenous and Northern Affairs Canada, two new departments of the Canadian federal government were created in its place: Indigenous Services Canada and Crown–Indigenous Relations and Northern Affairs Canada.

Using administrative data on births and deaths for status First Nations people that include information on the gender, age, band of membership and whether an individual resides on or off reserve allows us to create measures of mortality rates at the national level and by location on and off reserves. We also link patterns in mortality over time and, at the regional level, with data available from the 1991 to 2006 Canadian censuses and 2011 National Household Survey.<sup>3</sup> With this data, we make three main contributions: (1) we provide the first national- and regional-level estimates of mortality among status youth, (2) we provide the first modern estimates of how status mortality rates differ by reserve residence and province and (3) we provide the first description of how status mortality rates have changed since the 1970s and how this is related to changes in status First Nations definitions. Despite the relative simplicity of our analysis, we find striking and unsettling results.

We begin by confirming the findings of earlier, less comprehensive studies using our data: age-standardized mortality is higher for status males than for status females and age-standardized mortality for status First Nations is always higher than for the general population. Using the most recent data available, 2010 to 2013, we find that age-standardized mortality rates are close to twice that of the general population. However, these aggregate statistics mask significant differences by age: status women and girls have mortality rates that are three to four times that of the general female mortality rates between the ages of 10 and 44. These relative mortality rates are statistically higher than the relative mortality rates for status males, which are themselves two to two and a half times that of the general population. Beyond that, the mortality rates of status girls between the ages of 10 to 14 are actually higher than those of status boys of the same age. While previous research has found some evidence for the relatively higher rates of mortality for status women, to our knowledge no one has identified the disproportionately high mortality rates borne by status women and girls at such young ages at the national level (Health Canada 2008, 2014; Mao et al. 1992; Park et al. 2015; Tjepkema et al. 2009). We also demonstrate that the proportional difference in mortality between status people and the general Canadian population is larger than the proportional difference in mortality between Native Americans and non-Hispanic Whites and the difference between African Americans and non-Hispanic Whites in the United States. The gender bias that we find in relative mortality rates for status First Nations women and girls is not present among either Native Americans or African Americans relative to non-Hispanic American Whites.<sup>4</sup>

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3 Unfortunately, the data do not provide information on cause of death or detailed individual socioeconomic characteristics, and we do not report on these causes in the current analysis.

4 This is not simply due to relatively higher female, non-Hispanic White mortality rates in the United States.

Next, we examine the patterns in mortality by place of residence. We show mortality rates are higher on reserve relative to off reserve: between the ages of 15 and 19 in 2010 and 2013, the mortality rate of status First Nations girls was *five times* the rate for girls in the general population. The mortality rates of boys on reserve was also notably higher, nearly four times that of boys in the general population. We also show that absolute and relative mortality vary significantly by province and age. While First Nations mortality rates are highest in Alberta, Manitoba and Saskatchewan, we find that Alberta and Ontario exhibit the highest relative mortality rates.

Finally, we examine trends in mortality rates from 1974 to 2013 (the years for which we have data). We find that there has been no improvement in relative, age-standardized mortality rates between status people on reserve and the general population in the past 40 years. In absolute terms, mortality rates for status women and girls below age 40 have not changed in the past 30 years and may have even increased for some age groups.

We believe our findings have implications for the recently called Canadian National Inquiry into Missing and Murdered Indigenous Women and Girls, which has gained international attention (Amnesty International 2015, Government of Canada 2015, Levin 2016, The Economist 2014). The inquiry was called to investigate the extremely high rates of disappearance and homicide experienced by Indigenous women and girls. Our findings suggest that the marginalization of Indigenous women and girls is more widespread and systemic than previously documented; our mortality rate estimates are generally larger than in previous analyses for status First Nations females.

This work also makes a more general contribution to the literature on “missing women.”<sup>5</sup> Since the seminal work of Sen (1992) nearly 30 years ago, high male-to-female gender ratios in the developing world have been associated with relatively high rates of female mortality (Bulte et al. 2011; Das-Gupta 2005, 2006; Duflo 2012; Jha et al. 2006; Klasen and Wink 2002; Rosenblum 2013; Sen 1992).<sup>6</sup> However, in our context, we see notably low male-to-female gender ratios in survey data but high rates of relative female mortality.<sup>7</sup> This is a similar result as is found by Anderson and Ray (2010), who identify

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5 The term “missing women” has been used differentially in the demography, economics and sociology literature than recently in Canada in the National Inquiry into Missing and Murdered Indigenous Women and Girls. The term “missing” in that literature has tended to refer to excess female mortality from all sources, not just murder or women who have gone missing from their communities.

6 This effect has also been observed among Asian immigrant families in Canada and the United States (Abrevaya 2009, Almond and Edlund 2008, Almond et al. 2009).

7 See Akee and Feir (2016) for an early working paper that includes previous mortality estimates and argues that high rates of institutionalization and homelessness of status men skew result in the low male to female gender ratio.

high relative mortality among women in developing countries with relatively balanced gender ratios; our results are novel in that we identify relatively high female mortality in a wealthy developed country with low male-to-female gender ratios.

In the next section, we provide some important background information on status First Nations in Canada and discuss prior estimates of Indigenous mortality in Canada. In section 3, we discuss the data we use to estimate First Nations mortality rates and note both the benefits and drawbacks of the data. In section 4, we discuss the methods we use to estimate status First Nations and general mortality rates. In section 5, we present our main results. We discuss variation in mortality by age, gender and location and over time. Finally, we contrast our results with previous estimates of status First Nations mortality. In the last section, section 6, we summarize the set of facts we establish and the questions they raise and then we conclude.

## 2. The Canadian context and existing estimates of registered Indian mortality

As of 2016, the status First Nations population in Canada was approximately 744,855, which represents roughly 76% of the total First Nations population in the country.<sup>8</sup> Overall, this figure represents about 2% of the Canadian population (Statistics Canada 2017).

It is well established that First Nations are among the most economically marginalized populations in Canada—in 2006, 37% of First Nations women off reserve were living below the low income cut-off, compared to 16% of non-Aboriginal women (Statistics Canada 2017).<sup>9</sup> Status First Nations, especially those living on reserve, are systematically poorer than non-Indigenous people or the Métis or Inuit in terms of health and income (O'Donnell and Wallace 2011).<sup>10</sup> However, much of the work in Indigenous health and mortality rates in Canada suffers from major data limitations (Feir and Hancock 2016).

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8 Some First Nations people may not meet the full legal requirement for status under Canada's *Indian Act*, which is largely based on ancestry, yet they still ethnically, culturally or politically identify as First Nations (Feir and Hancock 2016).

9 For other figures on the degree of First Nations income disparity see, for example, George and Kuhn (1994), Pendakur and Pendakur (1998, 2011) and AANDC (2015). Indigenous peoples elsewhere also face economic and social marginalization. See United Nations (2009) for a global discussion of Indigenous economic disparity.

10 The Métis and Inuit are the two other legally defined "Aboriginal" peoples in Canada under the *Constitution Act, 1982*. While there are legal infrastructures surrounding these groups as well, to our knowledge, there is nothing as systematic and pervasive as that which governs status First Nations (Feir and Hancock 2016).

The *Indian Act* is the legal framework that defines who has “status” and outlines the set of laws that govern “status Indians” (referred to here as “status First Nations”). Status confers certain rights and benefits. For example, status confers the right to live on reserve, vote in band<sup>11</sup> elections, receive money from one’s band and own or inherit property on reserve (Furi and Wherrett 2003). However, status has also historically limited other rights and access to benefits available to non-status people. The federal government also has jurisdiction over many services provided to status people that would typically be provided by the provinces.<sup>12</sup> Status can also be lost through out-marriage with a non-status person. In 1985, all women (and their children) who had lost their First Nations status through out-marriage had their status rights reinstated (Hurley and Simeone 2014). In 2011, there was also reinstatement of status right for the grandchildren of women who had lost status. Both these points will be important for interpreting the results presented later.

Indigenous and Northern Affairs Canada (INAC) implements the *Indian Act* and is the Canadian federal agency overseeing Indian peoples in Canada. The *Indian Act* establishes status people as wards of the state for whom the Canadian federal government has the responsibility of managing, defining and documenting. In 1951, the centralized Indian Register was established to more consistently document who has “status.” Before this, the lists of status First Nations individuals were created and maintained by government agents at the band level. The Indian Register is the official record identifying all status First Nations in Canada, and everyone who is classified as a status person is listed in the Indian Register (Indigenous and Northern Affairs Canada 2010). The Indian Register is kept up to date by band-level Indian registry administrators (IRAs); they are tasked with collecting and reporting vital statistics event data for their community.<sup>13</sup> Deaths must also be reported to the Indian Register in order to execute a will of a status person or make other arrangements for the administration of that person’s estate and to determine appropriate funding levels for the band.

To date, five reports document modern status First Nations mortality rates in Canada: Health Canada (2008, 2014), Mao et al. (1992), Park et al. (2015) and Tjepkema et al. (2009). One important advantage of this previous research is that they are able to identify the cause of death in the cases that they describe. Tjepkema et al. (2009) and Park et al. (2015) use the 1991 Canadian Census and cancer follow-up survey and are able to link mortality and cause of

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11 Bands are the political unit defined in the *Indian Act* that the federal government uses to discern different groups of First Nations peoples.

12 For example, up until the late 1960s, the provincial health care systems were not the main source of medical care and the federal government had responsibility for medical care for status First Nations provided often through Indian hospitals (Feir and Hancock 2016).

