Investigating kidney cancer outcomes among First Nations adults in Canada, 2006−2015: Followup of the 2006 Canadian Census Health and Environmental Cohort (CanCHEC)

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Funding: *This work was supported by the Canadian Institutes of Health Research under Grant Number 410545.*

Cite as: Saini G, Lowe M, Ellison LK, et al. Investigating kidney cancer outcomes among First Nations adults in Canada, 2006−2015: Followup of the 2006 Canadian Census Health and Environmental Cohort (CanCHEC). *Can Urol Assoc J* 2026 July 7; Epub ahead of print. http://dx.doi.org/10.5489/cuaj.9617

ABSTRACT

Introduction: Where reported at a regional level, kidney cancer incidence and mortality rates are disproportionately higher among First Nations people compared to the non-Indigenous population in Canada; however, national-scale reporting has been limited. This study aimed to examine kidney cancer outcomes among First Nations compared to non-Indigenous adults in Canada from 2006−2015.

Methods: Data were from the 2006 Canadian Census Health and Environmental Cohort (CanCHEC), which linked census respondents to national cancer and mortality databases. Age-standardized incidence and mortality rates were calculated using the 1960 World Standard Population and stratified by sex, age, and region. Relative risks were estimated using Poisson regression.

Results: First Nations adults were diagnosed with 445 kidney cancer cases from 2006−2015 and had nearly twice the incidence rate of kidney cancer compared to non-Indigenous adults (relative risk [RR] 1.99, 95% confidence interval [CI] 1.68–2.35). Incidence rates were also elevated by sex, across age groups, and within certain regions. Mortality rates were higher among First

KEY MESSAGES

- Kidney cancer incidence rates were nearly twice as high in First Nations adults compared to non-Indigenous adults.
- Incidence rates among First Nations adults were elevated in both men and women, across all age groups, and for certain provinces (notably in Manitoba, Saskatchewan, and Ontario) compared to their non-Indigenous counterparts.
- Mortality rates were significantly higher among First Nations adults compared to non-Indigenous adults across all categories, including all-cause, cancer-specific, and kidney cancer mortality, with over twice the risk of death from kidney cancer observed in both women and men.
- Findings highlight the need for early detection, culturally safe care, and chronic disease prevention.

Nations adults across all categories, including all-cause, cancer-specific, and kidney cancer mortality, in both sexes and overall.

Conclusions: These findings support concerns raised by First Nations partners about rising kidney cancer incidence and mortality. Interventions targeting risk factors, improved chronic disease management, and access to care are needed. Consistent national data, including stage information, would support better surveillance, early detection, and equitable cancer outcomes.

INTRODUCTION

Kidney cancer, the 10th most diagnosed cancer in Canada,[1] has seen a 10.7% decrease in incidence rates compared to the average annual rates from 2015 to 2019.[2] However, higher kidney cancer incidence and mortality among First Nations peoples have been observed in British Columbia,[3] Quebec,[4] Manitoba,[5] and Ontario[6] compared to non-Indigenous populations. Nationally, a systematic review among First Nations, Inuit, and Métis people reported age-adjusted mortality rate ratios ranging from 1.24 to 1.70.[7] Similar disparities are also observed among Indigenous populations globally.[8–10]

Kidney cancer risk factors such as smoking, physical inactivity, obesity, hypertension, diabetes, and chronic kidney disease (CKD) are more prevalent among First Nations people.[11–14] Smoking and second-hand smoke exposure remain significantly higher among First Nations people, regardless of sex or residency.[11,15] CKD is particularly elevated among First Nations populations in Manitoba,[13] Saskatchewan,[14] and Ontario,[12] with prevalence reaching 30% in some communities. Elevated CKD has also been linked to higher rates of diabetes and obesity in these populations.[13] Consequently, First Nations individuals are three times more likely to require dialysis for end-stage renal disease (ESRD),[16] often facing travel barriers to access care.[17] These challenges are further compounded by systemic barriers to timely kidney care, including geographic isolation and limited availability of primary and specialist services in rural and remote communities, jurisdictional fragmentation between federal and provincial health systems, and experiences of systemic racism within the healthcare system.[18,19]

As a call to action, this study provides the most recent national estimates of kidney cancer outcomes among First Nations adults using the 2006 Canadian Census Health and Environmental Cohort (CanCHEC). This study aims to support community concerns shared with the study team through the Joint Ontario Indigenous Health Committee (JOIHC) about rising kidney cancer rates among First Nations peoples.

