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ABSTRACT

Excess Mortality, Institutionalization and Homelessness Among Status Indians in Canada*

In this paper we use confidential-use Census and administrative data to produce the first national estimates of excess mortality, institutionalization and homelessness for the largest Indigenous population in Canada from the ages of 5 to 64. We identify mortality rates at least twice the Canadian average and find exceptionally high mortality rates for young Indigenous women and girls – up to four times the Canadian average at certain ages. We show mortality rates are even higher on reserve – up to five times the Canadian average. These relative mortality rates are higher than the relative mortality rates of African Americans and the Native Americans to non-Hispanics in the United States. We also estimate very high rates of institutionalization and homelessness, especially among men and as a result there are stark gender ratio imbalances among this population. We speculate that this gender imbalance may play a role in excess female mortality in addition to several other socioeconomic factors.

JEL Classification:	J10, J15, J16, 015, I15, I14, I32
Keywords:	mortality, First Nations, Native American, Status Indian, homelessness, institutionalization, gender bias

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1 Introduction

Indigenous peoples have faced numerous dimensions of marginalization since colonization (United Nations, 2009). In Canada, Australia, the United States, and elsewhere differences in measurable conditions between Indigenous peoples and their non-Indigenous counterparts are well documented.[1] However, to our knowledge, no one has examined the extent to which excess mortality, institutionalization and homelessness have affected Indigenous peoples by age and gender. While a lack of available data makes these sorts of estimates impossible in many contexts, we demonstrate that the unique institutional structure in Canada makes them feasible for the largest Indigenous group in the country; Status Indians.[2] In this paper we provide the first Canada-wide estimates of the degree of institutionalization, homelessness, and excess mortality by gender and age. The results of this exercise are striking.

The first result is that, relative to their non-Indigenous counterparts, Status Indian females face exceedingly high rates of mortality. Using the "Indian Register" data set, maintained by the Indigenous and Northern Affairs Canada (INAC), we find that young Status Indian females have mortality rates that are 3 to 4 times the female non-Indigenous mortality rate and this difference begins as early as the age of 5. These relative mortality rates are statistically higher than the relative mortality rates for Status males which are themselves 2 to 3 times that of the non-Indigenous average. While previous researchers have found that there were higher rates of excess mortality for Status Indians women in Canada in general, no one has identified the disproportionately large burden of avoidable mortality borne by Status Indian women and girls at such young ages and at the national level (Tjepkema et al., 2009; Park et al., 2015; Health Canada, 2010).[3] We also are

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[1]See Feir and Hancock (2016) for a list of citations documenting this for Canada. For the American case see Greenfeld, Lawrence, and Smith (1999), Jones (2006), and Akee and Taylor (2014). For Australia, see Pink and Allbon (2008). Schulhofer-Wohl and Todd (2015) identify counties in the US that have mortality rates for American Indians that exceed national averages.

[2]Status Indians are individuals who are governed under the *Indian Act*. We discuss this in more detail in the next section. Generally the term First Nations person rather than Indian is preferred. However, to be consistent with legislation, we use the term Indian throughout.

[3]These findings are in line with Park et al. (2015) who find that mortality rates for all First Nations

the first researchers to calculate excess Status Indian mortality rates on and off reserve in Canada. We find that excess mortality rates are extremely high for the on-reserve population of Status females, almost five times the comparable non-Indigenous Canadian average. However, off-reserve, we see higher mortality rates for the youngest age groups we study. The Status Indian relative mortality rates are higher than for the Native American and African American population relative to non-Hispanics in the United States.[4]

The second result is that there is a large percentage of Status Indian men who are homeless and institutionalized which has a direct effect on the male to female Status Indian gender ratio. Using a novel method to estimate institutionalization and homelessness that combines Census and administrative data, we show that as much as 13 percent of the Status male population falls into one of these categories. These high rates of institutionalization and homelessness create a large imbalance in the gender ratio at ages where individuals would typically start families. By our calculations, between the ages of 20 to 55 there are approximately 8.5 Status Indian men to every 10 Status Indian women. Similar gender imbalances have been observed in the African American population in the United States (Wolfers, Leonhardt and Quealy, 2015) and have been shown to have significant effects on family formation and female well-being (Angrist, 2002; Chiappori, Fortin and Lacrouix, 2002; Charles and Luoh, 2010; Mechoulan, 2011). Based on prior literature, we suggest that this gender ratio imbalance could play a role in the high mortality rates of Status Indian women and girls and provide suggestive evidence consistent with this hypothesis.

The simultaneous finding of high rates of excess female mortality and gender ratios that are skewed in favor of women makes an important and general contribution to the

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peoples was at least twice the Canadian average and found slightly higher mortality rates for all First Nations women. Tjepkema et al. (2009) shows higher rates of mortality for Status Indian women and has closer estimates to our own but their findings are limited to women above the age of 25. In addition, our results extend over a greater time period than both these works. Health Canada (2011) presents mortality statistics by age group for 2001/2002 for a select geographical region.

[4]This is not simply due to relatively higher average non-Hispanic, non-minority American mortality rates.

literature on "missing women."[5] 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 excess female mortality (Sen, 1992; Klasen and Wink, 2002; Jha et. al., 2006; Das Gupta, 2005; Das Gupta, 2006; Erwin, Heerink, and Zhang, 2011; Duflo, 2012; Rosenblum, 2013).[6] However in our context, we see low male to female gender ratios in survey data, but very high rates of excess female mortality. This excess female mortality would go unnoticed if one looked at gender ratios alone; the extremely high rates of institutionalization and homelessness among the male population obscures excess female mortality when examining only gender ratios. This is a similar result as found by Anderson and Ray (2010) who identify excess mortality among women in developing countries with relatively balanced gender ratios; our results are novel in that we identify excess female mortality in a wealthy, developed country with gender ratio imbalances in favor of women (Anderson and Ray, 2010).

Our findings make three important contributions in the Canadian context. First, our findings may have implications for the recently called Canadian National Inquiry into Missing and Murdered Indigenous Women and Girls (The Economist, 2014; Amnesty International, 2015; Government of Canada, 2015; Levin, New York Times, 2016). The inquiry was called to investigate circumstances that have given rise to the extremely high rates of disappearance and homicide experienced by Indigenous women and girls. Our estimates of excess mortality and institutionalization and homelessness for Status Indian women and girls dwarf the estimates of the number of all missing Indigenous women and girls reported by the RCMP (2014). The rates of excess mortality of Status Indian women and girls between the ages of 10 to 30 alone average more than 3 times the numbers of reported missing or murdered Indigenous women and girls. In addition, off reserves,

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[5]The term "missing women" has been used differential in the demography, economics, and sociology literature than recently in Canada in the National Inquiry for Missing and Murdered Indigenous Women and Girls. The term missing in this 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 (Almond and Edlund, 2008; Almond, Edlund, and Milligan, 2009; Abrevaya, 2009).

Status Indian girls between the ages of 5 and 9 face mortality rates twice that of Status Indian boys of the same age. Our estimates suggest that the marginalization of Indigenous women and girls is much wider spread and systemic than commonly understood and likely due to sources beyond homicide that affect girls very early on in life. While we are unable to causally determine the extent to which factors such as poverty and poor access to health care may explain the extreme mortality rates for Status Indians, we do investigate the correlation between excess mortality and community-level employment rates, quality of housing and self-governance. While the results are noisy, we believe some of our findings merit further investigation. We also suggest that future work should investigate the role of the gender imbalance in causing excess female mortality.

Second, we provide a method for estimating institutionalization and homelessness for Status Indians in Canada and identify ages and genders where excess mortality is especially severe. This is a preliminary contribution to the broader need to develop indicators of Indigenous well-being which has been identified as a major policy issue in Canada (Truth and Reconciliation of Canada, 2015). Third, our findings may have implications for the continued existence of "Indians" as a political category in Canada due to the effects of gender ratio imbalances on exogamy (Pagnini and Morgan, 1990; Anderson and Saenz, 1994; Hwang, Saenz, and Aguirre, 1997). The relatively low numbers of non-institutionalized Status men with fixed addresses may affect the availability of suitable Status Indian partners for Status Indian women. This could explain the relatively high rates of out-marriage of Status women. At the current rates of out-marriage, the population eligible for Indian Status, and the rights and benefits associated, may cease to exist within five generations (Clathworthy, 2001, p.42). Thus our analysis provides potentially important insight into this emerging phenomenon that affects both genders of Indian peoples in Canada.

In the next section, we describe the Canadian context and then discuss the institutions that generate the data we use and the data itself. In Section 3 we discuss the methods we use to estimate the number of Status women and men affected by institutionalization,

homelessness and excess mortality. In Section 4 we present our main results and in Section 5 we expand upon our main results and discuss their implications. We conclude in last section.

2 A Brief Background on Indian Status and Data Description

2.1 The Status First Nation Population in Canada

As of 2011, the Status Indian Population in Canada was approximately 637,660 which represents roughly 75 percent of the total North American Indians in the country (the more accepted term in Canada is First Nations but we use the terms here consistent with legislation and the survey sources).[7] Overall, this figure represents two percent of the Canadian population (Statistics Canada, 2013). The legal definition of Status Indian confers certain rights and benefits. For example, Indian Status confers the right to live on reserve, vote in band elections, receive money from one's band, and own or inherit property on reserve (Furi and Wherrett, 2003).

Indian Status has also historically limited other rights and access to benefits available to non-Status peoples. In order to be granted certain rights, individuals had to give up their Status. For example, until 1960 an Indian had to give up their Status in order to vote in a Canadian election (Government of Canada, 2011). While virtually no one gave up their Status between 1867 and 1918, after a change in legislation approximately 2 percent (2400 people) applied for and received enfranchisement between 1919 and 1939 (Brownlie, 2006). The 1954 Indian Affairs departmental report suggests almost 800 people were enfranchised in that year alone (Canada, 1955). Individuals could also be involuntarily enfranchised if they earned a university degree or became a doctor, lawyer or

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[7]The remaining Indigenous people are not considered Status for various reasons. They may have never formally applied. Others may not meet the full legal requirement for Status yet still either ethnically, culturally or politically identify as First Nations.

clergyman (Furi and Wherrett, 2003). Indian Status could also be lost through marriage.

Historically, under Canadian federal rules the male lineage has been privileged in determining who was legally classified as an Indian. The *Indian Act* of 1876, which consolidated previous laws regarding Indians, dictated that if an Indian woman married a non-Indian man she would lose her Status as an Indian and her children would not be entitled to Status. For Indian men, if they married a non-Indian woman, the woman would gain Status and their children would be entitled to Status as well. The 1951 revisions to the *Indian Act* maintained the loss of status for Indian women who married non-Indian men (paragraph 12(1)(b)). The 1951 revision also introduced the double mother clause under which a person registered at birth would lose status and band membership at age 21, if his/her parents had married after the new legislation came into effect in September 1951 and his/her mother and paternal grandmother had acquired status only through marriage (subparagraph 12(1)(a)(iv)) (Hurley and Simeone 2010, p. 2). In 1985, Bill C-31 removed the double mother clause and re-instated the status of women and their children who had previously lost it. If a woman was entitled to registration prior to the 1985 changes to the *Indian Act* and lost their Status due to marriage to a non-Indian, then they regained it. Her children may be entitled for Status after the change as well. Approximately 117,000 individuals (of both genders) regained their status due to the changes induced by Bill C-31 as of 2010 (Hurley and Simeone 2010; Indian and Northern Affairs, 2009).

However, Bill C-31 did not remove all gender discrimination from the act. A further step came in 2011 with Bill C-3 (Gender Equity in Indian Registration Act). After this revision to the *Indian Act*, if an individual's grandmother lost her Indian status as result of marrying a non-Indian and their parents became eligible for registration under sub-section 6(2) of the 1985 revised *Indian Act*, then this Individual who would have previously lost Status, regained it due to Bill C-3.[8] As a result of Bill C-3, as many as

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[8]There are date of birth restrictions that complicate matters, but we omit discussion of this here for simplicity.

an estimated 40,000 will regain status (Hurley and Simeone 2010).

These changes in the Status Indian population, as well as gender composition over time time can be seen in Figure 1. The Status population has been growing consistently, with a significant change in the gender composition after 1985 (as would be expected given rules about out-marriage). By the late 1990s the gender ratio began to stabilize. The legislative change in 2011 increased the number of Status Indians in approximately equal numbers across gender.

2.2 Data Description

The two primary sources of data are administrative data from the Indian Register and from the Canadian Long-Form Census. We use other data sources to supplement our analysis; however, the majority of data we use comes from these two primary data sources.