13 This was determined through conversations of the head of the Indian Register through email correspondence. No public record of this could be found.

death to individual level demographics available from the long-form Census in 2001 and 2006.<sup>14</sup> Health Canada (2008, 2014) uses vital statistics data from the provinces or sub-provincial areas that have identifiers for people with status to examine mortality rates by age and gender averaged over 2001–2003 and later averaged over 2003–2007. The Health Canada studies include cause of death but do not include individual-level demographics. Mao et al. (1992) use data from the Indian Register as we do, but their data include only two time periods, 1979–1983 and 1984–1988. They match the Indian Register with data from the Canadian Generalized Iterative Record Linkage System to obtain cause of death for 1981.<sup>15</sup> To our knowledge, it is not currently possible to link these records.

A significant drawback to these studies is that they are unable to describe the entire population of status First Nations people. First, both Tjepkema et al. (2009) and Park et al. (2015) necessarily exclude First Nations people living on reserve that were not enumerated in the 1991 Census (approximately 98 reserves were not enumerated). Those two studies include individuals linked through probabilistic matching across Census data and tax-filer data in order to obtain an individual's name. This name is then used to identify whether an individual was deceased or not in the mortality database and obtain their cause of death. The record matching was not complete, however, and differed significantly by gender and First Nations status. The match rates were 47% for status men, 59% for status women, 79% for non-Aboriginal men and 75% for non-Aboriginal women. Their sample also excludes anyone without an address or those living in shelters, collective dwellings or institutions such as prisons. In addition, both Tjepkema et al. (2009) and Park et al. (2015) consider only the population aged 25 to 75 and thus are unable to estimate mortality rates for the youngest age cohorts—which we later show have some of the highest mortality rates overall relative to the general population.

The analysis by Health Canada (2008, 2014) includes people of all ages; however, its data do not cover all Canadian provinces or sub-provincial areas. Health Canada's analysis includes two provinces (British Columbia and Alberta) and the on-reserve population for Manitoba and Saskatchewan.

The substantial difference in population coverage between these four studies makes comparing their results difficult. For example, the findings of Health Canada (2008) are most comparable in time frame to Tjepkema et al. (2009), but the estimates of life expectancy in Health Canada (2008) are much

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14 Tjepkema et al. (2009) and Park et al. (2015) differ in the precise population and time frame they study: Tjepkema et al. (2009) focus on status First Nations people, Métis and non-status people and use data linked between the 1991 and 2001 censuses to determine mortality rates. Park et al. (2015) focus on all First Nations people and non-status people and use data linked between the 1991 and 2006 censuses to determine mortality rates.

15 The match rate for males was 90% for males and 88% of females.

shorter than those in Tjepkema et al. (2009). It is difficult to conclude whether the difference is due to the different regions included or due to the differential population match rates. Similar issues arise when comparing the results of Health Canada (2014) to Park et al. (2015).

While Mao et al. (1992) used data that covered the entire population of status individuals, there was a significant change in 1985 in the status First Nations qualification requirements. Specifically, as mentioned previously, all women (and their children) who had lost status through out-marriage had their status rights reinstated (Hurley and Simeone 2014). Therefore, the estimates of Mao et al. (1992) are not generalizable to the current population governed by the *Indian Act* given that there are likely compositional differences between status women who out-married and status women who did not out-marry. We return to the importance of this in section 5.4. In table 1, we summarize how our work differs from prior work and contrast the time periods and populations covered in each study.

Despite the literature's shortcomings, it provides critical information about Indigenous mortality in Canada. The literature currently suggests that status people over the age of 25 have mortality rates one and a half to two and a half times higher than the average population for both men and women. The mortality rates of status men are the highest; status women's are the second highest and comparable to non-status men; and non-status women have the lowest mortality rates. The existing evidence suggests that the difference between status and non-status people's mortality is higher at younger ages (although this evidence is available only for specific subregions of Canada). While estimates of the ratio of status to non-status mortality rates are often higher for women than for men, there is only sporadic evidence of statistically significant gender differences (Health Canada 2008, 2014; Mao et al. 1992; Park et al. 2015).

The studies summarized here attribute from 50% to 70% of the differences in mortality rates between status and non-status people to the differential incidence in endocrine and digestive system diseases and to the differential incidence in death from external causes (such as accidental death, suicide or homicide). Tjepkema et al. (2009) and Park et al. (2015) find that while differences in income, education, occupation and urban residence can explain two thirds of the differences in the probability of death between the ages of 25 to 75 between status and non-status men, these factors can explain less than one third of the difference for women.

### 3. Data description

#### 3.1. Data from the Indian Register

The primary data set for our analysis comes from the Indian Register at INAC. The register contains two separate types of information: the first data set is a population count for all status First Nations individuals for each year

**TABLE 1**  
 Summary of previous literature regarding status First Nations mortality contrasted with current paper

Source	Years	Population coverage	Data source	Advantages
Health Canada (2008, 2014)	Averaged; 2001/2002, 2003/2007	On reserve in SK and MN; & all off reserve AB & BC	CVSDD+	Information on cause of death
Park et al. (2015)	Death between 1991 and 2006	15% sample of long-form Census pop. tax filers over 25	CCMFS*	Data on cause of death and individual-level demographic data
Tjepkema et al. (2009)	Death between 1991 and 2001	15% sample of long-form Census pop. tax filers over 25	CCMFS*	Data on cause of death and individual-level demographic data
Mao et al. (1992)	1979–1983	All status First Nations matched via CGIRLS**	Indian Register	Data on cause of death
This paper	1974–2013	All status First Nations, band members	Indian Register	Total status pop. by gender, band and location

NOTES: +CVSDD = Canadian vital statistics and death databases. \*CCMFS = Canadian Census Mortality Follow-Up Study. \*\*CGIRLS = Canadian Generalized Iterative Record Linkage System.

from 1974 to 2013 in five-year age groups for everyone aged 64 and below, gender, place of residence (whether they live on or off reserve) as well as First Nations band of membership over this time period. The second data set contains an accounting of every death event by date of birth, year of death, gender, place of residence at the time of death (whether they live on or off reserve) and First Nations band membership. We combine these two data sets and estimate status mortality by gender and age group. Unfortunately, the death event data collected by INAC do not contain the cause of death.

### 3.2. Indian Register data limitation discussion

While the Indian Register data contain the official count of status people, there may be concerns about its accuracy as there are often delays in the reporting of births or deaths. The register relies on band-level Indian registry administrators (IRAs) to report deaths. Births are under-reported on average by about three years and thus this would affect the most recent data for the age group zero to four. Additionally, for infants that die before being registered, a death certificate is not required to be submitted to the Indian Register. Therefore, it is possible that there is an under-reporting of infants and infant deaths.

A second potential limitation is that if deaths go unreported for adults or older children, then the Indian Register will have a larger than actual population count since those who have already died will still be included in the data set. For example, if someone dies in 1970 at age 69 and their death is not recorded, that individual will still be included in the register in 2000 and will be reported as 99 years old. This under-reporting of deaths would result in an underestimation of mortality rates at older ages.

A third potential limitation of our data is that while the Indian Register has provided population counts in five-year age groups for most ages, the population count of those over age 64 is reported as one large age category. As a result, comparisons of mortality rates between status people and the general population will be confounded by differential age distributions within the “65 and over” age category.

Another concern is that some status people are not members of a First Nations band recognized by INAC and therefore their vital statistics are not recorded by an IRA in a band office. The vital statistics for these individuals are administered by a regional administrative body for multiple bands. This may result in a greater degree of under-reporting of deaths for this population. In addition, some bands have their governmental affairs and data administered by a regional body, and, thus again, these deaths may be less likely to be recorded. Thus, we will consider only status people who are members of a First Nations band.<sup>16</sup>

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16 Approximately 92% of status people are members of a First Nations band. Including all status people has little impact on our conclusions. Upon the suggestion of INAC Indian Register officials, we also estimated our results

### 3.3. Additional data

To construct comparable estimates of mortality for the general population, we use population and death count data compiled by gender, province and five-year age groups from Health Canada vital statistics.<sup>17</sup> These data are available for the general population by age, gender and province from 1974 to 2013. For a more complete description of the advantages and disadvantages of Canadian data as they relates to Indigenous peoples, see Feir and Hancock (2016).

## 4. Methods for estimating mortality rates

### 4.1. Estimating mortality by age group, age-standardized mortality rates and the probability of death

Our analysis focuses on estimating mortality for status First Nations individuals. We use the INAC data with the methods described below to produce First Nations and Canadian average mortality rates overall, in five-year age groups, across provinces, on First Nations reserves and over time. We estimate mortality rates for status people and the general population separately by age and gender by calculating

$$\eta_{agt} = \frac{\#deaths_{agt(endofperiod)}}{population_{agt(startofperiod)}} \times 100,000, \quad (1)$$

where  $a$  denotes the five-year age group,  $g$  denotes gender and  $t$  denotes year. Reporting deaths per 100,000 is consistent with prior literature. Data for the numerator and the denominator in equation (1) come from the Indian Register for the status population and from Health Canada vital statistics for the general population. The Indian Register provides information on the date of birth, the age at death and the year of death; thus, even if a death is reported a few years after it occurs, we are still able to identify the year and age group to which that death belongs. Late reporting of death appears to be a very minor concern for the age groups we focus on.

In addition to these simple five-year age range mortality rates, we also compute age-standardized mortality rates (ASMRs) between the ages of 5

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including and excluding First Nations in the Yukon, Northwest Territories and Nunavut, and there is no effect on our main conclusions. However, when assessing regional or First Nations level variation in mortality rates, we exclude the Territories because of concerns with under-reporting. We inquired about a list of vital statistics data for these territories, but, according to our discussions with Indian Register officials, no list for these territories and provinces has been kept over time.