METHODS

Project support and approvals

This study was supported by the Canadian Institutes of Health Research grant team (co-authors) and the Joint Ontario Indigenous Health Committee (JOIHC), which is comprised of members from First Nations, Inuit, Métis and urban Indigenous political territorial organizations and provincial organizations. The overall research objectives were shaped by discussions in face-to-face meetings with JOIHC and the grant team. Project updates were provided for discussion at annual JOIHC meetings. Throughout the project, committee members were invited to participate in all stages of the work. Ethics approval (RIS Human Protocol number 37899) was obtained from the University of Toronto.

Data sources and cohort

The 2006 CanCHEC is a large population-based dataset that combines the 2006 Long-Form Census with the Canadian Cancer Registry (CCR), the Canadian Vital Statistics Death Database (CVSD), and annual mailing address postal codes from tax files.[20] The CCR includes 13 provincial and territorial cancer registries with diagnoses since 1992.[20] The 2006 Long-Form Census was administered to 1 in 5 Canadian households and all households in remote Northern communities (except for Whitehorse and Yellowknife that were sampled 1 in 5) and First Nations reserves.[21] There were 22 incompletely enumerated First Nations reserves in the 2006 Census.[22] Individuals 18 years or older on census day (May 16, 2006) were included. The period of follow-up for cancer diagnoses was from census day up to or maximum of December 31, 2015. Because no cancer data from Quebec was available after 2010 at the time of linkage,[23] cohort members living in Quebec on census day and those with a known Quebec postal code from 2006 to 2015 were excluded.[24–26] Individuals with any malignant cancer diagnosis between January 1, 1992 to May 15, 2006, those with dates of death before date of diagnosis, and cases that were identified by death certificate/autopsy only were excluded.

Definitions

Kidney cancer

Kidney and renal pelvis cancer cases were identified according to the SEER Site Recode[27] for ICD-O-3 site C649 and C659 between 2006 and 2015. Analysis of kidney cancer stage at diagnosis was not possible due to limited availability of stage data across provinces and territories.

Vital status

Date and underlying cause of death were from the CVSD and were used to calculate all-cause, cancer-specific (ICD-10 C00-C97)[28], and kidney cancer-specific (ICD-10 C64 and C65)[28] mortality up to December 31, 2019.

First nations status

In the 2006 Long-Form Census questionnaire, questions asking individuals to self-report being registered under the Indian Act of Canada (First Nations with status), whether the individual self-identified as an Indigenous person and whether the individual reported Indigenous ancestry are included/available.[29] In this study, individuals were classified as First Nations if they reported being status First Nations since this definition specifies First Nations people who are eligible for Non-Insured Health Benefits.[30] An individual was classified as non-Indigenous if they did not report being a status First Nations or any Indigenous ancestry or identity (including Métis and/or Inuit).

Demographic characteristics

Age at kidney cancer diagnosis was grouped as 18-49, 50-69, and 70+. Newfoundland and Labrador, Nova Scotia, New Brunswick and Prince Edward Island were grouped as 'Atlantic Provinces', and the Yukon, Northwest Territories and Nunavut were grouped as 'Territories' to overcome small cell counts. Weighted income quintiles ranked lowest (Q1) to highest (Q5) were derived from total annual household pre-tax income adjusted for household size within each census metropolitan area, census agglomeration or provincial residual.[31] Since these reflect 2005 income data, they may include missing values.[32] Additional geographic variables measured at the time of census included residence on- and off-reserve, band membership and rurality, with rurality dichotomized to denote urban vs. rural census areas.[29]

Statistical Analysis

Descriptive statistics were used to describe the demographic characteristics among First Nations and non-Indigenous individuals at census date. Comparisons were made using a Rao-Scott chi-square test or t-test, and p-values less than 0.05 were considered significant.