2.2.1 The 2001 and 2006 Census, and 2011 National Household Survey

We use the 2001 and 2006 confidential long-form Census and the 2011 National Household surveys to establish the Status Indian population counts. The 2001 and 2006 Canadian Censuses enumerate all households on census day and provide a snapshot of the Canadian population. The Canadian Census contains a long and short-form survey. All households and communal dwellings receive the short-form which collects only the most basic demographic information such as gender and age. While the short form Census is distributed to everyone in the population including those in institutions and shelters, the long-form Census is only distributed to 20% of households off Indian reserves and outside remote areas. The long form Census is provided to 100% of the households on Indian reserves and in other remote areas. The long-form includes a rich set of information on households including whether the individuals can be categorized as Status Indians. We use Census years that ask long-form Census households whether each person in the household is a Treaty Indian or a Registered Indian as defined by the *Indian Act* of Canada. A Treaty

Indian is someone who is a member of a First Nation who has a treaty with the Crown. Treaty or Registered Indians are also called Status Indians (Statistics Canada, 2015). The long-form Census does not identify Status Indians residing in institutions such as correctional institutions, shelters, institutions for people with psychiatric conditions, and long-term care facilities. People without a fixed address with also not receive the long-form Census. As such, the Census count of Status Indians will miss those that are located in institutions or are without a fixed-address.

The National Household Survey (NHS) was entirely optional and replaced the mandatory Canadian Census questionnaire in 2011. Approximately one-third of the Canadian population were invited to participate in the National Household Survey in 2011 while 100% of the population on Indian reserves were invited to participate. As a result of this change between the long-form Census and the NHS, the response rate for the NHS was only 69% (a weighted response rate of 77%) while it had been approximately 94% for the long-form Census (Statistics Canada, 2012). Additionally, there was a change in the eligibility to qualify as a Status Indian starting in 2011 which would confound any comparisons between previous Status Indian populations. These factors work in conflicting directions and would effect our estimates of institutionalization and homelessness in an unknown way. Thus, due to the lower response rate, the possibility of selection-bias, and the change in the Status Indian population, we do not use the 2011 NHS in the analysis that follows other than in Section 5 to compute gender ratios.[9]

While censuses are intended to enumerate the entire population, an individual may not be included for a number of reasons. First, individuals may decide not to fill out the Census form or they may misreport information on the form. In both 2001 and 2006, not responding and misreporting information was illegal in Canada and we assume that any information reported in the Census data for these years is accurate. Those who do not fill out their census forms or misreport face fines up to 500 dollars or 3 months in prison. One exception to this would be the non-participation of a number of entire Indian reserves,

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[9]Its inclusion does not affect the results.

most noticeably in Ontario.[10] A number of reserves and settlements refused enumerators entry to their communities in 2001 and 2006 based largely on sovereignty grounds and thus entire reserves were not enumerated. We account for these non-enumerated reserves in the analysis that follows.

Individuals who have migrated abroad will also not be enumerated and will therefore not be counted in the Census. While there are many potential destinations for Canadians, the United States is the most frequent. Examining the migration flow of Canadians to the US indicates that these migrants are highly educated and tend to be concentrated in the knowledge-based industries (Dion and Vezina, 2010). Given the average characteristics of both groups, it is unlikely that Status Indian men comprise a large proportion of migration from Canada to the US. While we cannot speak directly to the characteristics of the Status population living in the United States or elsewhere, we will form some estimates of the degree to which Status peoples may migrate to the US using some administrative records from INAC by gender.

Third, the long-form Census will miss individuals with no fixed address and does not collect information on individuals living in shelters or in other institutions. This means Status Indian men or women in these institutions or who are homeless will not be included in official Census population counts.

Finally, a person may not be included in the Census if they are deceased. Vital statistics data on the Status Indian population is sparse; however with access to administrative records of deaths and the Indian Register discussed below, we attempt to identify the extent to which mortality may explain differences between the Status Indian population and the Canadian population as a whole.

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[10]Some large Indian reserves refused to participate in the Census some years. This issue and how we deal with it is discussed more in the data section.

2.2.2 The Indian Register Population Counts and Records of Death

We use two data sources that are available from Indigenous and Northern Affairs Canada (INAC), the Canadian Federal agency overseeing Indian peoples in Canada. The Indian Register is an administrative branch of INAC which manages all Indigenous affairs at the federal level. Since confederation, the Canadian government has perceived Indigenous peoples as wards of the state for whom it has the responsibility of managing, defining and documenting. In 1951, a centralized Indian Register was established which consolidated all existing band membership data into a single list. Everyone who is classified as a Status Indian is on the list no matter where they live and whether they are institutionalized or not. All death events must be reported to the Indian Register in order execute a will of a Status Indian or make other arrangements for the administration of their estate. Indian governments are also required to submit death certificates to INAC as part of funding requirements.

The first data set is the Indian Register which provides the official record identifying all Status Indians in Canada (INAC, 2010). The Indian Register provides population counts for all Status Indians for each year from 1975 to 2015 in 5-year age groups, gender, place of residence (whether they live on or off reserve) and First Nation.[11] Thus all Status Indians will be included in the register whether they are institutionalized, homeless or living outside of Canada.

We use death event data from the Indian Register as our second source of data. We combine this with Indian Register population counts to estimate Status Indian mortality by gender and age group. Unfortunately, death event data collected by INAC does not contain many demographics nor does it contain the cause of death (the data includes age, date of death, gender, band of membership, location and marital status, but not the cause of death).

While the Indian Register should contain the official count of Status Indians, there are

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[11]The 5-year age groups are not available for 1987 and 1989.

often delays in the reporting of births or deaths that may lead to some discrepancies in the data. The register relies on band authorities to report deaths to the federal government (INAC). In the cases where registered members live off-reserve, or are hard to trace, the band authorities may not, as a result, receive their birth or death certificates. Because the delays in reporting births average about 3 years and infants that pass on before they are registered are not required to have a death certificate submitted on their behalf, we view our information in this age range as quite poor. At older ages, mortality rates are very non-linear in age (the mortality rate at 65 is very different than the mortality rate at 69), so we omit it from our analysis here. For these reasons we focus on ages 5 to 64, as we believe within these ranges, the reported mortality represents a reasonably accurate picture of actual death events. We present evidence of this in Appendix Figure A1, where we compare the available Status Indian mortality rates constructed by Health Canada vital statistics to our computed mortality rates from the Administrative data. The data from Heath Canada is only available in a few selected provinces and geographical areas that collected data on Indian Status and is only available for 2001/2002. While there seems to be a significant amount of under reporting of mortality between the ages of 0 to 4, our mortality rates are roughly the same as those of vital statistics up until the ages of 25 and up where our estimates of mortality are slightly lower. We find a slight gender bias where the mortality rates of Status Indian girls between the ages of 5 and 9 are under reported in the Register. This implies any excess mortality and gender bias we estimate will be underestimates of true mortality.[12]

We use mortality data for the Canadian population available from Vital Statistics at Health Canada in order to estimate relative mortality rates between Status Indians and the Canadian average.

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[12]This possible under counting of deaths in the register may mean we under estimate mortality and over estimate the institutionalized population. In order to account for this we form estimates of the degree of under counting. Overall it has little effect on the results. We discuss the process for doing this in the Appendix Section A and report the estimates in Appendix Table A1.

3 Methodology

Our analysis focuses on identifying two dimensions of marginalization for Status Indians in Canada: institutionalization and homelessness, (which we are unable to separate) and excess mortality. We discuss how we estimate each of these categories below. While our methodology for estimating institutionalization and homelessness is particular to the Canadian context, some of our methods may be transferable for calculating similar statistics for other Indigenous populations elsewhere in the world.

3.1 Estimating the Institutionalized and Homeless Population

Let $\eta_{a,t}^R$ and $\eta_{a,t}^C$ be the Indian Register and Canadian Census population counts respectively which are allowed to vary by gender, age and time period. Let $\eta \in [m, f]$ where m denotes males and f denotes females, and let a denote the age group for the population count. Note that for our purposes $a \in [0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 54, 60]$ where each number denotes the lower bound of each age group.[13] Let t equal the year in which an individual is observed.

The unique aspect of the Canadian Census Data and the administrative data from the Indian Register is that they have a clear theoretical relationship.[14] While the Indian

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[13] We also do not estimate the institutionalized or excess mortality for those over the age of 65 or under the age of 5. We do not consider those over the age of 65 because of the data available and because our estimates of the institutionalized or homeless population in this age group may not be a meaningful measure of marginalization. For example, if someone is in a hospital, nursing home, or hospice at advanced ages they would also be counted as institutionalized. Arguably, presence in these types of institutions are more measures of inclusion rather than exclusion. We exclude the under 5 age group for reasons elaborated on below.

[14] Note that between the ages of zero to four, there is a discrepancy between the Census and the Indian Register (the Census reports far more registered Indian children than the Indian Register does). This is because children entitled to status are not immediately entered into the register at birth, but parents may report the child in the Census as a registered Indian because they are aware the child is entitled to status and is likely in the process of attaining it. The average lag in the register of the reporting of birth is approximately 3 years (Health Canada, 2011). While we are able to correct for the average late reporting of death (1.5 years) because of the data we have available, we cannot directly correct for late reporting of births. So instead, we adjust the Indian Register counts in the 0-4 age category in year t by adding the population count of the 5-9 age category in year t+5, minus the reported population in the 0-4 age category in t. Otherwise, we make no adjustment to the register for late reporting of Status because we predict that late discovery of eligibility for status in life would show up in both the register and the Census within the same time frame.

Register includes all individuals that are Status Indians, the long-form Census data only includes a subset. We can express the relationship between the population counts in these two data sets as:

$$\eta_{a,t}^R = \eta_{a,t}^C + \eta_{a,t}^H + \eta_{a,t}^A + \eta_{a,t}^{NE}. \tag{1}$$

Where the population count of the number of individuals that have emigrated abroad is denoted by $\eta_{a,t}^A$, the population count of individuals whose reserves did not participate in the census is denoted as $\eta_{a,t}^{NE}$, and the population count of individuals that are without a fixed address or are institutionalized as $\eta_{a,t}^H$. Thus, given administrative data for both those Status Indians living abroad, and the population sizes of those reserves that did not participate in the Census by gender and age group, simple algebra implies we can infer $\eta_{a,t}^H$ if we have Indian register and Census population counts.[15] Below we discuss how we construct estimates of those living abroad $(\eta_{a,t}^A)$ and not enumerated in the Census from administrative data. Once we have these estimates, we can back out the number of institutionalized and homeless individuals by gender and age group by re-arranging Equation 1 into the following:

$$\widehat{\eta_{a,t}^H} = \eta_{a,t}^R - \eta_{a,t}^C - \widehat{\eta_{a,t}^{NE}} - \widehat{\eta_{a,t}^A}, \tag{2}$$

where the estimates of the variables in Equation 1 are denoted with hats. We use Equation 2 to provide estimates of the institutionalized and homeless population. In our results section and in the appendix, we also show how our estimates of the homeless and institutionalized population would change if we allowed for varying degrees of non-compliance in filling out the long-form Census.

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[15]Note that in the appendix we describe an additional potential component, over-count of Indians in the Indian Register due to non-reporting of deaths to the federal agencies. Our analysis does not change substantially due to the addition of this addition component. See Appendix Table A1 for these estimates.

3.2 Non-Enumeration in the Census (Estimating $\eta_{a,t}^{NE}$)

We adjust the Indian Register counts by excluding population counts of Status Indians that did not participate in the Canadian Census. The confidential-use Census data allows us to identify the communities and bands that are not enumerated in the Census, and we are thus able to remove these individuals from the Indian Register data. In 2001, 30 reserves were not included in the Census and in the 2006 Census, 22 reserves were not included. Some of the excluded reserves are quite large, including the reserve with the largest population in Canada; Six Nations 40 which has over 25,000 members with approximately half living on-reserve. The vast majority of individuals who chose not to participate are from the province of Ontario.

Appendix Table A2 reports the number of individuals excluded from the register. Depending on the year we exclude as many as 48,350 individuals. In our estimates, we make various assumptions regarding response rates. While our baseline estimates assume only those living on reserves did not fill out the Census, in the appendix we make the extreme assumption that all individuals who were members of bands who were associated with reserves that were not enumerated did not fill out the Census. We show these results for two reasons. First, it provides more conservative estimates of the homeless and institutionalized population. Second, it seems to be a plausible assumption given the observed response rates of communities when the Census is viewed as optional.[16] If band members interpret their reserves not participating in the Census as giving them legal immunity from filling out the census, then they may be less likely to participate.