<sup>17</sup> In constructing the general population mortality estimates, we do not explicitly exclude status First Nations individuals. Given the relatively small proportion of status First Nations people relative to the population as a whole, we do not expect this to confound any reported figures.

and 64. These age-standardized mortality rates are useful when comparing populations over time or across populations with very different underlying age distributions. Since mortality rates are highly age-dependent and the status population is much younger than the general Canadian population, comparing the overall mortality rates of the general Canada population with the status population may provide an overly optimistic view of equality of mortality rates. This skew towards younger ages in the status population alone could result in lower mortality rates for status populations. Therefore, we calculate a direct age standardization (Ahmad et al. 2001) using the age distribution approximated in five-year age bands with the base population of status First Nations people of all genders in 2010. Let the proportion of the population age  $a$  for all status First Nations individuals in 2010 be denoted as  $p_{a2010}$ . Thus, the age-standardized mortality rate (ASMR) is given by

$$\eta_{gt} = \sum_{a=5t09}^{60t064} p_{a2010} \times \eta_{agt}. \quad (2)$$

We compute the ASMR for both genders, for all years, for status people and for the general population. It is worth noting that different base age distributions will emphasize differences in different parts of the life cycle across the populations. We also present our results by each five-year age group as well, rather than only the ASMR.<sup>18</sup>

#### 4.2. Data validation exercise for degree of under-reporting of deaths in the Indian Register data

In order to assess the degree of under-reporting of deaths to the Indian Register, we compare the mortality rate estimates from our data to the most credible, independently collected data we are aware of: the data collected by Health Canada vital statistics from Alberta, British Columbia and on reserve in Manitoba and Saskatchewan. We restrict our Indian Register data to the same regions and time periods as in Health Canada (2008, 2014) and then we estimate mortality rates from our data by age and gender and calculate a simple ratio of Health Canada's estimates to our estimates.

Figure A1 depicts the results of restricting the register sample to the same subregions of Canada and years available in Health Canada (2008, 2014) and generating the ratio of Health Canada's mortality rates to our own. The mortality rates are computed in each year via the estimation method described in equation (1) and averaged over either 2001 to 2002 or 2003 to 2007. The time variation is used to construct the standard errors for the estimated ratio. Ratios that are above 1 indicate the extent to which the Indian Register data under-report deaths in those age groups assuming the

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18 We do not conduct an associative or decomposition analysis because of the lack of common support across the different communities being compared. We provide evidence for this and discuss the lack of common support in appendix figures A8 and A9.

Health Canada data are accurate. We see in figure A1 that, in most age groups, our mortality estimates are statistically indistinguishable from Health Canada's. However, as expected, the Indian Register data likely under-report both infant mortality and mortality over the age of 65.<sup>19</sup> It appears that, on average, the Health Canada estimates of the mortality rate between zero and four years of age is twice as high as ours. There also seems to be some under-reporting of deaths over the age of 65 in both periods, with Health Canada's estimates 1.30 to 1.45 times as large as our estimates. For these reasons, in most of what follows, we focus on estimating mortality rates between the ages of five and 64.<sup>20</sup> Overall, however, we find that our results from the Indian Register align with the independently collected data from Health Canada and, thus, have confidence in our results for the age range of five to 64 years.

## 5. Status First Nations and general population mortality rate results

### 5.1. A snapshot of mortality rates by gender, age and status in 2010–2013

In this section, we provide an overview of status First Nations mortality rates averaged over 2010 to 2013 and compare them with the mortality rates in the general population by gender and age.<sup>21</sup> Our analysis focuses on the most recent years where there is a consistent definition of First Nations status. For the analysis over time, we directly address the issue of changes in the definition of First Nations status in section 5.3.

In table 2, we provide the overall age-standardized mortality rates calculated as specified in equation (2) as well as the five-year age group mortality rates by gender for status First Nations individuals and the Canadian average. The age-standardized mortality rates (ASMRs) are provided in the first row. Between ages five and 65, the ASMR is 226 deaths per 100,000 for the status First Nations male population and 161 deaths per 100,000 for the general Canadian male population averaged over 2010 to 2013. For the status female population, the ASMR is 165 deaths per 100,000, and, for the general female population, it is 101 deaths per 100,000. Note that these ASMR estimates are not strictly comparable to other studies because we have age standardized to the status First Nations age distribution in 2010; thus, we provide the

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19 The result regarding infant mortality is unsurprising given that if infants die before they are registered, neither their birth nor death will be registered.

20 There is also some evidence of marginal under-reporting of deaths over the age of 40 in 2001 to 2002 and over 60 in 2003 to 2007, particularly for males. However, this small degree of potential under-reporting would not change the conclusion of this work in a substantive fashion.

21 We focus on these years since they are the most recent years for which we have data. We report the average of three years in order to reduce noise in the yearly mortality rate. The results are unchanged if 2010 is excluded.

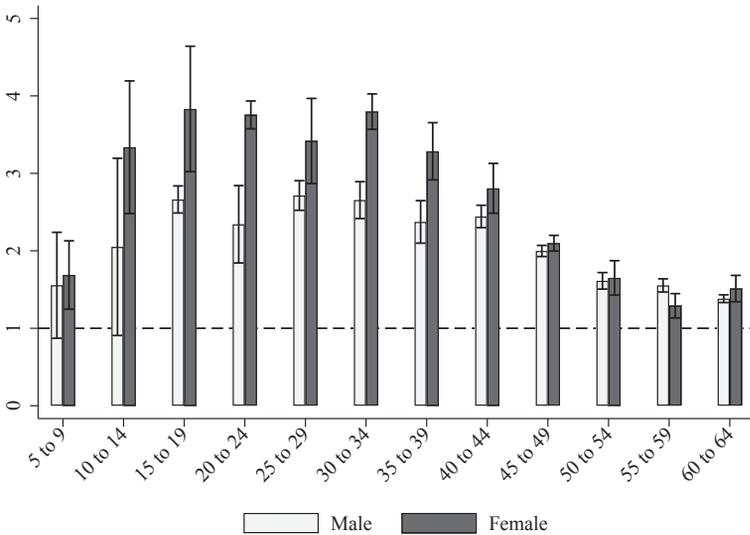
**TABLE 2**  
Summary of mortality rates per 100,000, 2010–2013

Age group	Males		Females	
	Canadian average	All status First Nations	Canadian average	All status First Nations
ASMR (05 to 64)	160.71 (1.94)	225.89 (9.26)	100.81 (0.92)	165.41 (1.62)
05 to 09	9.12 (0.8)	13.51 (5.67)	7.88 (0.73)	12.83 (2.92)
10 to 14	11.97 (1.23)	23.85 (12.08)	10.77 (1.24)	35.62 (10.73)
15 to 19	46.9 (4.31)	123.22 (8.66)	24.72 (1.17)	92.85 (18.35)
20 to 24	73.18 (3.93)	172.05 (38.84)	30.42 (0.44)	113.25 (3.89)
25 to 29	75.64 (2.19)	204.53 (15.5)	32.95 (0.98)	112.84 (19.72)
30 to 34	81.15 (2.43)	217.34 (17.09)	43.46 (1.16)	165.46 (3.82)
35 to 39	101.44 (2.89)	241.24 (18.74)	59.04 (1.6)	191.98 (24.67)
40 to 44	149.58 (5.4)	358.6 (28.48)	93.61 (2.32)	257.43 (33.35)
45 to 49	232.3 (4.94)	459.84 (20.93)	155 (2.81)	324.95 (18.45)
50 to 54	372.6 (9.52)	593.2 (53.19)	247.96 (8.35)	408.75 (41.4)
55 to 59	595.89 (10.49)	926.5 (26.97)	383.4 (4.18)	493.62 (52.78)
60 to 64	926.3 (10.41)	1,288.04 (49.34)	576.24 (9.44)	883.98 (76.01)

NOTES: Data are from the Indian Register and Health Canada vital statistics birth and death databases. The age-standardized mortality rates (ASMRs) are standardized to the age distribution of status people in 2010. Averages over each year are presented by age group with the standard deviations in parentheses.

mortality rates in five-year age groups for males and females in the remaining rows. We find that status men consistently have the highest mortality rates at almost all age groups. It is worth noting, however, that the mortality rate of status girls between the ages of 10 to 14 is actually higher than that of status boys (36 per 100,000 as compared to 24 per 100,000, respectively). This is the only age group for which the mortality rate of status females is above that of status males. Next, notice that status females have mortality rates that are higher than both non-status males and non-status females.<sup>22</sup>

22 In table A2, we show the mortality rates for status First Nations individuals and the general population by age and gender computed by year and averaged over 2000 to 2009 and demonstrate that the patterns observed in 2010–2013 are not anomalies. The estimates in this table show that the patterns described above are characteristic over the decade of the 2000s: status male mortality rates are higher than the general population and status female mortality rates are lower than status men in most age groups but significantly higher than for



**FIGURE 1** Relative mortality rates (status First Nations mortality per 100,000 divided by average Canadian mortality rate per 100,000) averaged over 2010 to 2013, by gender and age

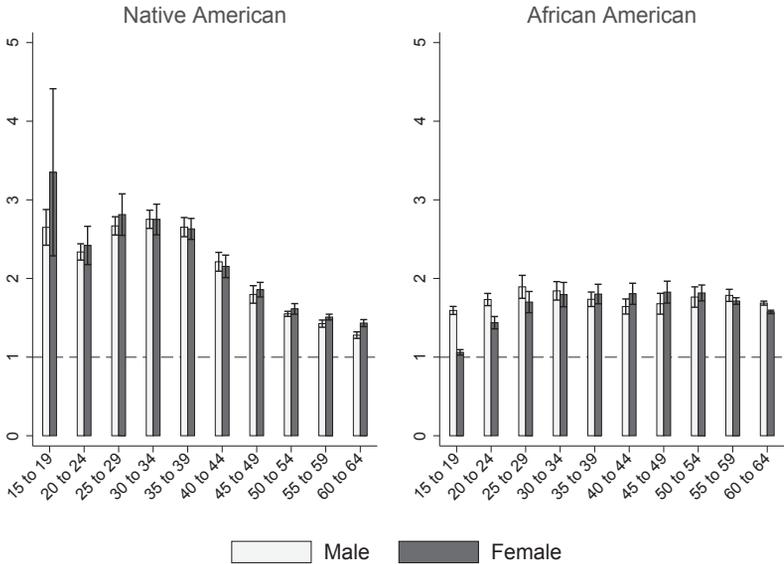
NOTES: Figure 1 shows relative mortality rates between status First Nations individuals and all Canadians with their 95% confidence intervals averaged over 2010 to 2013. Data are from the Indian Register (on population size and death rates by age and gender) and from vital statistics data sets from Health Canada