Incidence rates of kidney cancer stratified by sex and region of residence were age standardized to the 1960 World Standard Population.[33] Age-specific incidence rates were calculated for age groups 18-49, 50-69 and 70+. Person-years at risk for cancer incidence rates were accumulated from census date to first of date of death, first date of kidney cancer diagnosis (if one occurred), or December 31, 2015. Age-standardized mortality rates for kidney cancer-specific deaths for First Nations and non-Indigenous individuals were calculated based on person years accumulated from census date to the first of date of death or December 31, 2019. Poisson regression models, controlling for age and sex (where applicable), were used to compare the incidence and mortality rates of kidney cancer in First Nations people to that in non-Indigenous peoples. Rates were calculated only for counts greater than or equal to 20. A five-year survival analysis was conducted; however, these results were not reliable due to limited sample size and insufficient statistical power and are therefore not reported here.

Analyses were performed using SAS version 9.4. Weights provided by Statistics Canada were applied to the calculation of proportions, incidence rates, and statistical tests. This is important to consider differences in sampling and non-responders across different groups. The bootstrapping method was used for the descriptive results. Bootstrapping was not used for the Poisson regression models. Therefore, re-scaled weights were used to reflect the sample size of the cohort more accurately and to prevent artificially boosting the power. Counts were kept unweighted and randomly rounded to base 5 in accordance with confidentiality requirements.

RESULTS

The cohort included 165,650 First Nations individuals (Table 1). First Nations individuals were more likely to be female (53.9% vs. 51.6%) and younger on average (39 vs. 46 years) than non-Indigenous adults. There was a greater representation of First Nations individuals in Western provinces and territories, particularly in Manitoba (16.5% vs. 4.2%) and Saskatchewan (14% vs. 3.6%). Additionally, a higher proportion of First Nations individuals were in the lowest income quintile (48.5% vs. 19.2%), resided in rural areas (52.0% vs. 18.4%), and lived on-reserve (43.8% vs. 0.1%).

There were 445 cases of kidney cancer among First Nations individuals (Table 2). First Nations adults had an age-standardized incidence rate (ASIR) of kidney cancer nearly two times higher compared to non-Indigenous adults (relative risk (RR) = 1.99, 95% CI: 1.68–2.35). This was consistent across sexes, with rates nearly double in both women (RR= 1.84, 95% CI: 1.40–2.40) and men (RR= 2.09, 95% CI: 1.69–2.58).

Kidney ASIRs were elevated across all age groups among First Nations men (Ages 18-49: RR=3.15, 95% CI=2.17-4.59; Ages 50-69: RR=1.76, 95% CI=1.31-2.38; Ages 70+: RR=1.90, 95% CI=1.15-3.16) and both sexes combined (Ages 18-49: RR=2.50, 95% CI=1.81-3.45; Ages 50-69: RR=1.88, 95% CI=1.50-2.36; Ages 70+: RR=1.76, 95% CI=1.20-2.58) (Table 2). Kidney ASIRs were higher among First Nations women aged 50-69 (RR=2.03, 95% CI=1.46-2.91) (Table 2).