3.3 Migration Abroad (Estimating $\eta_{a,t}^{A}$)

We also adjust the Indian Register data to account for individuals who are living outside of Canada. The Indian Register provides information on population counts by band,

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[16]The 2011 NHS is an optional survey and thus Statistics Canada published non-response rates by Census subdivision for this survey. These non-response rates can be matched to reserves. In the communities that did not participate in the Census the year before, response rates were extraordinarily low: sometimes as low as 6% (Statistics Canada, 2015).

gender, place of residence, and year (but not age group) of the numbers of Status Indians living outside of Canada. We use these counts to estimate the number of Status Indian people who are included in the Indian Register data but would not be included in the Census since they are outside of the country. In order to estimate this by age group, we use recent reports on the age distribution of Canadians living in the United States to back out the Status Indian counts. Finnie (2006) reports that 1 in 1,000 Canadians leave Canada in a given year. While not strictly comparable, the Indian Register data suggest that in 2006, approximately 16,000 Status Indians were residing outside Canada or nearly 2% of all Status Indians. For these numbers by gender and age group, see Appendix Table A4.[17]

3.4 Estimating Excess Mortality

The second dimension of marginalization we are interested in estimating is the mortality rates of Status Indians by gender as compared to the average Canadian at similar ages. Both male and female counts from the register and the Census will exclude people that have died. There is substantial evidence that Status Indians are more likely to suffer from premature mortality than the Canadian population as a whole (Health Canada, 2011; Park et al., 2015). The death event data from the Indian register allows us to account for the number of men and women by age group and year that suffer from "excess" mortality. Excess deaths are estimated by calculating the number of Status Indian people that would have died if they had similar mortality rates as the general Canadian population by gender and age group. We estimate the "excess" deaths in the following equation:

$$\eta_{a,t}^{AD} = \eta_{a,t}^{RD} - (\eta_{a,t}^{RD})/(\phi_{a,t}^{r}/\phi_{a,t}^{CAN}). \tag{3}$$

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[17]Once one excludes reserves that did not participate in the Census from these migration counts, the estimated Status Indians living outside of Canada falls to only approximately 9000 individuals. It is these adjusted numbers that are reported in Appendix Table A4.

In the equation above let $\eta_{a,t}^{RD}$ denote the population counts of Indians who are recorded in the Indian Register data. The term $\phi_{a,t}^{CAN}$ indicates the estimated mortality rate of average Canadians in age group a at time t, and $\phi_{a,t}^{r}$ is the estimated mortality rates of Status Indians.[18] The variable $\eta_{a,t}^{AD}$ denotes the number of Status people by each gender and age group who would not have died in that year if they had mortality rates similar to that of the average Canadian. While we report this number, we will generally report "excess" mortality as a ratio of the Status Indian mortality rate relative to the average Canadian mortality rate ($\phi_{a,t}^{r}/\phi_{a,t}^{CAN}$) rather than the number of individuals. We acquire the mortality rates for all Canadians using Statistics Canadas estimates of mortality from Canadian Vital Statistics birth and death databases and population estimates (Statistics Canada, 2015).

4   Results

4.1   Excess Mortality

In Figure 2 we present the ratio of the mortality rates of Status Indians and average Canadians by age and gender. For nearly all age groups over this time period, the Status Indian population had mortality rates double that of the average Canadian population. Excess mortality is especially pronounced under the ages of 35, notably for females. While the mortality rates for Status Indian boys between 10 and 14 are almost twice that of their Canadian counterparts, the mortality rates of Status girls the same age are 3.5 times higher that of their Canadian counterparts. These differences persist through the teenage years and into their 30s. To our knowledge, we are the first to identity these extremely high mortality rates at such young ages.

These findings are in line with Park et al. (2015) who find that mortality rates for all First Nation people were at least twice the Canadian average. They also find that First

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[18]In the appendix, we estimate excess deaths with an adjustment for the under-reporting of mortality to the Indian Register. While these estimates are larger and by a non-trivially amount, they are qualitatively similar.

Nations women had higher mortality rates than First Nations men[19]. However, their estimates of the relative mortality rates were only 2.00 for Indian men and 2.50 for Indian women and they attribute this to avoidable mortality. Tjepkema et al. (2009) estimates higher rates of mortality for Status Indian women which approach our estimates of approximately 3.5 between the ages 25-35. Their analysis, however, is unable to examine mortality rates for younger age groups as we are able to in our analysis. In addition, our results strengthen their findings as we see these differences persist throughout the first decade of the 2000s. These persistently high mortality rates for young Status girls and women suggest that more can be done to improve the conditions of this population.[20]

The raw mortality rates used to create Figure 2 are provided in Appendix Table A5. Schulhofer-Wohl and Todd (2015) find high female mortality rates for a few select counties in the U.S. 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, Wis., has ranged between the highest and fourth-highest among all counties in the 48 states.'' However, the mortality rate ratios presented here are substantially higher than for North American Indians and African Americans in the United Status. In Appendix Figure A2 we estimate the relative mortality rates by gender for African Americans and North American Indians from the National Center for Health Statistics.[21] While there appears to be slight gender bias against young African American men, and a gender bias against young North American Indian females, the patterns are not nearly as stark as what is observed among the Status Indian population in Canada.

Figure 3 provides a statistical test of differences between the Status male and female mortality rates. As was shown in Figure 2, Status women and girls have higher mortality

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[19]First Nations includes all North American Indians, not just Status Indians

[20]Health Canada (2011) presents some statistics for western Canada and the Atlantic provinces that show results somewhat similar to our findings here, but they are region specific and the results are only presented in an appendix and not fully discussed.

[21]http://www.cdc.gov/nchs/hus/american.htmdeaths

rates than their male counterparts and as compared to the average Canadian. Figure 3 indicates that the relative mortality rates of Status women and girls are statistically higher than their male counterparts between the ages of 5 to 34. This difference is significant at the 95 percent level.

On average, we estimate that 530 Status males and 435 Status females suffered from excess mortality per year in our sample using Equation 3. Given that our sample excludes a number of very large reserves and individuals under the age of 5 and over the age of 65, this implies that there are probably over a thousand needless deaths of Status Indian people per year as compared to rates for the average Canadian.[22] We find that many of these deaths occur quite early in life. Approximately 110 females and 165 males die each year between the ages of 5 and 30 alone. To put these numbers into context, the number of missing and murdered Indigenous women and girls identified by the RCMP (2014) per year was about 37 from 1980 to 2012. Our estimate of excess mortality for Status Indian women and girls is almost three times the number of all missing and murdered Indigenous women and girls reported by the RCAP.

4.2   Institutionalization and Homelessness

Having no fixed address or living in an institution also obscures the true size of the Status population; homeless or incarcerated Status Indian people will not be included in any Census population counts. Figure 4 shows the estimated institutionalization rates by gender for Status Indians using Equation 2 and assuming full compliance with the long-form Census.

The patterns of institutionalization and homelessness differ dramatically by gender as shown in Figure 4 below. While men and women below the age of 19 show similar rates of institutionalization or homelessness, between the ages of 20 to 44 Status Indian men are far more likely to be counted as institutionalized or homeless and nearly 3 times as

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[22]This is averaged over 2000 to 2012 and calculated using Equation 3. These counts are only for those Status Indian communities that participated in the Census. If we include the individuals that did not participate, the average number of excess deaths are 580 for males and 460 for females.

likely in certain age groups as compared to Status Indian women. However, according to our estimates there are still a significant number of women and youth living in marginal or institutional circumstances. Given the fact that Status Indian youth are dramatically over-represented in the child welfare system, the results regarding youth are plausible.

Table 1 reports these estimates averaged over 2001 and 2006 under various assumptions regarding participation in the Census. The first two columns of estimates correspond to Figure 4. The first section of the Table assumes that there was no participation in the Census enumeration for any members of bands that decided not to participate in the Census whether they lived on the reserve or not. The first column of Table 1 assumes that there is full compliance with the Census, the next two columns assume a 95 percent compliance rate (which is approximately the compliance rate of the population as a whole), and the last two columns of the first panel assume a 90 percent response rate. Appendix Table A3 repeats the assumptions about response rates, but now assumes that only band members who lived on reserve (and are from a reserve that decided not to participate in the Census enumeration) did not fill out the long-form Census. The proportion of the Status male population institutionalized or homeless in this category is approximately 13 percent of the population.

Determining the true size of the Status incarcerated and homeless population depends heavily on which Census response rate we choose. We believe the most realistic assumptions yield an estimate of somewhere between 18,000-30,000 Status men and 4,000-20,000 Status women between the ages of 5 to 65 not having a fixed address or living in an institution. While this may seem like a large range, further information may be gleaned from other data sources on institutionalization and homelessness. Using data from Juristat, collected from CANSIM Tables 251-006 and Tables 251-005 we aggregate the number of Youth and Adults in Canada that were either Federally or Provincially incarcerated in 2001/2002 and 2005/2006. We then use survey data from admissions to provincial custody on Aboriginal identity and gender (CANSIM Tables 251-0022) to infer the percent of Status Indians that are incarcerated assuming 50 percent of those with Aboriginal

identity were Status Indians (as in the general population). Under those assumptions, an average of 2,765 Status Indian men were currently incarcerated and 340 Status Indian women were incarcerated at those times. However, this does not count anyone in local city jails. The estimated flow of custodial admissions to the provincial system of people that were Status Indians was approximately 18,890 males and 2,320 females averaged between 2001/2002 and 2005/2006.[23]

However, incarceration and jail are likely only a small part of our estimates. Belanger, Awosoga, and Head (2013) use data collected from 18 Canadian city's homeless population counts to estimate the Urban Aboriginal homeless population. The study counted a total of over 20,360 homeless people of Aboriginal identity. If one assumes that 50 percent of these individuals were Status Indians (which is the same rate as in the general Aboriginal population) and 47.5 percent were men (Gaetz et. al., 2013), then this would mean there are approximately 4,835 Status homeless men and 5,345 Status homeless women in these cities alone. These homeless numbers exceed our lowest estimate for the number of Status Indian women and girls institutionalized or homeless (roughly 4,000 women and girls). This implies our lower bound on institutionalization and homelessness are likely conservative.

5   Discussion, Implications and Further Results

5.1   The Status First Nation Gender Ratio in Canada

One implication of the unusually high mortality rates for Status Indian females and for the institutionalization and homelessness of Status Indian males in Canada is that this will necessarily produce gender imbalances at different age groups. Existing research in other countries has shown conclusively that gender imbalances can result in increased criminality, alcohol, drug and physical abuse, as well as a reduction in marital status and

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[23]These numbers count admissions rather than individuals. Re-offenders may be counted multiple times.

fertility levels.[24] These findings would only exacerbate already dire conditions in First Nations communities in Canada. In our analysis below we document the existence of skewed gender ratios for the First Nations communities in Canada in favour of women. Our results show that, even given the existence of the relatively high mortality rates of Status Indian females at young ages, there are still proportionately more Status Indian males that are either institutionalized or homeless and hence do not participate in the marriage market or other social and political realms. Neither of these results are conducive to the successful long-run economic, social and political well-being of these communities. Documenting the magnitude and persistence of these effects is an important step in identifying a serious problem plaguing Status Indian communities.[25]

Figure 5 contains the gender ratio for the Canadian population and the Status population in the 2001 and 2006 Census and in the 2011 National Household Survey. In each year there are significant differences between the gender ratios in the Status population relative to the general Canadian population. However, these gender ratios are skewed in favour of women. In the figure below, there are approximately 93 Status males for every 100 Status females, while in general there are 97 Canadian males for every 100 Canadian females.

The fact that the gender ratio is lower in the Status population is surprising given the relative age distribution of the Status First Nation population relative to the rest of Canada and the National Inquiry on Missing Indigenous Women and Girls. At birth, the male-female gender ratio is typically above one meaning that there are more male live births relative to female live births (Dyson, 2012). Since the Status population is substantially younger than the Canadian population on average, we would expect the

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[24]For evidence of the effect of gender ratios on marriage rates, single parenthood, female bargaining power and labour force participation see Angrist (2002); Chiappori, Fortin and Lacrouix, 2002); Amuedo-Dorantes and Grossbard (2007); Brainerd (2007); Charles and Luoh (2010); and Mechoulan (2011). For evidence regarding the effects of gender ratios on crime, see Edlund et al. (2013) and South, Trent and Bose (2014).

[25]While we have not discussed this in detail here, most of the gender imbalance we have identified regarding institutionalization and homelessness likely occurs off-reserve. In fact, if one examines gender ratios on reserves, they tend to be skewed in favour of Status men. We leave the more detailed examination of this to later work.

Status gender ratio to reflect this birth pattern and have a relatively greater number of males.

In Figure 6 we calculate the average gender ratio in 5-year age groups averaged over the Census years 2001, 2006 and 2011 for all of Canada and Status Indians. The results indicate that there is relative parity in Canadians and Status Indian gender ratios up to 19 years of age. Above these ages, there is a drop in the Status Indian male-female ratio which reaches 0.8 by retirement ages, while it is still above 0.95 for the Canadian population in general.

It is immediately obvious from this figure that the skew in the Status gender ratio relative to the general population is attributable to the population over the age of 20 and the skew in the gender ratio becomes more dramatic in older age groups. Between the ages of 25 to 54 there are about 8.5 non-incarcerated men for every 10 non-incarcerated women. This is about the same gender ratio observed in the African American community in the United States (Wolfers, Leonhardt and Quealy, 2015).

The two figures taken alone would indicate that Status women are not facing as dire circumstances as Status men. However, we maintain that our results are consistent with the well-known missing and murdered Indigenous women phenomenon in Canada (RCMP, 2014). Our analysis shows that the population count of Status Indian males from the Census is smaller than that for Status Indian females; this difference in the population count can be attributed to the relatively high rates of male incarceration or homelessness. Both groups of Status Indians are facing adverse conditions; one is attributable to excess mortality while the other is due to institutionalization or homelessness. These are two different issues, but potentially related, that both deserve to be addressed.