To more clearly illustrate the relative patterns in table 2, we present in figure 1 the ratio of the status First Nations mortality rate to the general population mortality rate. The dashed horizontal line at 1 represents parity with the average Canadian mortality rate for each age group. The figure indicates that the relative mortality rates are above one in all cases and above at least two in most age and gender groups. This indicates that the mortality rate for status First Nations people has nearly doubled compared to that for their relevant reference group for the population as a whole. Relative mortality rates are particularly high for females (approaching a ratio of four) starting at age 15 and going through 34 years of age. Status males have higher levels of mortality in this age range compared to the average Canadian male and have a ratio approaching three. We note that the differences in the male and female relative mortality are statistically different from one another from ages 15 to 39.<sup>23</sup>

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women and comparable to the general male population in many age groups. In addition, relative mortality rates are more significantly biased against status women between 10 and 39.

23 If we were to inflate our estimates of male and female mortality by fraction suggested in the first panel of figure A1, this conclusion would not change.



**FIGURE 2** Relative mortality rates of Native Americans and African Americans to White Americans, 2010–2013

NOTES: The y-axis denotes ratio of either Native American or African American mortality rates divided by the non-Hispanic White mortality rate. The data on mortality rates by race were computed using counts on number of deaths and population from CDC Wonder Underlying Cause of Death data files, 1999–2015, Centers for Disease Control and Prevention.

SOURCE: [wonder.cdc.gov/ucd-icd10.html](http://wonder.cdc.gov/ucd-icd10.html)

To our knowledge, we are the first to document these gender-biased relative mortality rates at such young ages across Canada. These high rates of female mortality are not identifiable in survey data through imbalances in male–female gender ratios. Our results echo the finding of female-bias relative mortality rates in developing countries (Anderson and Ray 2010) where there are relatively balanced gender ratios.<sup>24</sup>

We estimate mortality rates of Native Americans and African Americans in the United States and compare them with the mortality rates of non-Hispanic White Americans in order to assess whether these disparate results by gender are present in other Indigenous and minority populations. In figure 2, we present the results of this exercise using data from the National Center for Health Statistics.<sup>25</sup> The first panel depicts the relative mortality rates for Native Americans relative to the majority population in the US across the

24 In the case of status First Nations people, the high rates of institutionalization and homelessness among status First Nations men (Akee and Feir 2016) actually skew the gender ratio in the status First Nations population towards women.

25 [cdc.gov/nchs/hus/american.htm#deaths](http://cdc.gov/nchs/hus/american.htm#deaths)

range of ages 15 to 64; the relative mortality rates are particularly high in the young adult years and are approximately of equal magnitude for both males and females.<sup>26</sup>

The relative mortality rates for Native Americans exceed three for females in the age group 15–19 and hover around three until about age 40 for both male and females. These are quite high relative mortality rates, but they are smaller than those found for the status First Nations population in Canada, especially for status First Nations women and girls.<sup>27</sup> The next panel provides similar data for African Americans. At younger ages, there appears to be higher relative mortality rates for males than for females especially at ages 15–19, and the relative mortality rate hovers around two. The comparison of the status First Nations mortality rates to these two US-based groups suggests the extreme nature of the former's conditions in Canada. We find that the ratio of the Native Americans' and African Americans' mortality rates compared to White Americans is lower than the ratio of First Nations mortality to the general population in Canada; it should be noted that Native Americans and African Americans are among the most at-risk and impoverished groups in the US. Additionally, relative mortality is approximately similar by gender for these two groups in the US. However, the mortality rates we estimate (as opposed to *relative* mortality rates) for status First Nations men are roughly comparable to those in the African American population before the age of 35, while status First Nations women have higher mortality rates than those in the African American population.

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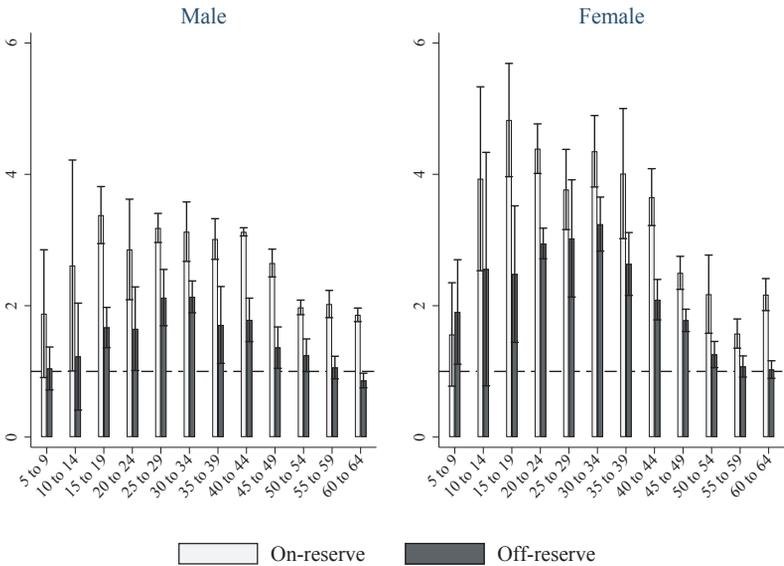
26 Schulhofer-Wohl and Todd (2015) find high female mortality rates for a few select counties in the US with relatively high American Indian populations. While their estimates include non-American Indians, the implication is that a large proportion are most likely American Indian females. They report that “for the four decades since the late 1960s, the age-adjusted mortality rate for women (of all races) in American Indian-dominated Menominee County, Wisconsin, has ranged between the highest and fourth-highest among all counties in the 48 states.” However, the relative mortality rates we presented for Canada are substantially higher than for North American Indians and African Americans in the United States on average.

27 To determine if this is simply due to the general female population in Canada having significantly better outcomes than their American or status counterparts, we re-compute figure 2 using the Canadian mortality rate as the denominator. While this raises relative mortality rates across the board, the patterns across age groups and genders in figure A2 suggest the same narrative as figure 2. This implies that differences in the age–gender patterns in the relative mortality rates between Native Americans and the First Nations population are not due to differences in the age–gender patterns in mortality of the general population in Canada and the US.

### 5.2. A snapshot of mortality by location – On or off reserve and by province in 2010–2013

In this section, we examine differences in mortality rates for the status First Nations population and average Canadian mortality rates by geographic location. We examine two different geographic areas: Canadian provinces and locations on and off First Nations reserves. Our analysis provides deeper insight into the differences in mortality rates across these different geographic regions in Canada. While this analysis is not causal, it does illuminate several potential paths for future research on this topic. This is also the first, to our knowledge, display of differences in mortality rates between the on- and off-reserve populations of status First Nations individuals.

We depict these mortality rates in figure 3 as a ratio of the on- and off-reserve status First Nations mortality rates divided by the relevant Canadian average. Once again, the horizontal line at 1 indicates parity with the Canadian average mortality for the age group and location.



**FIGURE 3** Relative mortality rates (status First Nations mortality rate divided by Canadian average mortality rate) averaged over 2010 to 2013, by place of residence, gender and age

NOTES: This figure shows the difference between women and men in the ratio of mortality rates between status First Nations people and all Canadians with their 95% confidence intervals averaged over 2010 to 2013 using data from the Indian Register (on population size and death rates by age and gender) and from vital statistics data from Health Canada. The label “On-reserve” indicates the figure that provides the relative mortality rates calculated for the population reported to be living on legally defined reserve land. The label “Off-reserve” indicates the figure that provides the relative mortality rates calculated for the population reported to be living off legally defined reserves.

Overall, the mortality rates for the on-reserve population tend to be almost always twice that (or more) of the Canadian average for males across most of the five-year age groups; the rate for females on reserve is often triple to quadruple the Canadian average at many ages. In the first panel, we present the results for males. The on-reserve relative mortality rates are consistently above two for ages 10 to 49 for status First Nations males. In young adulthood, the ratio is above three. The ratios for off-reserve status First Nations males is consistently above one except for at ages 60 to 64, where it is slightly below one. In general, the relative mortality rate for off-reserve status First Nations population is more muted than for the on-reserve populations.

For females, the on-reserve population has a relative mortality rate that is around four or higher for ages 10 through 44. The rate declines after that but increases again at ages 60 to 64. The off-reserve status First Nations women all have high mortality rates relative to their Canadian counterparts. Overall, there is evidence that status First Nations females have higher relative mortality rates (both on and off reserve) than those of their male counterparts.

In table A1, we provide the mortality rates for status First Nations males and females residing on and off of reserves and the average Canadian mortality rates that underlie figure 3. The ASMRs for males and females are higher for the on-reserve population as compared to both the off-reserve and Canadian averages. The off-reserve status First Nations population also has a higher ASMR than the Canadian average.

Previous work suggests several reasons why mortality rates are higher on reserve than off reserve: economic conditions for those living on reserve in Canada are systematically poorer than for those living off reserve (AANDC 2015, Feir 2013, Pendakur and Pendakur 2011), unsafe drinking water is a reality for many communities (Simeone 2010) and access to emergency medical care is limited (Lavoie et al. 2010). However, caution is warranted in interpreting the on- and off-reserve difference in mortality rates. Individuals who live off reserve without a will or who have lost contact with their communities and families may be less likely to have their deaths reported to the register. That being said, our earlier validation exercise makes us less concerned that this is a serious issue for a given period of time.