Regional variation was also observed. First Nations individuals (both sexes combined) had higher ASIRs in the Atlantic Provinces (RR = 1.85, 95% CI: 1.02–3.34), Ontario (RR = 2.33, 95% CI: 1.74–3.13), Manitoba (RR = 3.03, 95% CI: 2.10–4.38), and Saskatchewan (RR = 2.04, 95% CI: 1.28–3.27) compared to their non-Indigenous counterparts. Among First Nations women, the risk of kidney cancer was more than double in Saskatchewan (RR = 2.32, 95% CI: 1.19–4.53). Among First Nations men, the risk was over twice as high in Ontario (RR = 2.77, 95% CI: 1.95–3.94) and more than triple in Manitoba (RR = 3.71, 95% CI: 2.41–5.73). Mortality was significantly higher among First Nations individuals for any-cause, cancer-specific, and kidney cancer mortality, among both sexes combined as well as among women and men individually. For any-cause mortality, the relative risk was 2.24 (95% CI: 2.19–2.29) overall, 2.29 (95% CI: 2.21–2.36) among women, and 2.21 (95% CI: 2.14–2.28) among men. Cancer-specific mortality was also elevated, with a relative risk of 1.37 (95% CI: 1.29–1.45) overall, 1.45 (95% CI: 1.34–1.57) among women, and 1.27 (95% CI: 1.16–1.39) among men. Kidney cancer mortality was significantly higher among First Nations individuals as well, with a relative risk of 2.12 (95% CI: 1.50–2.99) overall, 2.24 (95% CI: 1.26–3.98) among women, and 2.07 (95% CI: 1.34–3.17) among men compared to non-Indigenous adults.

DISCUSSION

This study observed nearly twice the incidence rates of kidney cancer among First Nations adults in Canada compared to non-Indigenous adults, which was also consistent when stratified by sex. Findings by age showed high incidence rates among First Nations aged 18-49, 50-69 and 70+.

Findings by region showed high incidence rates among First Nations in some provinces. Additionally, mortality rates were higher among First Nations compared to non-Indigenous adults. These results align with international research reporting elevated kidney cancer incidence and, in some cases, mortality among Indigenous populations in Canada,[6] the United States,[10] Australia,[8] and New Zealand.[9]

Higher kidney cancer incidence rates in Ontario, Manitoba, and Saskatchewan align with literature showing a greater prevalence of chronic diseases in these provinces.[13,34,35] In Ontario, kidney cancer was the fifth most commonly diagnosed cancer among First Nations people, compared to 12th overall among other people in the province.[35] Manitoba and Saskatchewan, which had the highest proportions of First Nations people in 2001,[36] also reported the highest ESRD incidence rates in 2005 among adults aged 20–64 and 65–74 compared to other Canadian provinces.[37] First Nations individuals are more likely to be on dialysis, and prolonged exposure to this treatment, a known risk factor for kidney cancer, may contribute to the higher kidney cancer incidence and mortality rates in these regions.[16] Additionally, the high prevalence of diabetes—a leading cause of ESRD among Indigenous populations—along with other chronic conditions such as obesity and hypertension, are likely factors contributing to these findings.[12,38] Early identification and management of these conditions are critical to reducing kidney cancer risk.[39,40]

Smoking is a major risk factor for kidney cancer.[41] This is particularly pertinent among First Nations populations, with high rates of smoking[15] and risk increasing with both cigarette consumption and duration. Continuing to smoke after diagnosis raises mortality risk by 30%, while quitting can reduce kidney cancer risk by up to 25% within 15 years.[41] Programs like the Indigenous Tobacco Program, which partners with over 200 First Nations, Inuit, Métis, and urban Indigenous communities in Ontario, have made progress in raising awareness and providing culturally tailored cessation support.[15] Expanding such initiatives, addressing systemic barriers, and integrating culturally relevant approaches will be crucial in reducing the disproportionate impact of kidney cancer in these communities.[15,41]

Given the absence of organized population-based screening for kidney cancer, early detection among the First Nations population is crucial. While early-stage kidney cancer is highly treatable with options like nephrectomy or ablation, late-stage disease often requires more invasive treatment and is typically incurable at Stage IV. This further emphasizes the importance of collecting national staging data. Moreover, inadequate access to primary care providers, particularly among Indigenous populations, could contribute to delayed diagnosis and poorer outcomes.[42] From 2017–2020, higher proportions of First Nations people living off-reserve (20.3%), Métis (17.9%), and Inuit (56.5%) lacked access to a primary care provider compared to non-Indigenous individuals (14.5%).[43] This lack of access has been observed to increase reliance on emergency departments, which for those with CKD is linked to delayed diagnosis, more advanced disease at presentation, a 41% increased rate of hospitalization, and a 53% increased risk of mortality.[42] Expanding access to primary care and ensuring timely diagnosis could improve treatment outcomes.