5.2 Patterns and Correlates with Excess and Gender-Biased Mortality

Determining the causal effects of various social and economic factors on Status Indian mortality is beyond the scope of this paper. However, an important first step is to identify the factors that may be correlated with high mortality for the Status Indian population. We are unable to conduct a similar analysis for the institutionalized and homeless population because our estimates are only really sensible at the national level. On the other hand, our mortality estimates are available by band and place of residence (on or off reserve) which facilitates a more in-depth analysis of factors that correlate with high mortality for Status Indians.

Figure 7 reports the relative mortality rates by gender and age group reported earlier but in this figure, we split the results by whether the deaths occurred on or off of an Indian reserve. Mortality rates may differ by location on and off-reserve for many reasons given the well-documented differences in living conditions and the lack of access to basic health services on-reserve. We believe we are the first to show the differences in mortality rates between the on and off-reserve population of Status Indians. Similar to our previous results, the mortality rates for male and female Status Indians are much higher than that of the average Canadian regardless of whether they reside on or off reserves. Mortality rates on-reserve do appear to be higher for all genders from ages 10-34 as compared to their off-reserve counterparts. For young Status Indian women, mortality rates are over five times higher than the average female Canadian of the same age; the comparable rates for Status males are approximately four times higher than the average male Canadian of the same age. Off reserve, excess mortality rates are still very large, reaching over 3 and half times the Canadian average mortality rate.

In Figure 8 we test whether there are statistically significant differences between male and female mortality rates on and off reserves. The tests indicate that females have statistically higher mortality rate ratios up until about 40 years of age on reserve and

up until about 50 years of age off-reserve. The results for the 5-9 age group are notable: while girls on reserve do not appear to have higher relative mortality rates than their male counterparts in this age group, girls have significantly higher relative mortality rates off reserve. This is an intriguing puzzle and warrants further investigation.

In Table 2 we use information from INAC's First Nation Profiles to estimate the correlates of excess mortality by gender with some basic descriptive factors about the First Nation. The community profiles provide consistent measures of a number of important band characteristics such as the proportion of those with a Bachelors degree, the employment rate, the proportion of dwellings that are in need of repair, the degree of isolation of the community (an INAC provided measure), the latitude of the most populous reserve and its geographic region.[26] The community profiles are available for the years 2001, 2006 and 2011. We estimate mortality rates averaging over a five year period surrounding these years by gender and age. The dependent variables in these ordinary least squares regressions are the ratio of the mortality rate for the band relative to the average for a Canadian in the same province. We have separated our observations by band, age group and gender. It is important to understand the statistics presented in Table 2 as merely associative, rather than causal, statistics.

In the first column of Table 2 we find that higher employment rates are associated with lower and statistically significant rates of female mortality. On the other hand, a higher proportion of dwellings in need of repair is correlated with slightly higher female mortality rates. Both measures are related to economic development and are of the expected signs. We do observe that the proportion of individuals with a BA is negatively related to mortality for both males and females; however, it is not statistically significant in either case.

In the second column we find that the economic characteristics do not appear to be related in a statistically significant way to male mortality. This is a surprising result and

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[26]On the other hand, the community profiles do have some drawbacks. They are only generated for communities that participated in the Census, have population sizes greater than 40, and are able to be constructed for bands that have a clearly defined legal land base.

may be due to selective migration from reserves, high institutionalization rates or because the data is quite noisy at the First Nation level. The variable measuring whether the First Nation is self-governing is negatively related to male mortality and is statistically significant. Determining whether this is causal is beyond the current analysis but may indicate an important policy lever to be explored in future research. It is also notable that many of the geographic variables are correlated with both positive and negative male mortality ratios while only one was correlated for females. One final association indicates that the lack of road access to the closest service center (non-reserve city or town) is positively related to male mortality ratios. This result appears to indicate that the relative remoteness of reserves are associated with higher male mortality ratios. These findings build on the work of Tjepkema et al. (2009) and Park et al. (2015) who also show correlates with socio-economic characteristics and excess mortality at the individual level.

In Table 3 we explore the possibility that the rates of institutionalization and homelessness among men and their impact on the gender ratio may exacerbate excess female mortality. We conduct simple ordinary least squares regressions of excess female mortality on the gender ratio with the analysis separated by age. While hardly a test of causal mechanisms, we view this analysis as a first step in determining whether any relationships exist in the data. There are several types of endogeneity problems in this analysis and we do not intend to address all of them for the time being. However, we do run these regressions at the provincial level so that the individual band-level population sizes will have negligible effects on the overall Status Indian gender ratio. We estimate models controlling for the proportion of those with a Bachelor's degree, the employment rate, the proportion of dwellings that are in need of repair, and the degree of isolation of the community (an INAC provided measure) on reserves aggregated to the provincial level. We estimate mortality rates averaging over a three year period by gender and age. The dependent variable in these ordinary least squares regressions is the ratio of the mortality rate for Status Indians relative to the average for a Canadian in the same province.

Table 3 presents these associative results and presents models for the relative mortality of women above the age of 40 and under the age of 40.

The most relevant column in Table 3 is the first one, where we observe a strong negative relationship between the gender ratio and female mortality. The more men there are relative to women, the more scarce women are and the greater the possible relationship option for Status Indian women with Status Indian men. Prior literature would suggest that higher gender ratios should raise the bargaining power of Status Indian women within relationships and provide them with more alternatives for partners. These associative results are in line with the hypothesis that the lack of available Status Indian males make Status Indian women more vulnerable to violence. We do not see this relationship for women over the age of 40 who are outside the typical range of family formation. While this result is consistent with several theoretical frameworks and empirical results (Angrist, 2002; Chiappori, Fortin and Lacroix, 2002; Brainerd, 2007; Charles and Luoh, 2010; and Mechoulan, 2011), it is inconsistent with the work that shows a positive relationship with the male to female sex ratio and increasing violence (South, Trent, and Bose, 2014). However, there is a great deal of further work to be done to determine the relationship between the gender ratio and female mortality in the Status Indian context. We leave this to future work.

Many of the socio-economic factors significant at the band level for the on-reserve population are no longer significant at the provincial level when the off-reserve mortality rates are included. We also notice that Alberta, the excluded province, has higher levels of excess female mortality under the age of 40 relative to the rest of the provinces once the off-reserve population is included. We believe these findings warrant more investigation in future work.

6 Conclusion

We construct measures of two dimensions of social and economic deprivation for Status Indians in Canada: mortality rates, and institutionalization and homelessness. In comparison to the average Canadian, Status Indians are at a significant disadvantage. While most research has focused on gender imbalances and excess female mortality in developing countries, we demonstrate similar phenomena occurring within a large Indigenous community in a first world country.

First, we find extremely high levels of excess mortality among both Status men and women. However, Status Indian female mortality is almost four times the average Canadian female mortality rate between the ages of 10 to 29. To put this in the context of National Inquiry into Missing and Murdered Indigenous women and girls, we identify nearly 3 times more deaths of women and girls in this age range per year than the existing estimates of murdered and missing Indigenous women. For Status Indian males, the mortality rate is between 1 and 3 times that of their male Canadian counterparts. While the evidence is only suggestive, it appears that this gender bias in excess mortality is larger off reserves. Second, we find that there is a large number of Status Indians who are either institutionalized or homeless. We believe a reasonable estimate suggests as much as 7.5 percent of the Status Indian population is institutionalized or homeless. This estimate is extremely large when compared to the non-Indigenous population's institutionalization rate. In addition, since institutionalization and homelessness seem to disproportionately affect men, these channels of marginalization result in a gender imbalance in the non-institutionalized and housed population. This gender imbalance makes available partners more scarce for Status Indian women.

We show that excess mortality in the Status Indian population is significantly larger on reserves and that excess mortality is associated with socio-economic factors. We also provide suggestive evidence that the gender imbalance in the non-Institutionalized population is associated with excess female mortality. Female mortality ratios are lower in

communities with higher employment rates and higher in communities with poorer quality housing. Male mortality rate ratios are lower in communities that have self-governance agreements and higher in communities that are more remote. While we are unable to make causal assertions here, the correlations observed here are consistent with policies aimed at reducing poverty reducing excess female Status Indian mortality and increases in self-governance reducing male mortality. The extent to which different policies may differential impact male and female mortality is an important open question for future research and policymakers.

Compliance with Ethical Standards:
The authors declare that they have no conflict of interest.

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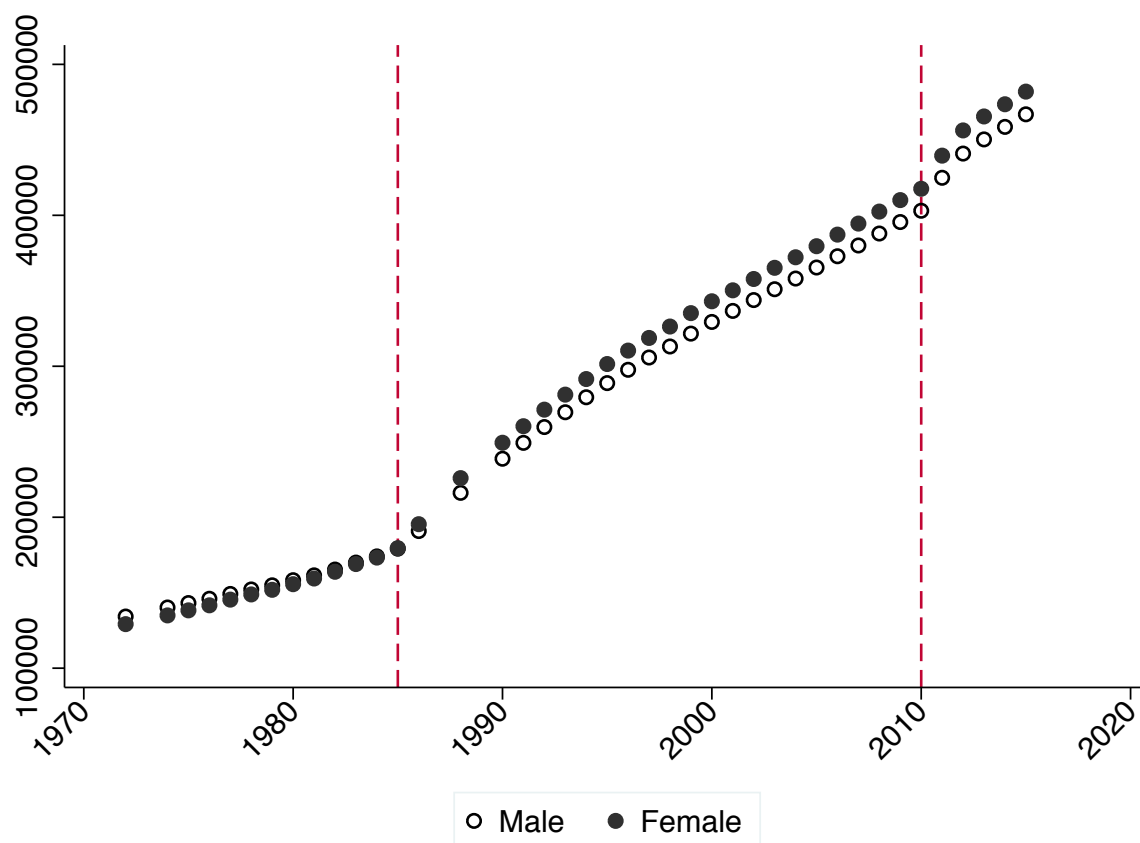
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Tables and Figures

Figure 1: The Status Indian Population Over Time

○ Male ● Female

Notes: These data are from the Indian Register population counts of Status Indians. Data are missing for 1973, 1987, and 1989 because of a change in data format for those years.

Online Appendix For "Excess Mortality, Institutionalization and Homelessness among Status Indians in Canada"

## A   Estimating Under-reported Deaths, (Estimating $\eta_{a,t}^{O}$)

If there is significant over counting of individuals in the Indian Register because their deaths are never reported, then taking the difference between the Census counts and the Indian Register counts may be uninformative regarding institutionalization and homelessness. In addition, if the death event data we acquired from INAC does not include all deaths in a given year the numerator in any mortality rate calculations will be incorrect. Since non-reported errors accumulate, the denominator in the estimates of mortality rates will be too large. Thus mortality rates will also be underestimated if deaths are not reported.

However, if we had accurate information on actual deaths in the Status population outside of those death events reported to INAC, we could make adjustments to the register count data. Unfortunately, Health Canada's Vital statistics data on Status Indians are sparse (Truth and Reconciliation Commission, 2015). Most provinces do not collect statistics of mortality by Aboriginal Identity or Indian Status; where data on Status Indians does exist they have not been collected for many years or all locations. However, there are some Heath Canada morality rates for Status people for the years 2001/2002 using data from the following provinces: Alberta, British Columbia and on-reserve in Manitoba and Saskatchewan (Health Canada, 2011).[27]

In order to estimate the amount of under reported deaths to the Indian Register, we make the strong assumption that the vital statistics data in these provinces and geographies can be applied to the rest of the country for the First Nations populations

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[27]Reporting of Registered First Nations status to the province for vital events is optional in Manitoba, Saskatchewan, and British Columbia but not in Alberta.