Next, we present relative age-standardized mortality rates by province in figure 4. These data provide a view of geographic differences in relative mortality rates for the status First Nations population by gender. Perhaps the most striking elements in the figure are the high relative mortality rates in Alberta and low relative mortality rates in Quebec. The results for Alberta illuminate the large disparate mortality rates across the status First Nations and general population. Mortality rates are particularly low for the general population in Alberta. Conversely, Alberta (along with Manitoba and Saskatchewan) has the highest mortality rates for both status First Nations males and females; as a result, the relative mortality rates are exacerbated when one compares First Nations mortality to average Canadian mortality in Alberta relative to other provinces. On the other hand, average Canadian mortality in Quebec



**FIGURE 4** Age-standardized relative mortality rates by province, 2010–2013  
 NOTE: Age-standardized mortality rate: status First Nations rate/general population.

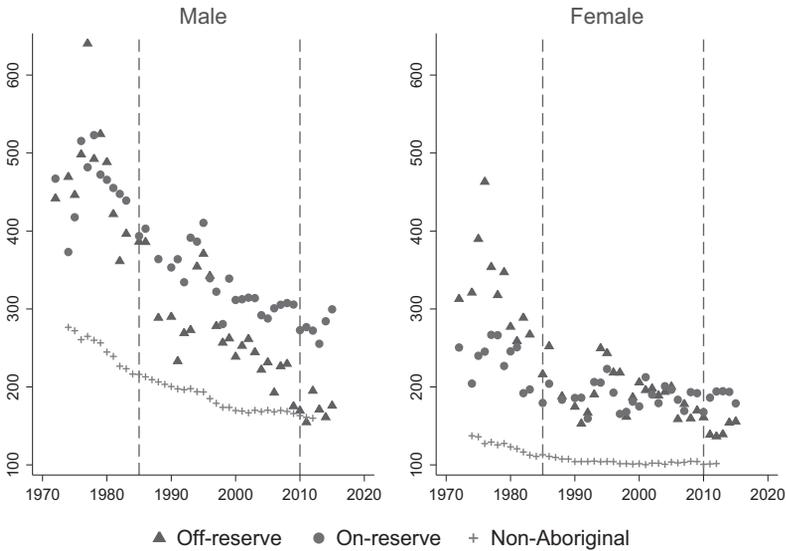
is comparable to that in the Prairie provinces, but the status First Nations population has lower mortality rates in this province. Figure A3 separates out the province-level mortality rates by gender and First Nations status. The observed ASMR for status First Nations individuals is shown in the first row of the figure and the average Canadian population in the bottom row. We show in figure A4 that there are differences in mortality rates across provinces by age group as well.

### 5.3. First Nations mortality across time, 1974–2013

We show in figure 5 the age-standardized mortality rates for status males and females and for the general population between 1974 to 2013. The vertical lines indicate the year of Bill C-31 and Bill C-3, which both resulted in significant changes in the definitions of the status First Nations population. There are distinct increases in population counts off reserve after these changes are made to the definition of First Nations status, as shown in figure A5.<sup>28</sup>

We first note that mortality has declined significantly for Canadian males from the 1970s onward. A similar decline in mortality rates is observed for

28 We address the importance of this further in section 5.4.

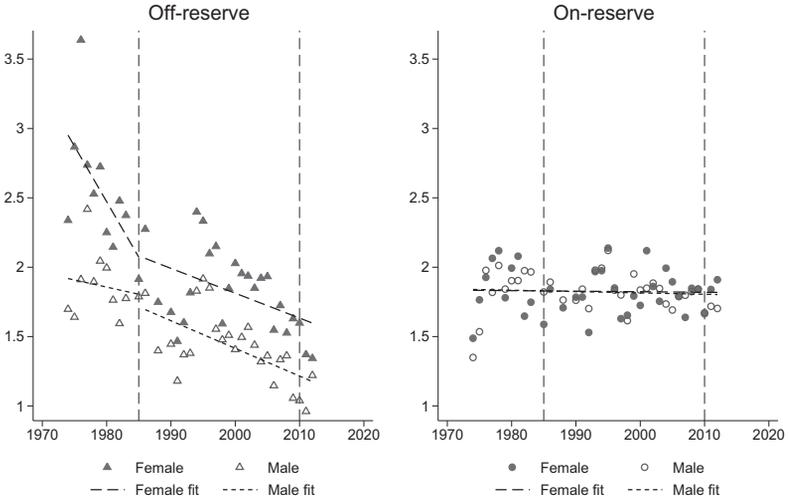


**FIGURE 5** Status First Nations and general population mortality rates, per 100,000  
 NOTES: All populations are standardized to have the age distribution common to all status First Nations individuals at the national level in 1991. The vertical lines indicate the years Bill C-31 (L) and Bill C-3 (R) came into force.

both the on- and off-reserve status First Nations male populations. Two points are worth noting in regard to the decline in mortality for status First Nations males. First, there is higher variability in mortality rates primarily due to the fact that these estimates are based off of much smaller populations than for the average Canadian male. Second, while it appears that the average mortality rate has converged for the off-reserve status First Nations male population, it is consistently higher for the on-reserve population.

There is a relative reduction in average mortality rates for Canadian females over time, but it is smaller than for men. For status First Nations females, before 1985, there appears to be significant declines in the ASMR, but there is quite a lot of variability. After 1985, there appears to be a level shift in mortality for status First Nations females. There has been virtually no change in ASMR for women subsequently. One reason for this shift downward in mortality rates for women could be compositional changes of the First Nations populations as a result of changes to the definition of First Nations status in 1985. The relatively low mortality rates after versus before 1985 among the off-reserve status population suggests that those who gained/re-gained status after 1985 had lower mortality rates than those who had status before 1985.

Figure 6 shows the ratio of the ASMR in the status to non-status ASMR and highlights the extent to which trends in mortality have mirrored those in the general population. We have fitted a line to the data by gender and location on or off reserve. We have allowed for a trend and intercept break in 1985 for the off-reserve sample because of the substantive change in status



**FIGURE 6** Relative mortality rates over time and reserve status  
 NOTE: Ratio of 5 to 64, age-standardized mortality rate: status First Nations rate/general population.

eligibility. The first panel presents results for the off-reserve population and the second panel for the on-reserve population. In the first panel, we observe that both the male and female off-reserve population have experienced a significant reduction in the ASMR ratio (which is indicated by the two downward sloping fitted-lines in the graph). We note, however, that if one allows for a break in the trend and level shift in mortality rates after 1985, the downward trend in off-reserve mortality rates is less pronounced. There are still level differences in the ASMR ratio between males and females (with females having higher relative mortality rates), but both appear to have decreased at approximately the same rate from 1985 onward relative to the general population.

In the second panel, we fit two lines to the data points for status female and male mortality rates for the on-reserve population. These two lines are both horizontal lines. This result indicates that over time the ratio of the on-reserve status to non-status ASMR has not changed in over 40 years. This is a striking result and merits future research to explain the lack in advancement of on-reserve mortality rates over time.<sup>29</sup>

29 However, given that there were significant changes in the definition of status during the mid-1980s, we consider in the appendix what has happened over time from 1991 to 2011; this period is subsequent to the largest change to First Nations status, which occurred in 1985, for women. Our intention in this analysis is to investigate whether there have been systematic changes in status First Nations female mortality over time holding the definition of status constant. Over this period, status male mortality rates decreased more quickly than those of status females. We also include variation by age group. In figures A6 and A7, we show trends in the mortality rate by age group. While

#### 5.4. Reconciliation and comparison with previous estimates

In this section, we compare our estimates of status First Nations mortality rates to those of previous research. Our findings are broadly consistent with the patterns observed in previous work (for example, the age and gender distribution of mortality over the age of 25). However, we do differ with the Mao et al. (1992) findings that mortality rates on reserve are significantly lower than those off reserve in data. Our results show that on-reserve mortality rates are much higher than off-reserve mortality rates.

In order to reconcile this stark difference with the findings of Mao et al. (1992), we restrict analysis to the pre-1985, period, which is prior to the change in the definition of First Nations status and a time frame that is consistent with that in Mao et al. (1992). The data from this time period can be seen in figure 5. Examining the data points to the left of 1985 (the first vertical line in the figure) it is immediately clear that the mortality rates for off-reserve status females are higher than for their on-reserve status counterparts. For males, it is a bit more mixed, but there are several high mortality years for off-reserve status males prior to 1985. Subsequently, there is an inversion in the mortality rates, with off-reserve status males experiencing a lower mortality rate over time and an approximately similar result for off-reserve status females relative to their on-reserve counterparts. We see this as being driven primarily by compositional changes in the status First Nations populations both on and off reserves subsequent to the change in the definition of status in 1985.<sup>30</sup>

A second potential explanation for the observed differences in mortality rates over time by residence on reserves is the availability of and access to quality health care services. Until the late 1960s, status people's health care was the responsibility of the federal government and status First Nations people were cared for in racially segregated federal "Indian hospitals" (Waldram et al. 2006). During the 1960s, 70s and 80s, there was significant reform in the delivery of health care to status people and a shift of responsibility towards the provinces. We see a constant trend downward in the ASMR during this period, which would be consistent with these reforms improving the health

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generally all figures show a similar pattern, improvements in mortality tend to be greatest among older age groups and start earlier for men. On the other hand, in some age groups, on-reserve female mortality appears to be rising.