In this study, a higher proportion of First Nations individuals were from lower income households and rural areas, factors that exacerbate barriers to healthcare access.[44] Geographic isolation, lack of transportation, and financial constraints contribute to delays in kidney cancer diagnosis and treatment.[44] Additionally, Indigenous cancer patients often face higher out-of-pocket expenses for supportive medications, dietary supplements, allied healthcare, childcare, and travel-related costs such as food, lodging, and gas, deterring timely treatment.[45,46] Fear of a positive diagnosis and experiences of racism can further discourage care-seeking,[47] leading to more advanced disease at diagnosis and potentially contributing to the higher mortality rates observed. Addressing these systemic barriers requires acknowledging their historical and structural roots while implementing culturally safe practices and decolonizing healthcare systems. Programs such as Indigenous Navigators initiatives demonstrate the importance of culturally informed supports, as these navigators advocate for Indigenous patients, facilitate access to cancer services, and address cultural and spiritual needs.[19] Expanding and recognizing such initiatives are critical steps toward bridging healthcare access gaps and improving outcomes for First Nations individuals.

This study has several limitations. Firstly, survival analyses were not conducted due to limited sample size and insufficient statistical power. Given the disproportionate impact of kidney cancer on First Nations populations across Canada, future research should prioritize the investigation of survival outcomes and treatment patterns to better inform equitable care strategies. Second, kidney cancer staging data are not collected in all provinces and territories, and as a result, stage data was available for only 31.6% of kidney cancer cases in Canada (excluding Quebec) between 2010 year to 2015.[23] This prevented the assessment of stage at diagnosis and stage-specific analyses. Third, while this was the most recent data available at the time of grant funding and analysis (i.e., to 2015), these findings highlight the need for updated data to reflect current kidney trends and to support opportunities for future research. Moreover, there are several important exclusions: data for First Nations people living in incompletely enumerated reserves/communities and institutional residents were not available and the analyses did not include Quebec residents (9% of the Indigenous population of Canada reside in Quebec).[22] The results are also specific to First Nations people with status; however, a previous sensitivity analysis[48] including non-status First Nations individuals supported the generalizability of these findings. Given the known role of diabetes, chronic kidney disease, and hypertension in kidney cancer risk, future research should aim to incorporate comorbidity data to further explore potential risk factors and survival differences among First Nations individuals. Future studies should also examine the impact of known environmental risk factors for kidney cancer and kidney disease, including exposure to air and water pollutants,[49] within and/or near First Nations communities. This is particularly important given the long-standing crisis of disproportionate environmental contamination affecting First Nations in Ontario, such as Aamjiwnaang First

Nation’s proximity to Ontario’s ‘Chemical Valley,’[50] and the numerous long-standing drinking water advisories on First Nations reserves.[51]

CONCLUSIONS

This study confirms a disproportionately high impact of kidney cancer among First Nations adults in Canada, marked by higher incidence and mortality rates by sex, and across different age groups and regions. These disparities may be partly driven by a combination of chronic disease prevalence, risk factors such as smoking, and systemic barriers to timely, equitable care. Limited access to primary care providers and culturally safe services likely contributes to poorer outcomes. Addressing these inequities will likely require a multifaceted approach such as sustained investments in Indigenous-led initiatives, chronic disease prevention, and accessible care.

REFERENCES

1. Canadian Cancer Society, Statistics Canada, Public Health Agency of Canada. Canadian cancer statistics 2019. Toronto (ON): Canadian Cancer Statistics Advisory Committee;