Figure 2: Mortality Rate Ratio (Status Indian Mortality per 100,000 divided by Average Canadian Mortality Rate per 100,000) averaged over 2000 to 2012 By Gender and Age
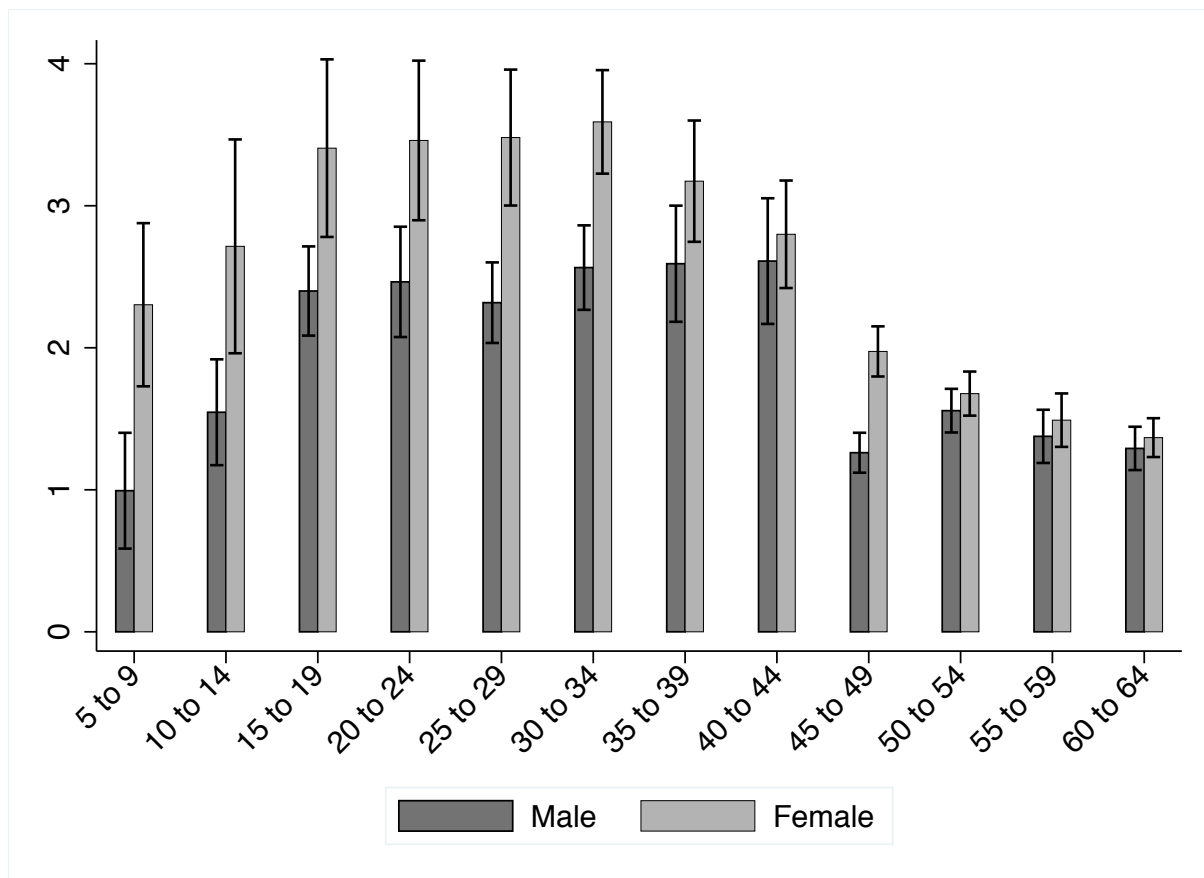

Notes: This figure shows the mortality rate ratio between Status Indians and all Canadians with their 95% confidence intervals averaged over 2000 to 2012. The data is from the Indian Register on population size and death rates by age and gender and from Vital Statistics data from Health Canada.

Figure 3: Difference between Women and Men in the Mortality Ratio of Status Indian Mortality / Canadian Mortality by Age Group averaged over 2000 to 2012
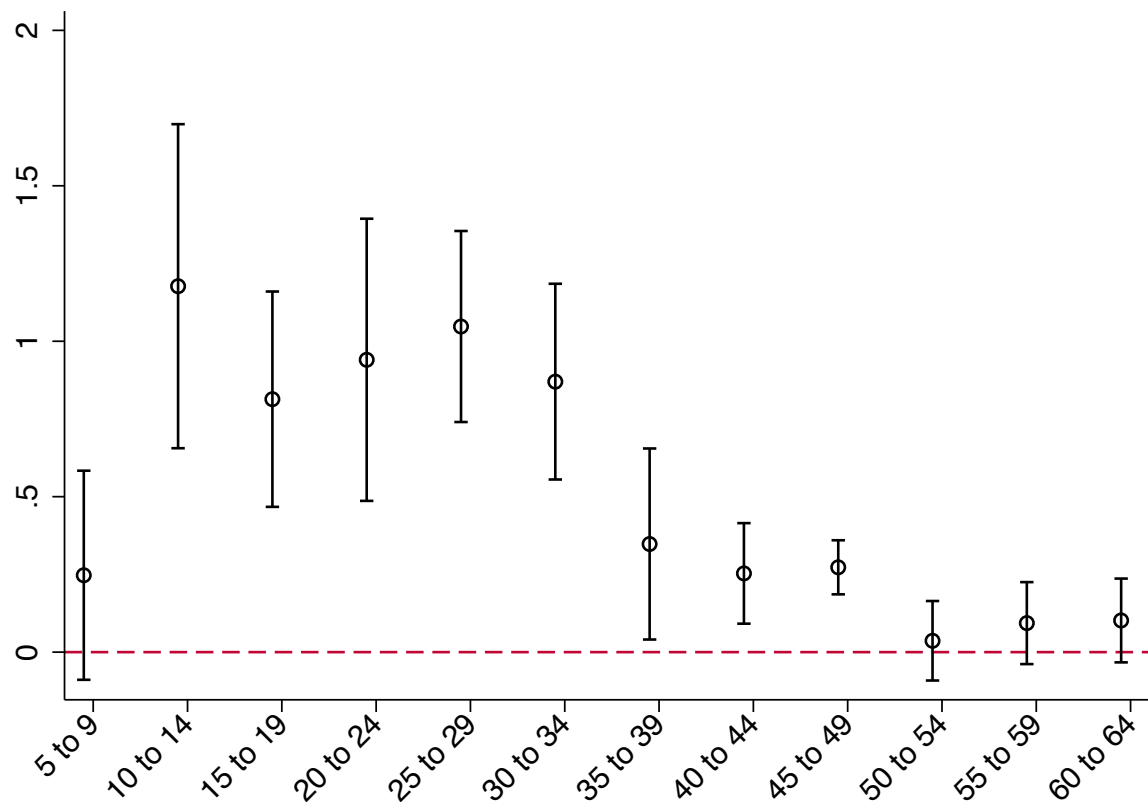
Notes: This figure shows the difference between women and men in the ratio of mortality rates between Status Indians and all Canadians with their 95% confidence intervals averaged over 2000 to 2012 using Data from the Indian Register on population size and death rates by age and gender and from Vital Statistics data from Health Canada.

Figure 4: Estimated Average Number of Status Indians by Gender and Age Insti-tutionalized or without a Fixed Address from 2001 and 2006
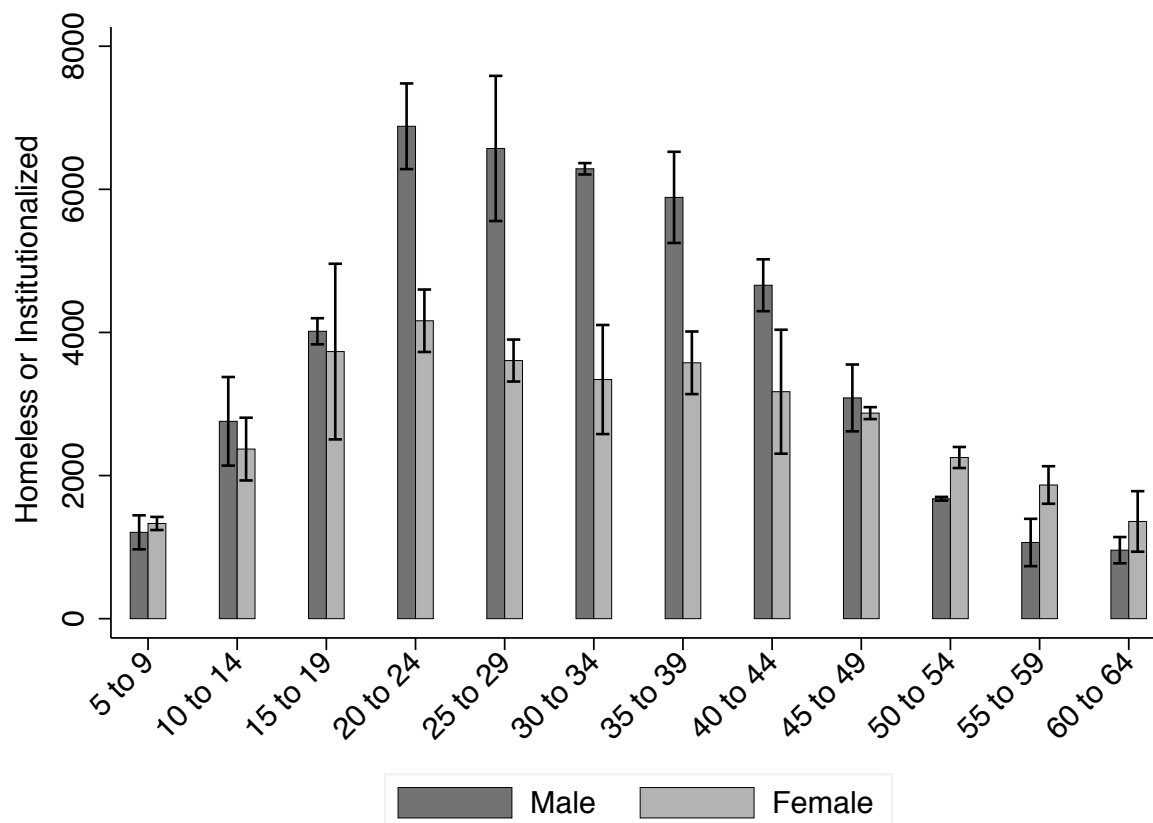

Notes: These results are calculated using Equation 2 assuming full compliance with the law after assuming that all members of bands who refused entry to their respective communities refused to participate in the Long form census. The results here are averaged over 2001 and 2006. The average count rounded to the nearest five. The 95 percent confidence interval is given for each data point in the histogram.

Table 1: Estimates of Institutionalized Population or those without a fixed Address

|	Average of 2001 & 2006 for all of Canada		Assuming a 95% Response Rate		Assuming a 90% Response Rate	
	Male	Female	Male	Female	Male	Female
05 to 09	1205	1330				
	(170)	(65)				
10 to 14	2760	2370	990	675		
	(445)	(315)	(585)	(230)		
15 to 19	4015	3735	2475	2255	770	615
	(130)	(885)	(75)	(720)	(310)	(535)
20 to 24	6880	4165	5730	2910	4455	1525
	(430)	(315)	(300)	(195)	(150)	(60)
25 to 29	6570	3605	5530	2420	4375	1095
	(730)	(210)	(720)	(185)	(705)	(150)
30 to 34	6285	3340	5240	2130	4080	780
	(55)	(550)	(45)	(555)	(30)	(565)
35 to 39	5885	3575	4835	2350	3665	985
	(460)	(315)	(430)	(320)	(400)	(325)
40 to 44	4660	3170	3680	2005	2595	705
	(260)	(625)	(120)	(785)	(35)	(960)
45 to 49	3085	2870	2270	1900	1365	820
	(335)	(60)	(145)	(140)	(70)	(365)
50 to 54	1675	2250	1045	1500	345	670
	(20)	(105)	(160)	(270)	(320)	(455)
55 to 59	1065	1870	590	1305	60	680
	(240)	(190)	(350)	(325)	(475)	(475)
60 to 64	955	1360	625	935	255	465
	(130	(305)	(60)	(235)	(15)	(155)
Total	**45050**	**33640**	**32415**	**20010**	**18375**	**4860**
	(1555)	**(1005)**	**(440)**	**(85)**	**(795)**	**(1295)**

Notes: *These results are calculated using Equation 2 under various assumptions of non-reporting to the Census. All these estimates assume no response only from those on-reserve from reserves that did not participate in the Census. The results here are averaged over 2001 and 2006. Negative numbers are suppressed and represented by a blank cell. The average count rounded to the nearest five is listed in the first row with its standard deviation below it in parenthesis.*

Figure 5: Male/Female Gender Ratio from 2001, 2006 Census and 2011 National Household Survey in Canadian Population and Status Population