30 Recall that before 1985, if a status woman married a non-status man, then she (and her children after the age of 21) would lose their status, thus implying she (and they) would no longer be included in the Indian Register. The woman and her children would also lose the right to live on reserve. Thus, the only off-reserve First Nations women who are included in the data are women who are either single or married to status men. This applies to their children as well—whether they are male or female. Thus the "off-reserve" population is a very select group. We can see that after 1985, the mortality rates off reserve fall for women and men. This suggests that differential composition of the on- and off-reserve populations is at least in part responsible for the change in mortality rates over time.

**TABLE 3**

Age-standardized mortality rate reconciliation with Tjepkema et al. (2009)

	Tjepkema et al. (2009)		Restricted Akee and Feir (2019)	
	Status	General pop.	Status	General pop.
<b>Men</b>				
25–34	310.2 (18.02)	105.1 (1.73)	340.8 (51.77)	110.9 (14.82)
35–44	508.9 (28.22)	207.3 (2.39)	440.1 (82.15)	175.7 (18.3)
45–54	1077 (54.26)	573 (4.87)	760.4 (112.32)	377.9 (26.86)
55–64	2411.1 (113.45)	1621.3 (9.34)	1652.3 (223.66)	1053.1 (105.77)
<b>Women</b>				
25–34	168.3 (11.32)	52 (1.17)	175.4 (27.78)	44.1 (3.11)
35–44	335.3 (20.15)	131.2 (1.88)	270 (47.92)	94.6 (3.59)
45–54	766 (41.17)	336.1 (3.86)	482.1 (45.49)	233.3 (12.05)
55–64	1837.5 (90.51)	844 (7.26)	1050.9 (126.48)	607.6 (42.21)

NOTES: Age-standardized mortality rates per 100,000 from 1991 to 2001 age standardized to the 1991 status age distribution as per Tjepkema et al. (2009). Our estimates (Restricted Akee and Feir 2019) refer to restricting the analysis to the same time period, standardizing by the closest age distribution we have available (we cannot fully replicate the sample selection in Tjepkema et al. 2009) and doing the same age groups.

of status people's. These declines are also much stronger for those living off reserve, which is the population that may gain the most from these reforms (specifically, they would have the greatest degree of access to pre-existing provincial systems of health care). We believe the ultimate reasons for this decline are of significant interest and would be an interesting and fruitful area for research.

A significant drawback of the Health Canada studies, Tjepkema et al. (2009) and Park et al. (2015) is that they have data only on status people's mortality in British Columbia and Alberta and on reserve in Manitoba and Saskatchewan. As we have shown previously in section 5.2, status mortality rates in Alberta, Manitoba and Saskatchewan are the highest in the country, and the on-reserve population is also subject to higher mortality rates. Thus, the national-level estimates are lower than those published by Health Canada for the subregions they report on, even accounting for the potential under-reporting to the Indian Register at older ages.

Another issue is that the mortality estimates in Tjepkema et al. (2009) and Park et al. (2015) may over-estimate mortality rates for the general status population. In table 3, we show our estimates of status and non-status mortality rates relative to Tjepkema et al. (2009) using the same age standardization to the status population in 1991 and excluding from our sample members of bands who did not participate in the 1991 Census to make our sample as comparable to Tjepkema et al. (2009) as possible.

We cannot match their sample completely because they excluded individuals that were not matched between Census records and tax records (less than 80% of non-status individuals were matched in their final analysis and only 50% to 60% of status First Nations individuals were matched); our analysis uses the entire population since we are not merging our data across different records. This creates an unknown sample selection, and we are unable to replicate this sample in our data for comparison, unfortunately. We exclude the estimates of Park et al. (2015) since they pool both the status and the non-status First Nations populations and thus are not strictly comparable to our results.

The first thing to note in table 3 is that, between the ages of 25–34 (for both women and men), our mortality rate estimates are either slightly higher or empirically indistinguishable from those of Tjepkema et al. (2009). Our estimates are lower on average for older age groups and this difference becomes more pronounced at older ages. If we scaled our estimates up by the amount suggested in figure A1, it still would not fully account for the difference between our estimates and Tjepkema et al. (2009) estimates. Our results also potentially differ from Tjepkema et al. (2009) due to the fact that their analysis follows a single 1991 cohort over time; our analysis averages over all cohorts in this period. Therefore, differences across Census cohorts (by age group) may account for some of the observed differences for both the status and general population results. Since we cannot identify a consistent cohort of individuals over time (for example, in the case of the First Nations population, changes in registration patterns; for the general population, immigration), we are unable to conduct a pure replication of the cohort-based analysis of Tjepkema et al. (2009). However, in unreported results, we used a synthetic cohort approach using 1991 as the base year, which results in higher estimates of mortality for both the general and First Nations populations.

Overall, we believe it is likely that the difference in our results with prior mortality findings is due to two potential sources: (1) the sample in Park et al. (2015) and Tjepkema et al. (2009) may be such that individuals with a higher probability of death are more likely to be observed in their data due to their matching requirements or (2) averaging across cohorts may underestimate mortality rates due to cohort (by age) specific conditions. We also note that the differences in estimates of mortality between Health Canada (2008, 2014) and Park et al. (2015) and Tjepkema et al. (2009) are likely due to the regional selection in Health Canada (2008, 2014) and the sample selection in Park et al. (2015) and Tjepkema et al. (2009).

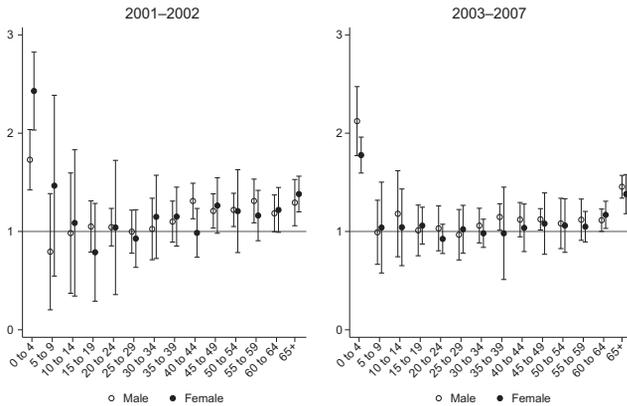
## 6. Conclusion

In this work, we provided novel estimates of status youth mortality, evidence on variation in mortality by region and residence and longitudinal estimates of First Nations mortality. We established several stylized facts about status First Nations mortality in Canada:

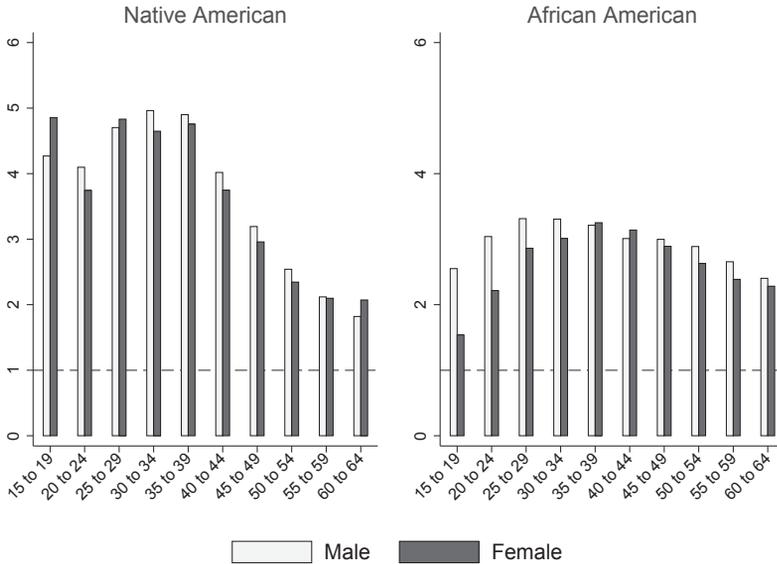
1. On-reserve mortality rates are higher on average than off-reserve mortality rates for status First Nations people.
2. The highest relative mortality rates are observed for status youth under the age of 25—the mortality rates of on-reserve status girls between 15 and 19 are nearly five times as high as those for the general population.
3. Status women and girls between the ages of 15 to 39 have higher relative mortality rates than status men.
4. There is significant regional variation in mortality rates, and the highest mortality rates are found in the Prairie provinces.
5. Mortality rates have not improved for women and girls on reserve in the last 30 years, and relative mortality rates have not improved on reserve for all status people in the past 40 years. However, absolute and relative mortality rates have fallen for off-reserve status men and women over time.

Based on these findings, we believe productive research in the future would examine the early, most dramatic declines in off-reserve status mortality rates and discern the effects of dramatic shifts in policy from dramatic shifts in selection. Developing a further understanding of differences between on- and off-reserve mortality rates and the shockingly high relative mortality rates of women and girls would also be a major contribution, as would be a more complete understanding of the regional distribution of mortality. Future work should continue with the recommendations of the Truth and Reconciliation Commission by tracking trends in mortality and other health statistics.

### A. Appendix figures

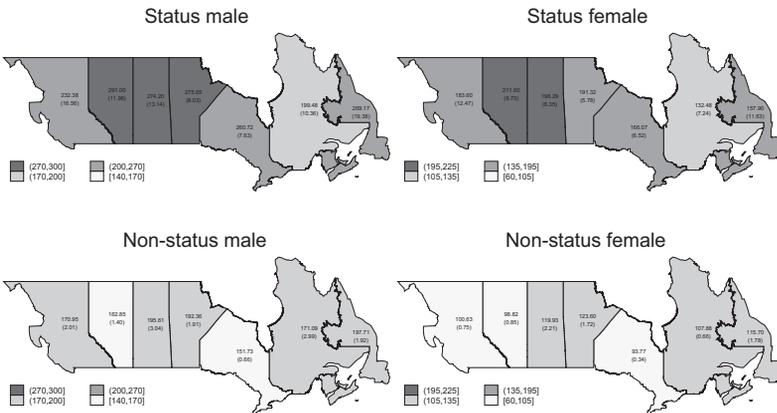


**FIGURE A1** Comparing Indian Register mortality rates per 100,000 relative to vital statistics rate of death for status First Nations individuals in Alberta, British Columbia and on reserve in Manitoba and Saskatchewan  
 NOTES: These are the ratios of the mortality rates from the vital statistics data for First Nations in Alberta, British Columbia and on reserve in Manitoba and Saskatchewan compared with those computed from the Indigenous and Northern Affairs Indian Register for the same geographies and times periods. The mortality rate from vital statistics is the numerator and the mortality rate from the Indian Register is the denominator.