2019. Available at: http://cancer.ca/Canadian-Cancer-Statistics-2019-EN. Accessed October 10, 2025.

2. Statistics Canada. Cancer incidence in Canada, 2020. Ottawa (ON): Statistics Canada; 2023. Available at: https://www150.statcan.gc.ca/n1/daily-quotidien/230516/dq230516c-eng.htm. Accessed October 10, 2025.
3. McGahan CE, Linn K, Guno P, et al. Cancer in First Nations people living in British Columbia, Canada: An analysis of incidence and survival from 1993 to 2010. *Cancer Causes Control* 2017;28:1105-16. doi:10.1007/s10552-017-0950-7
4. Louchini R, Beaupré M. Cancer incidence and mortality among Aboriginal people living on reserves and northern villages in Quebec, 1988-2004. *Int J Circumpolar Health* 2008;67:445-51. doi:10.3402/ijch.v67i5.18355
5. Horrill TC, Dahl L, Sanderson E, et al. Comparing cancer incidence, stage at diagnosis and outcomes of First Nations and all other Manitobans: A retrospective analysis. *BMC Cancer* 2019;19:1055. doi:10.1186/s12885-019-6296-7
6. Jamal S, Jones C, Walker J, et al. Cancer in First Nations people in Ontario, Canada: Incidence and mortality, 1991 to 2010. *Health Rep* 2021;32:14-28.
7. Wong ECL, Kapoor A. Epidemiology of prostate and kidney cancer in the Aboriginal population of Canada: A systematic review. *Can Urol Assoc J* 2017;11:E222-32. doi:10.5489/cuaj.4185
8. Morrell S, You H, Baker D. Estimates of cancer incidence, mortality and survival in Aboriginal people from NSW, Australia. *BMC Cancer* 2012;12:168. doi:10.1186/1471-2407-12-168
9. Delahunt B, Bethwaite P, Nacey JN. Renal cell carcinoma in New Zealand: A national survival study. *Urology* 1994;43:300-9. doi:10.1016/0090-4295(94)90070-1
10. Watson RA. Kidney cancer in American Indian and native Alaskan men and women-time to notice, time to care. *Urology* 2008;72:726-30. doi:10.1016/j.urology.2008.06.002
11. First Nations Information Governance Centre. National report of the First Nations Regional Health Survey phase 3: Volume one. Ottawa (ON): First Nations Information Governance Centre; 2018. Available at: https://fnigc.ca/data/proportion-of-first-nations-adults-and-youth-reporting-currently-smoking-cigarettes-according-to-mutually-exclusive-categories-of-personal-only-for-adult-population-or-parent-grandparent-irs-attend/. Accessed October 10, 2025.
12. Kelly L, Matsumoto C, Schreiber Y, et al. Prevalence of chronic kidney disease and cardiovascular comorbidities in adults in First Nations communities in northwest Ontario: A retrospective observational study. *CMAJ Open* 2019;7:E568-72. doi:10.9778/cmajo.20190040
13. Komenda P, Lavallee B, Ferguson TW, et al. The prevalence of CKD in rural Canadian Indigenous peoples: Results from the First Nations community based screening to improve kidney health and prevent dialysis (FINISHED) screen, triage, and treat program. *Am J Kidney Dis* 2016;68:582-90. doi:10.1053/j.ajkd.2016.04.014
14. Jiang Y, Osgood N, Lim HJ, et al. Differential mortality and the excess burden of end-stage renal disease among First Nations people with diabetes mellitus: A competing-risks analysis. *CMAJ* 2014;186:103-9. doi:10.1503/cmaj.130721