Figure 6: Male/Female Gender Ratio by Age Group Averaged Over 2001, 2006 Census and 2011 National Household Survey
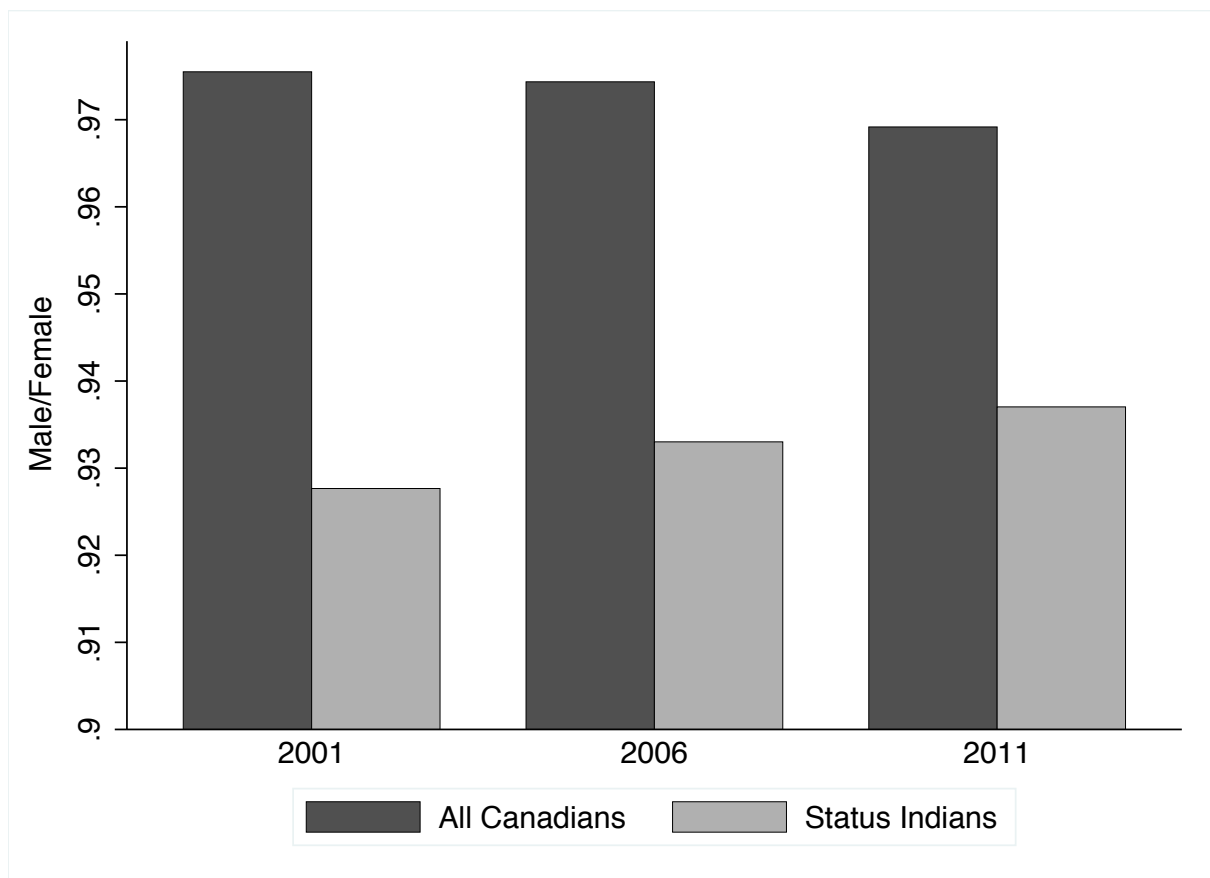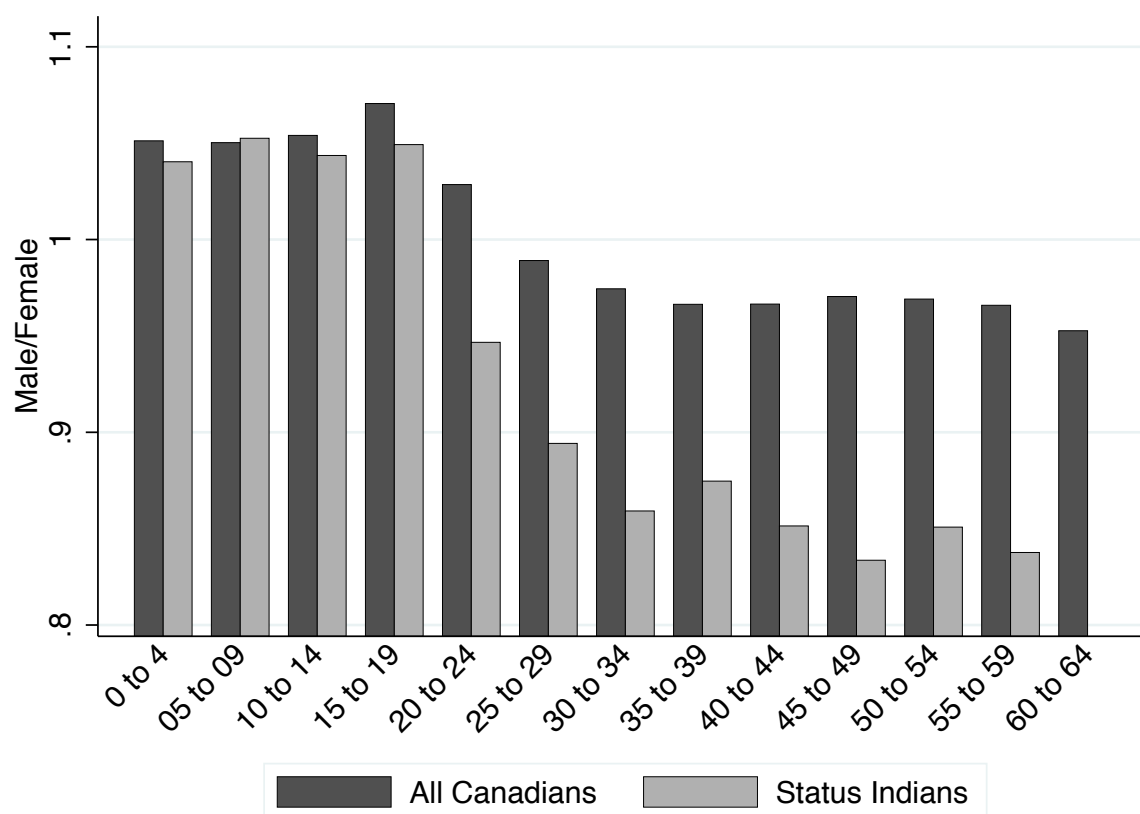

Notes: The data for these male/female gender ratios were acquired from the 2001 and 2006 Census and the 2011 National Household Survey.

Figure 7: Mortality Rate Ratio (Status Indian Mortality Rate divided by Average Canadian Mortality Rate) averaged over 2000 to 2012 By Place of Residence, Gender, and Age
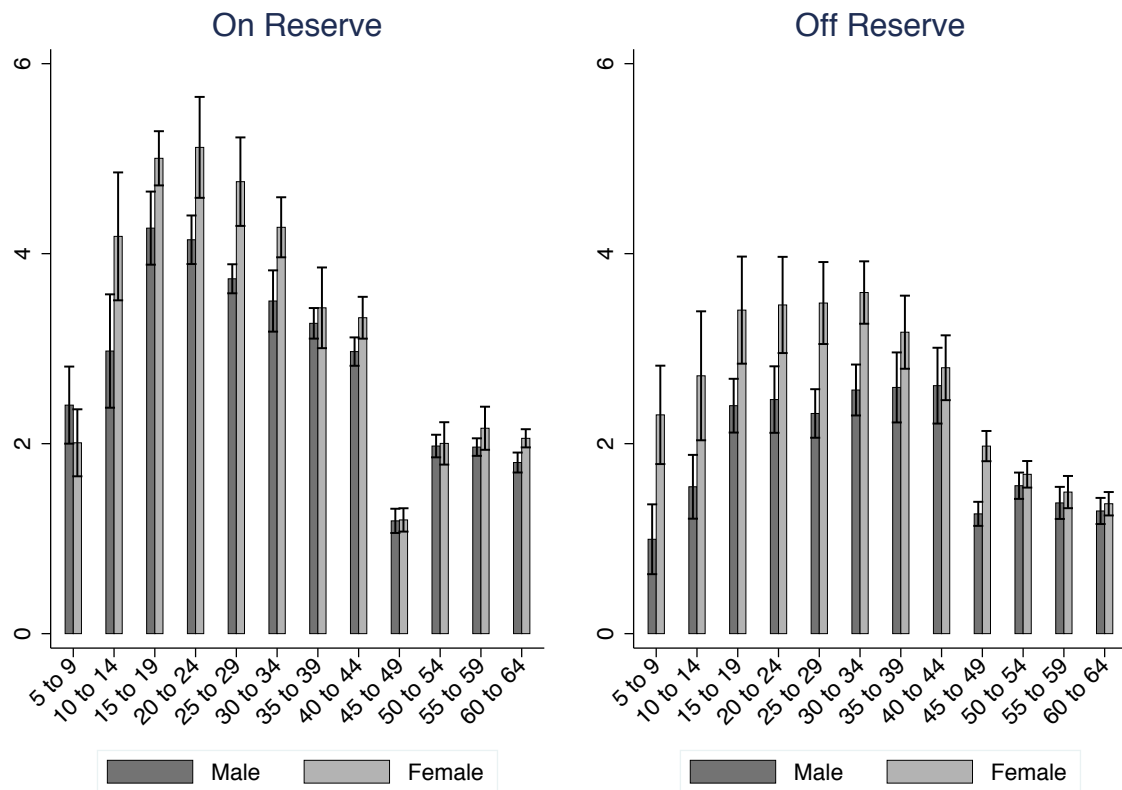
Notes: This figure shows the difference between women and men in the ratio of mortality rates between Status Indians and all Canadians with their 95% confidence intervals averaged over 2000 to 2012 using Data from the Indian Register on population size and death rates by age and gender and from Vital Statistics data from Health Canada. The title "on reserve" indicates the figure that provides the relative mortality rates calculated for the population reported to be living on legally defined reserve land and the title "off reserve" indicates the figure that provides the relative mortality rates calculated for the population reported to be living off legally defined reserves.

Figure 8: Difference between Women and Men in the Mortality Ratio of Status Indian Mortality / Canadian Mortality by Age Group and Place of Residence Averaged over 2000 to 2012
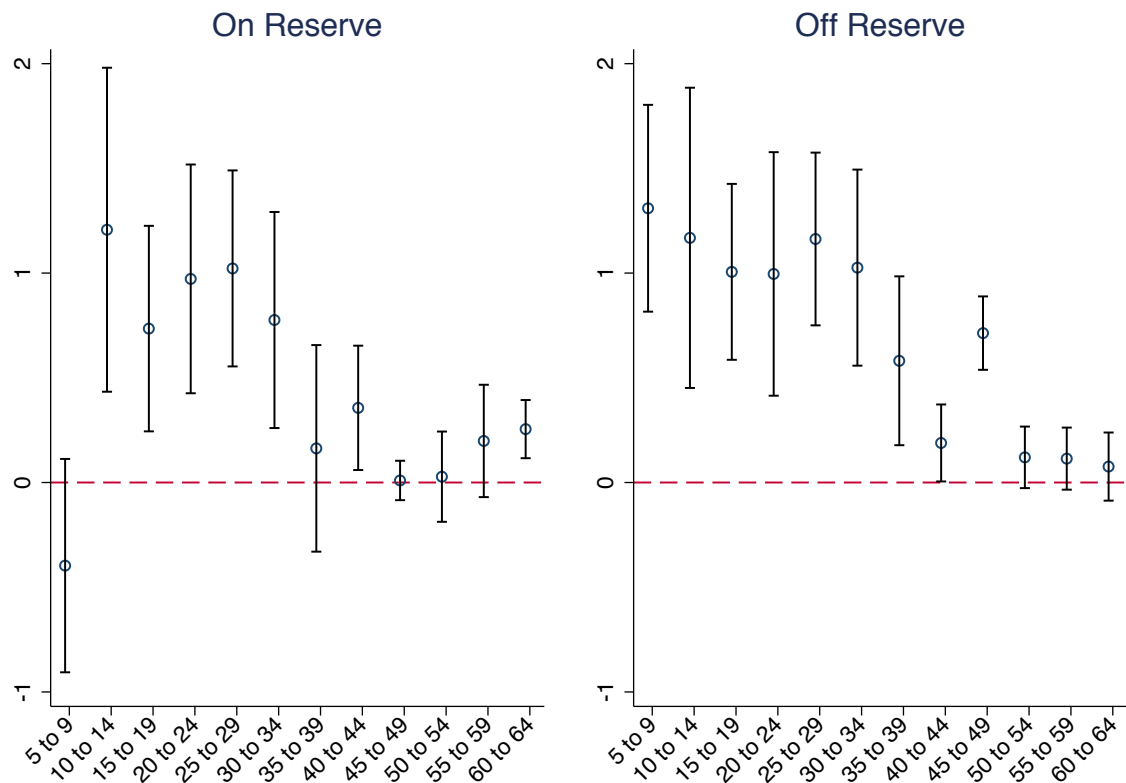
Notes: This figure shows the difference between women and men in the ratio of mortality rates between Status Indians and all Canadians with their 95% confidence intervals averaged over 2000 to 2012 using Data from the Indian Register on population size and death rates by age and gender and from Vital Statistics data from Health Canada. The title "on reserve" indicates the figure that provides the relative mortality rates calculated for the population reported to be living on legally defined reserve land and the title "off reserve" indicates the figure that provides the relative mortality rates calculated for the population reported to be living off legally defined reserves.