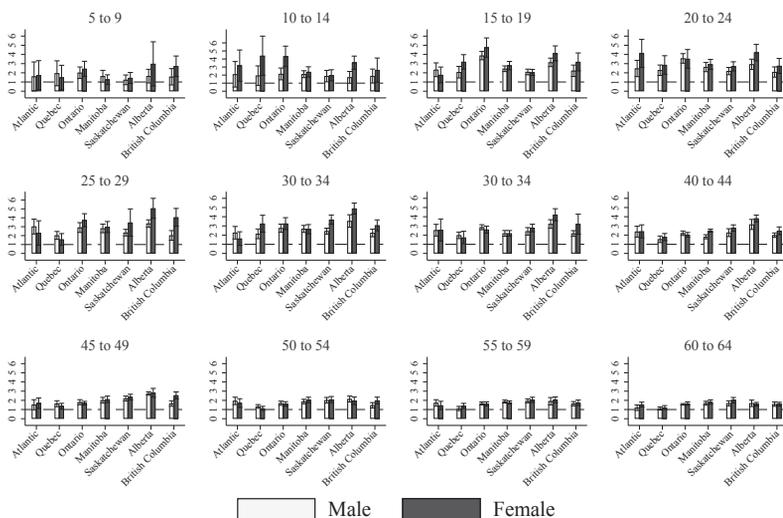
**FIGURE A2** Relative mortality rates of Native Americans and African Americans to general Canadian population, 2010–2013

NOTES: The y-axis denotes ratio of either Native American or African American mortality rates divided by the general Canadian mortality rate. The data on race mortality rates were computed using counts on number of deaths and population from CDC Wonder data files on Underlying Cause of Death, 1999–2015, Centers for Disease Control and Prevention, [wonder.cdc.gov/ucd-icd10.html](http://wonder.cdc.gov/ucd-icd10.html). The Canadian mortality rates were generated using data from Health Canada vital statistics birth and death databases compiled by Statistics Canada.

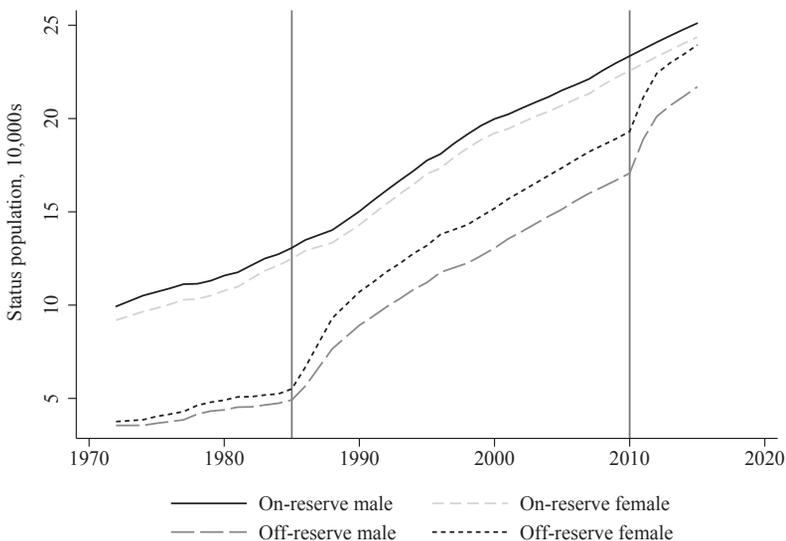


**FIGURE A3** Age-standardized mortality rates by province, 2010–2013

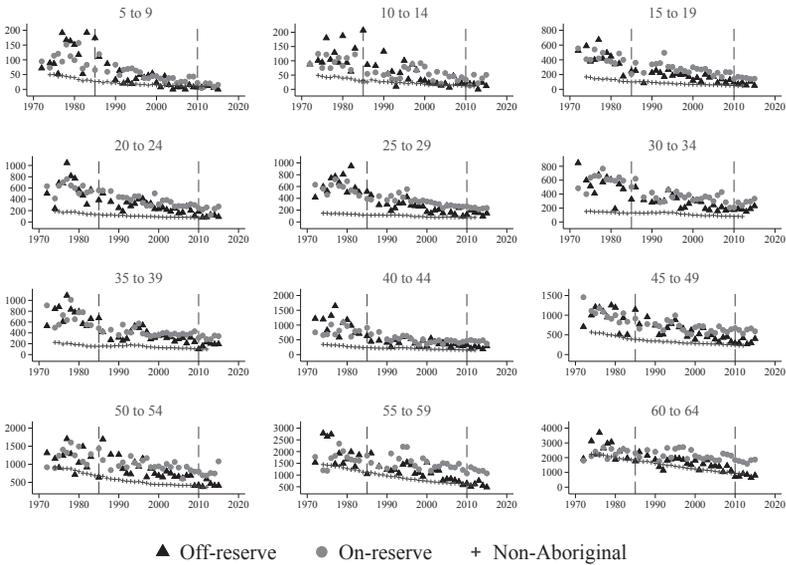
NOTES: Age-standardized mortality rates (ASMRs) for the status First Nations and general populations. Average ASMR over three years for each province is labelled with its standard error in parentheses.



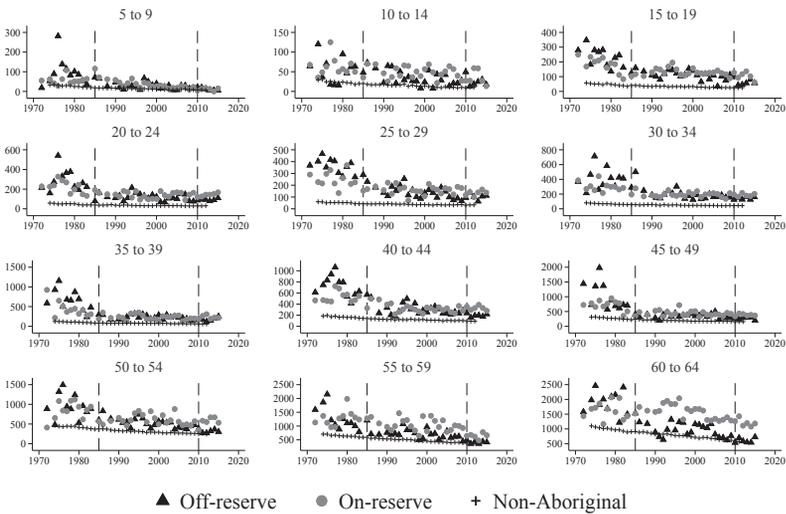
**FIGURE A4** Relative mortality rates by province and age group  
 NOTE: Ratio of 5 to 64, age-standardized mortality rate: status First Nations rate/general population.



**FIGURE A5** Status First Nations population, 100,000s  
 NOTES: This figure shows the increase in the status First Nations population from 1970 to 2016. The vertical lines indicate the years Bill C-31 (L) and Bill C-3 (R) came into force.



**FIGURE A6** Status male mortality rates and the general population per 100,000, by age group  
 NOTES: The mortality rate per 100,000 is on the y-axis. All data come from the Indian Register. The vertical lines indicate the years Bill C-31 (L) and Bill C-3 (R) came into force.



**FIGURE A7** Status female mortality rates and the general population per 100,000, by age group  
 NOTES: The mortality rate per 100,000 is on the y-axis. All data come from the Indian Register. The vertical lines indicate the years Bill C-31 (L) and Bill C-3 (R) came into force.

## B. Appendix tables

**TABLE A1**  
Summary of mortality rates per 100,000, 2010–2013

	Males			Females		
	Canadian average	On-reserve	Off-reserve	Canadian average	On-reserve	Off-reserve
ASMR (05 to 64)	160.71 (1.94)	261.06 (9.34)	181.36 (17.2)	100.81 (0.92)	179.79 (12)	149.56 (10.77)
Age group:						
05 to 09	9.12 (0.8)	16.23 (8.07)	9.25 (2.99)	7.88 (0.73)	11.65 (5.21)	14.80 (7.01)
10 to 14	11.97 (1.23)	29.32 (16.46)	16.00 (11.38)	10.77 (1.24)	42.09 (17.99)	27.20 (15.66)
15 to 19	46.9 (4.31)	152.02 (11.76)	82.75 (17.61)	24.72 (1.17)	114.95 (17.83)	62.49 (24.29)
20 to 24	73.18 (3.93)	204.38 (61.19)	127.88 (43.21)	30.42 (0.44)	129.92 (11.23)	91.97 (5.98)
25 to 29	75.64 (2.19)	233.64 (18.26)	167.65 (29.05)	32.95 (0.98)	121.24 (19.24)	103.39 (34.67)
30 to 34	81.15 (2.43)	244.91 (36.87)	186.93 (11.77)	43.46 (1.16)	182.23 (22.3)	148.54 (17.56)
35 to 39	101.44 (2.89)	296.71 (33.98)	183.17 (46.44)	59.04 (1.6)	228.07 (56.85)	159.53 (29.68)
40 to 44	149.58 (5.4)	448.19 (17.76)	270.6 (56.65)	93.61 (2.32)	328.15 (38.29)	196.95 (35.48)
45 to 49	232.3 (4.94)	590.52 (57.94)	329.79 (67.54)	155 (2.81)	372.12 (43.53)	286.82 (23.89)
50 to 54	372.6 (9.52)	708.02 (54.75)	474.83 (97.96)	247.96 (8.35)	514.52 (132.62)	328.41 (34.18)
55 to 59	595.89 (10.49)	1162.71 (111.74)	675.77 (108.54)	383.4 (4.18)	581.86 (86.86)	425.98 (50.28)
60 to 64	926.3 (10.41)	1657.44 (105.32)	876.77 (135.39)	576.24 (9.44)	1200.03 (128.8)	648.05 (63.75)

NOTES: Data come from the Indian Register and Health Canada vital statistics birth and death databases. The age-standardized mortality rates (ASMRs) are standardized to the age distribution of status people in 2010. Averages over each year are presented by age group with the standard deviations in parentheses.