15. Habash M, Sheppard AJ, Steiner R. An evaluation of Indigenous Tobacco Program smoking prevention workshops with First Nations youth in Ontario, Canada. *Can J Public Health* 2021;112:697-705. doi:10.17269/s41997-021-00493-9
16. Canadian Institute for Health Information. End-stage renal disease among Aboriginal peoples in Canada: Treatment and outcomes. Ottawa (ON): Canadian Institute for Health Information; 2013. Available at: https://publications.gc.ca/site/eng/441225/publication.html. Accessed October 10, 2025.
17. Harasemiw O, Milks S, Oakley L, et al. Remote dwelling location is a risk factor for CKD among Indigenous Canadians. *Kidney Int Rep* 2018;3:825-32. doi:10.1016/j.ekir.2018.02.002
18. Harasemiw O, Komenda P, Tangri N. Addressing inequities in kidney care for Indigenous people in Canada. *J Am Soc Nephrol* 2022;33:1474-6. doi:10.1681/ASN.2022020215
19. Sheppard AJ. "In a good way": Going beyond patient navigation to ensure culturally relevant care in the cancer system for First Nations, Inuit, and Métis patients in Ontario. *Int J Indig Health* 2019;14:293-306. doi:10.32799/ijih.v14i2.31995
20. Tjepkema M, Christidis T, Bushnik T, et al. Cohort profile: The Canadian Census Health and Environment Cohorts (CanCHECs). *Health Rep* 2019;30:18-26. doi:10.1186/s12940-019-0518-y
21. Statistics Canada. How Statistics Canada identifies Aboriginal peoples. Ottawa (ON): Statistics Canada; 2007. Available at: https://www150.statcan.gc.ca/n1/pub/12-592-x/12-592-x2007001-eng.htm. Accessed October 10, 2025.
22. Statistics Canada. Aboriginal peoples in Canada in 2006: Inuit, Métis and First Nations, 2006 Census. Ottawa (ON): Statistics Canada; 2008. Available at: https://www12.statcan.gc.ca/census-recensement/2006/as-sa/97-558/p2-eng.cfm. Accessed October 10, 2025.
23. Canadian Cancer Society, Statistics Canada, Public Health Agency of Canada. Canadian cancer statistics 2018. Toronto (ON): Canadian Cancer Society; 2018. Available at: https://cdn.cancer.ca/-/media/files/research/cancer-statistics/2018-statistics/canadian-cancer-statistics-2018-en.pdf. Accessed October 10, 2025.
24. Statistics Canada. Cancer incidence in Canada, 2014. Ottawa (ON): Statistics Canada; 2017. Available at: https://www150.statcan.gc.ca/n1/daily-quotidien/170221/dq170221b-eng.pdf. Accessed October 10, 2025.
25. Canadian Cancer Society's Steering Committee on Cancer Statistics. Canadian cancer statistics 2011. Toronto (ON): Canadian Cancer Society; 2011. Available at: https://publications.gc.ca/site/archivee-archived.html?url=https%3A%2F%2Fpublications.gc.ca%2Fcollections%2Fcollection_2011%2Fstatcan%2FCS2-37-2011-eng.pdf. Accessed October 10, 2025.
26. Ellison LF, Gibbons L, Canadian Cancer Survival Analysis Group. Five-year relative survival from prostate, breast, colorectal and lung cancer. *Health Rep* 2001;13:23-34.
27. Statistics Canada. Canadian Cancer Registry classification - ICD-O-3/SEER (cancer type). Ottawa (ON): Statistics Canada; 2014. Available at: https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=182622&adm=0&dis=0. Accessed October 10, 2025.