Table 2: Community-Level Correlates with the Relative Mortality Rate Ratio (Status Indian Mortality/Average Canadian) by Gender

	Female Relative Mortality Ratio		Male Relative Mortality Ratio	
Employment Rate	-0.035	***	-0.007	
	(0.01)		(0.01)	
Prop. of Dwellings Need of Repair	0.013	+	-0.004	
	(0.01)		(0.01)	
Prop. with a BA	-0.027		-0.035	
	(0.02)		(0.03)	
Self-Governance Agreement	-0.152		-0.573	**
	(0.35)		(0.25)	
Atlantic	-0.558		0.675	+
	(0.39)		(0.44)	
British Columbia	0.09		0.063	
	(0.41)		(0.33)	
Manitoba	-0.526	+	-0.413	+
	(0.34)		(0.26)	
Ontario	0.429		0.556	+
	(0.51)		(0.38)	
Quebec	-0.475		-0.718	**
	(0.41)		(0.28)	
Saskatchewan	-0.434		-0.593	**
	(0.33)		(0.27)	
Territories	-2.542	***	-2.823	***
	(0.38)		(0.27)	
50 to 350 km from service center	-0.352		0.425	
	(0.31)		(0.31)	
> 350 km from service center	-0.215		0.020	
	(0.54)		(0.37)	
No road access to service center	-0.266		0.473	+
	(0.37)		(0.31)	
Constant	2.883	***	2.677	***
	(0.74)		(0.78)	
Year = 2006	-0.149		-0.662	**
	(0.31)		(0.28)	
Year = 2011	-0.806	***	-0.868	***
	(0.26)		(0.29)	
R-squared	0.007		0.006	
N. of cases	15318		15318	

Notes: The coefficients of OLS regression where the units of observation by gender, band, age group and year. Mortality Rates for each band are average over a three year period centered on 2001, 2006 and 2011. The excluded province dummy is Alberta. All specifications include five year age group dummies and the standard errors are clustered at the age, year, and band level and are reported in parenthesis. Significant stars: + p < 0.10, * p < 0.05, ** p < 0.01, p < 0.001

Table 3: Province-Level Correlates with the Female Relative Mortality Rate Ratio (Status Indian Mortality/Average Canadian) by Gender and the Gender Ratio

	Under the Age of 40				Over the Age of 40			
	(1)		(2)		(1)		(2)	
Male/Female Gender Ratio	-2.135	**	-2.975	***	0.276		0.211	
	(0.89)		(0.94)		(0.91)		(0.97)	
Atlantic	-1.738	***	-1.393	+	-0.687	*	-0.393	
	(0.50)		(0.94)		(0.38)		(0.75)	
British Columbia	-1.710	***	-2.176	+	-0.361		-0.758	
	(0.34)		(1.38)		(0.38)		(0.74)	
Manitoba	-2.082	***	-4.789	***	-0.459		-1.097	
	(0.34)		(1.72)		(0.40)		(0.99)	
Ontario	-1.123	***	-1.030		-0.614	*	-0.705	
	(0.40)		(1.28)		(0.36)		(0.72)	
Quebec	-2.460	***	-2.300	+	-1.050	***	-0.987	
	(0.38)		(1.40)		(0.38)		(0.78)	
Saskatchewan	-1.941	***	-3.121	***	-0.214		-0.533	
	(0.34)		(1.03)		(0.45)		(0.91)	
Territories	-3.088	***	-4.666	**	-0.926	*	-1.459	+
	(0.36)		(2.29)		(0.47)		(0.98)	
Year = 2006	-0.139		-0.623	+	-0.351	*	-0.303	
	(0.24)		(0.43)		(0.19)		(0.28)	
Year = 2011	-0.677	***	-1.053	***	-0.515	***	-0.474	
	(0.22)		(0.34)		(0.19)		(0.33)	
Employment Rate			-0.057				-0.010	
			(0.08)				(0.09)	
Prop. of Dwellings Need of Repair			0.069				-0.005	
			(0.05)				(0.04)	
Prop. with a BA			0.485				-0.031	
			(0.35)				(0.22)	
Isolation Index			3.110	+			0.963	
			(2.05)				(0.88)	
Constant	7.068	***	0.200		2.428	***	1.533	
	(0.90)		(5.20)		(0.77)		(4.35)	
R-squared	0.397		0.430		0.211		0.216	
N. of cases	167		167		120		120	

Notes: The units of observation are at the region, age group, gender and year level and the dependant variable is the female Status Indian mortality rate divided by the female average mortality rate. Mortality Rates for each band are average over a three year period centered on 2001, 2006 and 2011. All specifications include five year age group dummies and the standard errors are robust to heteroscedasticity and are reported in parenthesis. The "Male/Female Gender Ratio" is for Status Indians for each age group and is averaged at the province level constructed from the Census. The "Isolation Index" is the average for reserves in the province and is from 1 to 4, ranked from within 50km to their nearest city, 50km to 350km to over 350km to communities with no road access with higher numbers representing more isolation. Significant stars: + p < 0.10, * p < 0.05, ** p < 0.01, p < 0.001

and that Registered Indian Status is accurately reported to the Vital Statistics agencies in these provinces. We estimate the degree to which there is over-counting in the Indian Register data by applying these mortality rates to the full data. We will call these ratios between the INAC mortality rates and the vital statistics data "scaling factors." To create these scaling factors, we use the simple ratio rather than scalers estimated using an iterative methodology that adjusts the INAC mortality rates. These scaling factors can be seen in Appendix Figure 1. Between the ages of 0 to 4, there is a substantial difference in calculated mortality rates that appears gender biased. While the INAC mortality rates and the vital statistics mortality rates are approximately the same between the ages of 5 and 14, there appears to be a slight under reporting of male deaths from 15 on-wards that gradually magnifies with age. However, female deaths at younger rates (5 to 14) are under-reported at the 10 percent significance level. Either way, this gender biased under-reporting does not over-turn our main results.

To calculate an estimate of over counting in the register, let us begin with the assumption that the vital statistics ratio in the Health Canada data in 2001/2002 between the ages of 5-9 is correct and the mortality rates calculated in the Indian register (number of reported deaths to the population registered not adjusted for late reporting) for the same geographies are not inflated because the denominator is correct. This assumes that all infants that die between the ages of 0-4 that are registered have their deaths reported. We can see from Appendix Figure 1 that the infant mortality rates of Status Indians are far higher than those calculated from the INAC data. However this sort of un-reporting of mortality is unlikely to result in over-counting in the register since there is an average three year lag in registering a child for Status. If the child is never registered, then its death will not be counted in the register.

Given this assumption, the ratio of the vital statistics' mortality rate to the Indian register's mortality rate multiplied by the 5 to 9 population would give an estimate of the number of children whose deaths were not reported. Let the mortality rates in the vital statistics data for geography g be given by $\phi_{a,2001}^{vg}$ and the mortality rates

computed in the Indian Register for the same geography be given by $\phi_{a,t}^{rg}$. Thus the scaling factor we estimate would be given by $s_{5,2001}^{g} = \phi_{5,2001}^{vg}/\phi_{5,2001}^{rg}$. Then to compute the number of deaths not reported to the Indian Register for all of Canada we calculate: $\eta_{5,2001}^{O} = \eta_{5,2001}^{RD} \times s_{5,2001}^{g} - \eta_{5,2001}^{RD}$ where $\eta_{5,2001}^{RD}$ is the number of deaths reported to INAC of those 5 to 9 years of age in 2001 Canada-wide. We assume these deaths are not subtracted from the register until the following period. So $\eta_{5,2001}^{O}$ tells us the number of individuals we should subtract from the register in the 10-14 age group in 2006.[28]

Then, to compute the scaling factor for the mortality rates for all of Canada for those who were 10-14 in 2001 from the Indian register to construct the "over-count" estimate for the 10-14 age group in that year, which will then be used to extrapolate the estimate of the over-count for the same age group in 2006, we use: $\eta_{10,2006}^{O} = \eta_{10,2006}^{RD} \times s_{10,2001}^{g} - \eta_{10,2006}^{RD} + \eta_{5,2001}^{O}$. For the 15 to 19 age group in 2006, we could perform a similar method where $\eta_{15,2006}^{O} = \eta_{15,2006}^{RD} \times s_{15,2001}^{g} - \eta_{15,2006}^{RD} + \eta_{5,1996}^{O} + \eta_{10,2001}^{O}$ and $\eta_{5,1996}^{O} = \eta_{5,1996}^{RD} \times s_{5,2001}^{g} - \eta_{5,1996}^{RD}$.

We have performed the above-noted calculations for all age groups up to 25-29. Beyond that, we no longer have reported deaths nor can we observe population sizes of cohort's over time. Thus for age groups beyond 30 and under 65, we assume that the population sizes and mortality rates have the same distribution over age and genders as in 1971.

Appendix Table A1 shows the estimated over-counting in the register using this method between the ages of 5 to 64. Generally speaking, the estimates of over-counting in this age range is small (it is more likely to be much greater in the 65+ category) and greatest in the older age categories (which may be over-estimated because of the lack of data before 1971). Overall, we suspect under-counting of deaths has little impact on our conclusions.

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[28]One can imagine an iterative methodology that adjust scaling factors for an incorrect base in the register maybe more appropriate. However, in practice this makes little difference and complicates the exposition significantly.

B Appendix Tables and Figures

Figure A1: Comparing Indian Register Mortality Rates per 100,000 Relative to Vital Statistics Rate of Death for Status First Nations in 2001/2002 in Alberta, British Columbia, and on-reserve in Manitoba and Saskatchewan
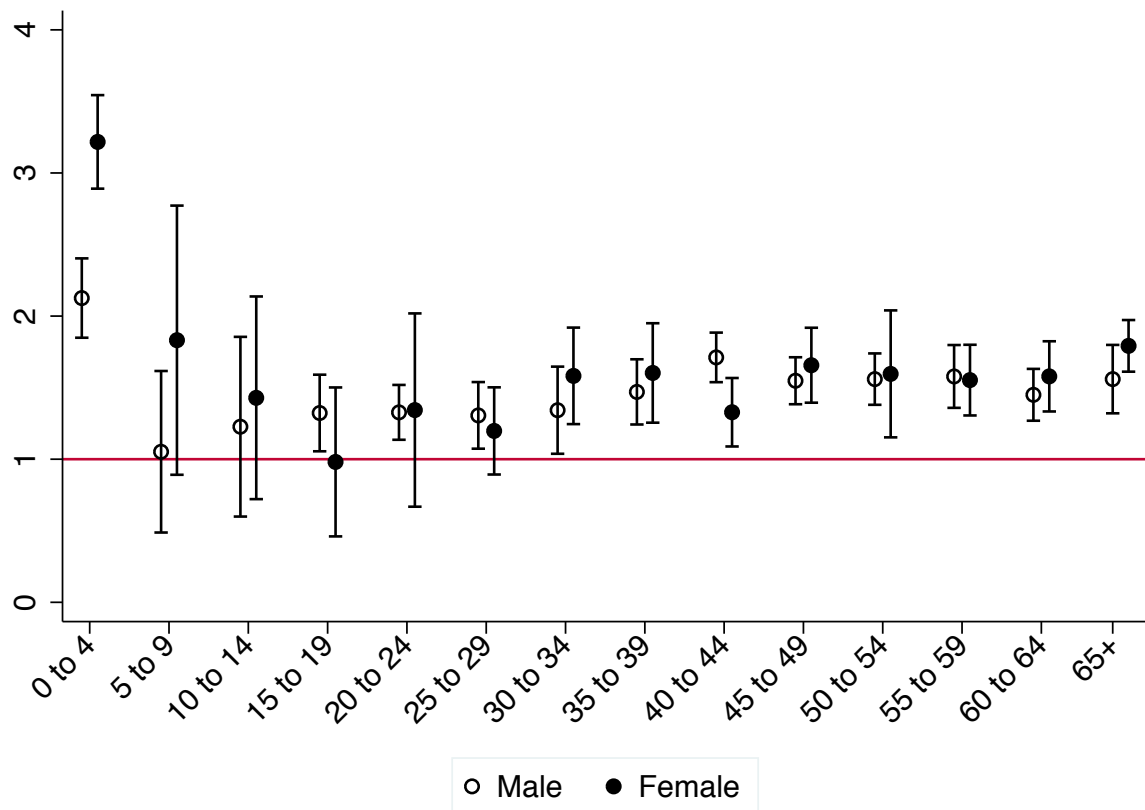
Notes: These are the ratios of the mortality rates from the vital statistics data in 2001/2002 for First Nations in Alberta, British Columbia and on-reserve in Manitoba and Saskatchewan compared with those computed from Indigenous and Northern Affairs registry of deaths for the same geographies and times periods. The mortality rate from Vital statistics is the numerator and the mortality rate from the Indian Register is the denominator.