**TABLE A2**

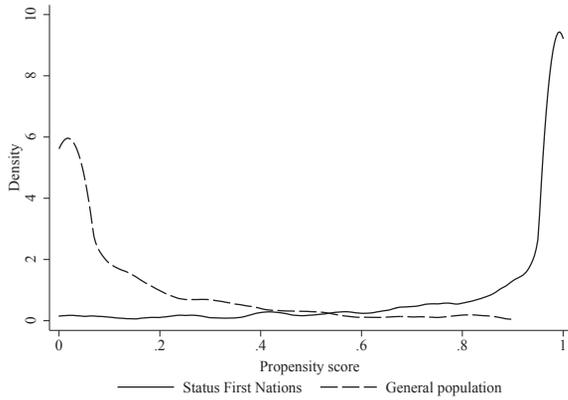
Summary of mortality rates per 100,000, 2000–2009

	Males				Females			
	Canadian average	All status First Nations	Off-reserve	On-reserve	Canadian average	All status First Nations	Off-reserve	On-reserve
ASMR (05 to 64)	129.89 (2.22)	229.08 (18.68)	199.55 (29.3)	249.72 (14.5)	76.56 (1.05)	154.15 (10.83)	156.16 (13.56)	152.59 (12.11)
Age group:								
05 to 09	12.04 (1.52)	24.21 (6.36)	12.26 (11.86)	31.18 (8.6)	9.35 (1.56)	19.81 (6.96)	21.35 (10.08)	18.82 (8.06)
10 to 14	15.13 (1.83)	33.75 (10.07)	22.78 (12)	40.3 (12.76)	10.89 (1.41)	39.12 (9.73)	32.21 (14.09)	43.29 (15.55)
15 to 19	58.73 (5.06)	186.73 (35.47)	138.43 (37.55)	216.63 (45.86)	27.41 (1.89)	109.63 (8.67)	94.98 (24.9)	119.01 (12.98)
20 to 24	82.16 (4.62)	264.89 (41.3)	212.77 (56.06)	299.78 (46.76)	31.37 (1.6)	127.57 (16.64)	108.96 (34.34)	140.9 (26.73)
25 to 29	79.78 (3.05)	235.26 (30.53)	186.59 (50.16)	271.98 (29.01)	33.69 (1.63)	140.29 (24.35)	119.6 (35.98)	157.59 (28.51)
30 to 34	88.78 (5.15)	270.35 (46.45)	228.42 (56.42)	306.16 (69.28)	44.45 (1.99)	180.31 (24.56)	176.02 (30.66)	184.38 (29.85)
35 to 39	116.98 (7.3)	325.96 (45.1)	284.42 (71.76)	363.29 (31.7)	66.92 (4.93)	210.45 (35.85)	211.97 (42.74)	208.87 (45.25)
40 to 44	167.85 (8.37)	403.76 (37.37)	382.68 (85.69)	423.65 (42.83)	104.15 (4.85)	284.57 (33.36)	276.59 (49.4)	293.42 (42.65)
45 to 49	264.06 (14.82)	540.13 (74.24)	460.92 (119.59)	609.5 (71.15)	171.69 (7.07)	363.37 (51.45)	352.01 (77.97)	376.38 (49.66)
50 to 54	421.8 (17.14)	768.91 (108)	674.99 (129.63)	843.97 (122.53)	268.26 (7.84)	499.81 (83.23)	466.22 (68.74)	540.03 (144.12)
55 to 59	662.51 (34.38)	1123.07 (132.06)	921.67 (218.51)	1279.66 (138.25)	412.69 (19.63)	776.27 (136.6)	624.33 (121.94)	961.25 (206.19)
60 to 64	1064.92 (90.64)	1707.91 (175.33)	1425.78 (326.69)	1919.47 (161.32)	654.06 (43.32)	1095.68 (171.82)	904.22 (223.69)	1324.76 (136.95)

NOTES: Data come from the Indian Register and Health Canada vital statistics birth and death databases. The age-standardized mortality rates (ASMRs) are standardized to the age distribution of status people in 2010. Averages over each year are presented by age group with the standard deviations in parentheses.

### C. Overlap in observable characteristics

It would be useful to decompose the differences in mortality rates between status people and the general population into the portion explained by economic characteristics and an unexplained residual. However, as discussed in the text, we do not conduct a decomposition exercise here because of the lack of overlap in observable characteristics at feasible levels of aggregation in our data. In other words, it is possible to nearly perfectly predict whether a Census subdivision (community) is a First Nations community or a non-Aboriginal community based on a very limited set of economic characteristics. Since economic characteristics can perfectly predict whether a community is a First Nations community, there are no comparable non-Aboriginal communities that can form counterfactual mortality rates. This is also true for any province–year–age–gender pair or other higher level of aggregation.



**FIGURE A8** Propensity score distribution for First Nations and non-First Nations communities by selected social economic characteristics

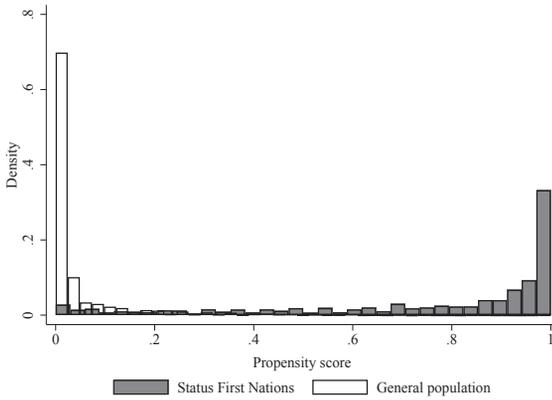
NOTE: This shows the distribution of the propensity score predicted based on high school graduation rates, unemployment rates and median income. The observations are by year–province–gender–age cells (1,456 cells in total).

To demonstrate the lack of overlap, we fit two probit models and estimate the propensity score associated with being a status First Nations observation. The first probit model is fit to data where the unit of aggregation is a province–year–age–gender average. We predict the probability of that average being a status average or a general population average based on high school graduation rates, median family income, unemployment, the proportion female, the proportion single and a set of year and province dummies. The economic observables are obtained from Census data for 1991, 1996, 2001 and 2006. Specifications were run without year fixed effects and by gender with no qualitative change in the conclusion. We present the propensity score for status observations and the general population in figure A8.

The figure indicates that there is virtually no overlap in the propensity score across First Nations and non-Aboriginal groups by province, age, gender or year.

To determine whether this is simply due to the higher level of aggregation, we use data at the level of the Census subdivision compiled by Indigenous and Northern Affairs Canada (INAC).<sup>31</sup> INAC generated a consistent series of data on economic characteristics for communities they identify as First Nations or non-Aboriginal from the 1981, 1991, 1996, 2001 and 2006 censuses and the 2011 National Household Survey by INAC. We run several specifications for a probit model and estimate the propensity score associated with being a First Nations community based on the observable characteristics provided by INAC. These characteristics include either the community well-being index, which is

31 Census subdivisions correspond roughly to cities, towns, Indian settlements and Indian reservations.



**FIGURE A9** Propensity score distribution for First Nations and non-First Nations communities by community well-being index  
 NOTE: This shows the distribution of the propensity score predicted based on the community well-being index variable and province variables.

**TABLE A3**

Community well-being index

Census year	Non-Aboriginal community	First Nations community
1981	65.8 (6.45) <i>2,884</i>	46.4 (10.86) <i>451</i>
1991	68.2 (6.87) <i>1,806</i>	50.9 (9.78) <i>420</i>
1996	69.2 (6.77) <i>1,816</i>	54.6 (9.62) <i>452</i>
2001	72.5 (6.11) <i>3,313</i>	56.5 (9.73) <i>512</i>
2006	75.9 (6.11) <i>3,305</i>	57.1 (10.24) <i>521</i>
2011	78 (5.65) <i>2,190</i>	58.6 (10.39) <i>557</i>

NOTE: Community well-being index average is given in the first row, the standard deviation in parentheses and the number of observations in italics.

a composite index of total income, labour force participation, housing quality and education (see [aadnc-aandc.gc.ca/eng/1100100016579/1100100016580](http://aadnc-aandc.gc.ca/eng/1100100016579/1100100016580) for details), or its subcomponents. Specifications were run with and without year and province fixed effects, with and without population size and with and without polynomials in the various observables. In all specifications, there was very little overlap across these communities.

The lack of overlap still exists even restricting the sample to include only communities under 7,000 people (which is the largest First Nations community in the data) and simply running a probit model with community well-being index and province dummies as the observables. Figure A9 presents the proportion of our estimates that falls, under different bins of the propensity score by whether the community was identified as a First Nations community or a non-Aboriginal community. Again, there is virtually no overlap in the propensity score.

Finally, we show in table A3 the difference in averages across the two types of communities. The average First Nations community in 2011 has a community well-being index that is lower than the 1981 community well-being index of non-Aboriginal communities. We conclude that any decomposition exercise or associative analysis would be highly reliant on parametric assumptions and out-of-sample predictions for identification.

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