Figure A2: African American and North American Indian Relative Mortality Rates
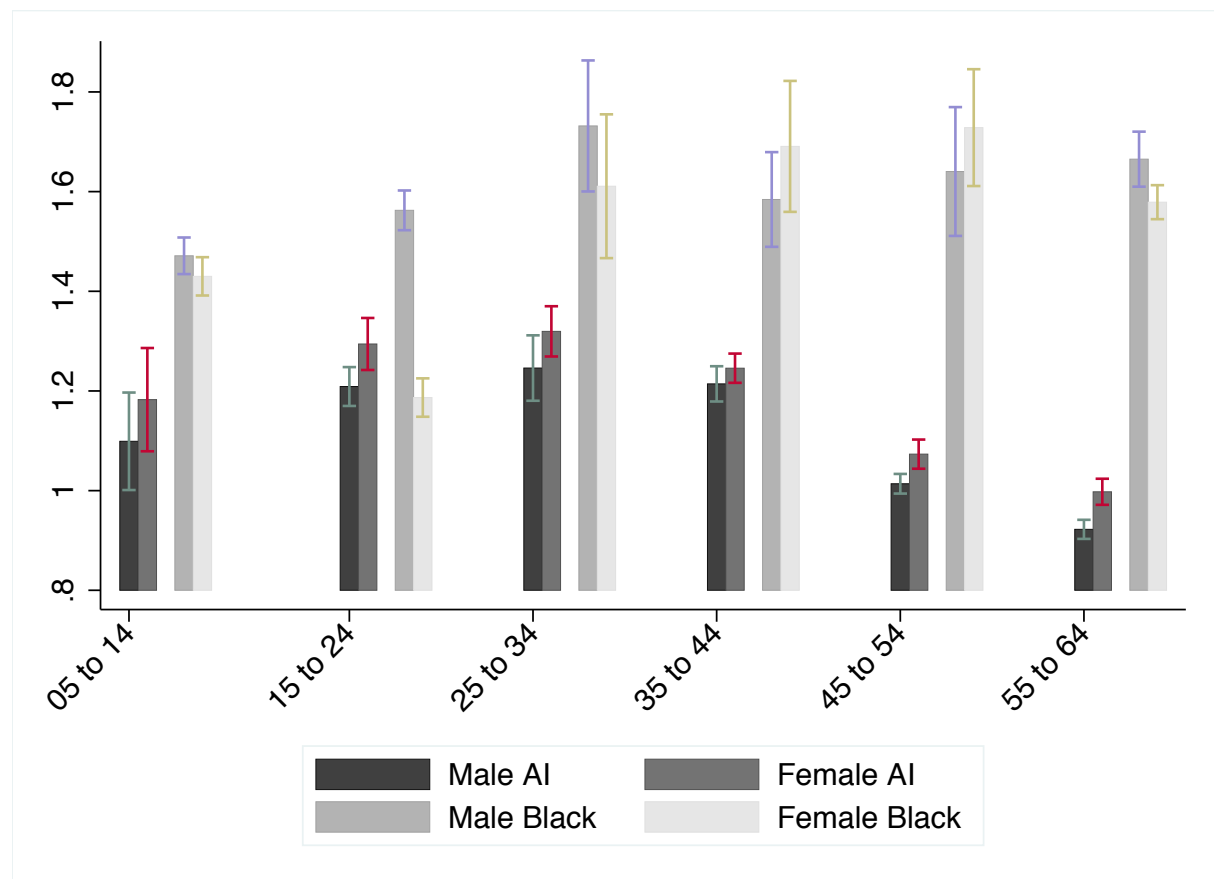
Table A1: Estimated Over Counting in the Indian Register

	2001		2006		2011	
	Male	Female	Male	Female	Male	Female
05 to 09	0	5	0	5	0	0
10 to 14	0	5	0	5	0	5
15 to 19	5	5	5	5	5	5
20 to 24	5	10	10	10	5	10
25 to 29	10	10	5	10	10	10
30 to 34	10	20	10	15	10	15
35 to 39	20	25	20	25	20	25
40 to 44	55	25	55	25	50	25
45 to 49	65	50	80	50	80	55
50 to 54	80	60	95	70	115	75
55 to 59	115	65	125	80	150	90
60 to 64	120	85	145	95	165	115
Total	490	360	550	390	610	430

Notes: These estimates constructed via the procedure Section A. These numbers of "over-counting" in the register due to under reporting of deaths are estimated using the number of deaths in the register by age and gender back until 1972 and the mortality rates for five year age cohorts estimated in each year until 2011 averaged over each five year period. Scaling factors for sub-geographies between the vital statistics data and the INAC data were used to form national level rates of under reported deaths ("over-counted persons") in the register.

Table A2: Bands Excluded from the Register Counts to Make the Register Comparable to the Census

	2001			
	Female		**Male**	
Age Group	**On Reserve**	**Off Reserve**	**On Reserve**	**Off Reserve**
0 to 4	1790	680	1930	640
05 to 09	2420	1070	2570	1140
10 to 14	2140	1050	2360	1150
15 to 19	1910	1230	2010	1130
20 to 24	1740	1240	1770	1250
25 to 29	1740	1450	1860	1430
30 to 34	1890	1590	1890	1500
35 to 39	1840	1620	1770	1410
40 to 44	1550	1510	1410	1080
45 to 49	2530	1000	2590	1100
50 to 54	1150	1320	1060	920
55 to 59	890	1070	790	690
60 to 64	770	830	580	480
65 +	2030	2370	1370	1340
All	24380	18040	23970	15250
Total	42420		39220	

	2006			
	Female		**Male**	
Age Group	**On Reserve**	**Off Reserve**	**On Reserve**	**Off Reserve**
0 to 4	1280	530	1360	510
05 to 09	2320	1110	2390	1180
10 to 14	2210	1200	2320	1250
15 to 19	1880	1190	2100	1230
20 to 24	1640	1310	1800	1170
25 to 29	1560	1280	1620	1240
30 to 34	1580	1490	1700	1410
35 to 39	1760	1670	1770	1490
40 to 44	1740	1680	1660	1420
45 to 49	2040	940	2140	910
50 to 54	1470	1530	1320	1100
55 to 59	1100	1280	1010	900
60 to 64	860	1050	720	680
65 +	2360	2910	1560	1550
All	23770	19150	23450	16030
Total	42920		39480	

Notes: All counts are rounded to the closest 10. These are the number of individuals excluded from the Indian Register counts in order to make them comparable to the Census.

Table A3: Estimates of Institutionalized Population or those without a fixed Address: High Non-Response Assumption

	Average of 2001 & 2006 for all of Canada		Assuming a 95% Response Rate		Assuming a 90% Response Rate	
	Male	Female	Male	Female	Male	Female
05 to 09	205	360				
	(40)	(110)				
10 to 14	1595	1285	130			
	(480)	(290)	(185)			
15 to 19	2820	2605	1280	1125		
	(60)	(780)	(150)	(615)		
20 to 24	5705	2955	4555	1705	3280	315
	(360)	(350)	(225)	(230)	(80)	(95)
25 to 29	5360	2335	4320	1145	3165	
	(790)	(165)	(780)	(135)	(765)	
30 to 34	4950	1975	3905	765	2740	
	(80)	(425)	(90)	(435)	(105)	
35 to 39	4435	2035	3380	810	2210	
	(520)	(390)	(490)	(390)	(460)	
40 to 44	3210	1525	2235	470	1145	
	(205)	(660)	(65)	(660)	(90)	
45 to 49	1835	1280	1020	310	170	
	(95)	(60)	(95)	(260)	(240)	
50 to 54	665	825	115	185		
	(140)	(250)	(165)	(260)		
55 to 59	275	695	75	230		
	(385)	(330)	(105)	(325)		
60 to 64	375	420	50	25		
	(10)	(145)	(70)	(35)		
Total	**31425**	**18295**	**18790**	**4660**	**4750**	**315**
	(1050)	**(495)**	**(60)**	**(595)**	**(1300)**	**(95)**

Notes: These results are calculated using Equation 2 under various assumptions of non-reporting to the census. All these estimates assuming no response for everyone who belonged to a band whose reserve did not participate in the census whether they lived on or off reserve. The results here are averaged over 2001 and 2006. Negative numbers are suppressed and represented by a blank cell. The average count rounded to the nearest five is listed in the first row with its standard deviation below it in parenthesis.

Table A4: Estimates of Migration by Age Group, Gender and Year

Age Group	% Assumed	2001 Female	Male	2006 Female	Male
0 to 4	5.75%	280	220	350	270
05 to 09	5.75%	280	220	350	270
10 to 14	5.75%	280	220	350	270
15 to 19	5.75%	280	220	350	270
20 to 24	10.60%	520	410	640	510
25 to 29	10.60%	520	410	640	510
30 to 34	10.60%	520	410	640	510
35 to 39	10.60%	520	410	640	510
40 to 44	10.60%	520	410	640	510
45 to 49	5%	240	190	300	240
50 to 54	5%	240	190	300	240
55 to 59	3.50%	170	130	210	170
60 to 64	3.50%	170	130	210	170
65 & over	0.60%	290	230	360	290
All	100%	4860	3850	6020	4780

Notes: All counts are rounded to the closest 10. These are the number of individuals subtracted from the Indian Register counts in order to make them comparable to the Census since these individuals are not living in Canada. Notes: The age distribution of Status First Nations no longer living in Canada was assumed to be the age distribution recent migrants to the united states and was taken from Statistics Canada publication (2010) estimated from the 2006 American Community Survey, catalogue no. 11-008-X Retrieved from: http : //www.statcan.gc.ca/pub/11 − 008 − x/2010002/c − g/11287/c − g004 − eng.htm. All counts in the table are rounded to the nearest 5. The distribution of emigrants is: 0-19, 23%; 20 to 44, 53%; 45-54, 10%; 55 to 64, 7%, and 65 years and over, 6%. We then divide up these percentages into equal parts for our age groupings. For example, we have 4 age groups from 0-19, so there is 5.75% in each group. We then divide this by 100 and multiply for each gender and year, the population counts living outside of Canada we derived from the Indian Register.

Table A5: Mortality Rates per 100,000 for Status Indians and the Canadian Average

Age Group	Male Mortality per 100,000			Female Mortality per 100,000		
	Status	Non-Status	Ratio Status	Status	Non-Status	Ratio Status /Non-Status
05 to 09	20.44	11.8	1.87	17.57	9.19	2.12
	(9.41)	(1.84)	(0.59)	(8.32)	(1.57)	(0.63)
10 to 14	34.22	14.91	2.42	37.98	11.07	3.6
	(14.84)	(2.21)	(0.84)	(12.95)	(1.48)	(0.93)
15 to 19	186.33	57.56	3.52	112.24	27.53	4.33
	(58.87)	(6.59)	(0.56)	(26.24)	(2.47)	(0.65)
20 to 24	262.75	81.79	3.42	137.5	31.55	4.36
	(57.25)	(5.42)	(0.48)	(17.28)	(1.9)	(0.68)
25 to 29	238.48	79.39	3.09	139.67	33.77	4.13
	(25.51)	(3.14)	(0.3)	(20.44)	(1.48)	(0.63)
30 to 34	271.84	88.1	3.06	176.88	44.63	3.93
	(44.74)	(6.5)	(0.4)	(21.96)	(1.87)	(0.48)
35 to 39	326.87	115.24	2.94	212.74	65.94	3.29
	(72.74)	(9.81)	(0.45)	(37.7)	(5.41)	(0.46)
40 to 44	442.48	166.82	2.79	303.75	103.01	3.04
	(92.6)	(11.29)	(0.39)	(62.77)	(6.49)	(0.46)
45 to 49	313.72	259.78	1.21	247.86	169.51	1.49
	(34.2)	(19.2)	(0.21)	(32.28)	(8.19)	(0.21)
50 to 54	722.05	415.11	1.79	481.16	267.17	1.82
	(124.51)	(25.69)	(0.22)	(75.47)	(12.43)	(0.25)
55 to 59	1073.21	658.29	1.7	698.4	412	1.79
	(195.41)	(47.35)	(0.16)	(176.92)	(23.73)	(0.31)
60 to 64	1588.39	1056.32	1.58	1041.04	646.86	1.68
	(264.69)	(109.81)	(0.17)	(199.62)	(52.39)	(0.18)

Notes: This figure shows the mortality rates per 100,000 and the mortality rate ratio between Status Indians with their 95% confidence intervals averaged over 2000 to 2012. The data is from the Indian Register on population size and death rates by age and gender and from Vital Statistics Data from Health Canada.