28. World Health Organization. ICD-10 version: 2019. Geneva (CH): World Health Organization; 2019. Available at: https://icd.who.int/browse10/2019/en#/C00-C97. Accessed October 10, 2025.
29. Statistics Canada. Dictionary, Census of Population, 2021. Ottawa (ON): Statistics Canada; 2023. Available at: https://www12.statcan.gc.ca/census-recensement/2021/ref/dict/index-eng.cfm. Accessed October 10, 2025.
30. Government of Canada. Who is eligible for the Non-Insured Health Benefits program. Ottawa (ON): Indigenous Services Canada; 2023. Available at: https://www.sac-isc.gc.ca/eng/1574187596083/1576511384063. Accessed October 10, 2025.
31. Statistics Canada. Table 98-10-0058-01: Household income statistics by household type: Census metropolitan areas, tracted census agglomerations and census tracts. Ottawa (ON): Statistics Canada; 2022. Available at: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810005801. Accessed October 10, 2025.
32. Statistics Canada. 2006 Census: Income and earnings reference guide. Ottawa (ON): Statistics Canada; 2006. Available at: https://www12.statcan.gc.ca/census-recensement/2006/ref/rp-guides/income-revenu-eng.cfm. Accessed October 10, 2025.
33. Segi M, Nippon TK, Tōhoku D, et al. Cancer mortality for selected sites in 24 countries. *Jpn Cancer Soc* 1950. Available at: https://onesearch.nihlibrary.ors.nih.gov/discovery/fulldisplay/alma991000157269704686/01NIH_INST:NIH. Accessed October 10, 2025.
34. Thomas DA, Huang A, McCarron MCE, et al. A retrospective study of chronic kidney disease burden in Saskatchewan's First Nations people. *Can J Kidney Health Dis* 2018;5:2054358118799689. doi:10.1177/2054358118799689
35. Chiefs of Ontario, Cancer Care Ontario, Institute for Clinical Evaluative Sciences. Cancer in First Nations people in Ontario: Incidence, mortality, survival and prevalence. Toronto (ON): Chiefs of Ontario; 2017. Available at: https://www.cancercareontario.ca/en/statistical-reports/cancer-first-nations-people-ontario-incidence-mortality-survival-and-prevalence. Accessed October 10, 2025.
36. Statistics Canada. Projections of the Aboriginal populations, Canada, provinces and territories: Analysis of the projections' results. Ottawa (ON): Statistics Canada; 2005. Available at: https://www150.statcan.gc.ca/n1/pub/91-547-x/2005001/4072120-eng.htm. Accessed October 10, 2025.
37. Canadian Institute for Health Information. 2008 annual report-treatment of end-stage organ failure in Canada, 1997 to 2006. Ottawa (ON): Canadian Institute for Health Information; 2008. Available at: https://publications.gc.ca/collections/collection_2008/cihi-icis/H115-38-2008E.pdf. Accessed October 10, 2025.
38. Nash DM, Dirk JS, McArthur E, et al. Kidney disease and care among First Nations people with diabetes in Ontario: A population-based cohort study. *CMAJ Open* 2019;7:E706-12. doi:10.9778/cmajo.20190164
39. Wong CS, Chen TT, Chang WP, et al. Prognostic effect of comorbid disease and immune gene expression on mortality in kidney cancer: A population-based study. *Cancers* 2020;12:1654. doi:10.3390/cancers12061654

40. Moore SP, Green AC, Bray F, et al. Survival disparities in Australia: An analysis of patterns of care and comorbidities among indigenous and non-indigenous cancer patients. *BMC Cancer* 2014;14:517. doi:10.1186/1471-2407-14-517
41. Minichiello A, Lefkowitz ARF, Firestone M, et al. Effective strategies to reduce commercial tobacco use in Indigenous communities globally: A systematic review. *BMC Public Health* 2016;16:21.
42. Toth-Manikowski SM, Hsu JY, Fischer MJ, et al. Emergency department/urgent care as usual source of care and clinical outcomes in CKD: Findings from the Chronic Renal Insufficiency Cohort Study. *Kidney Med* 2022;4:100424. doi:10.1016/j.xkme.2022.100424
43. Kelsang Y, Huda M, Tara H. Primary health care access among First Nations people living off reserve, Métis and Inuit, 2017 to 2020. Ottawa (ON): Statistics Canada; 2023. Available at: https://www150.statcan.gc.ca/n1/pub/41-20-0002/412000022023005-eng.htm. Accessed October 10, 2025.
44. Reading CL, Wien F. Health inequalities and the social determinants of Aboriginal peoples' health. Prince George (BC): National Collaborating Centre for Indigenous Health; 2009. Available at: https://www.nccih.ca/495/Health_inequalities_and_the_social_determinants_of_Aboriginal_peoples__health_.nccah?id=46. Accessed October 10, 2025.
45. Graham S, Muir NM, Formsma JW, et al. First Nations, Inuit and Métis peoples living in urban areas of Canada and their access to healthcare: A systematic review. *Int J Environ Res Public Health* 2023;20:5956. doi:10.3390/ijerph20115956
46. Ontario Health. A 20-year comparison: Identifying strengths and challenges in the cancer and health care system for First Nations, Inuit, Métis and Urban Indigenous peoples in Ontario. Toronto (ON): Indigenous Health Unit; 2025. Unpublished.
47. Belachew SA, Bizuayehu HM, Diaz A, et al. Lung cancer screening participation among Indigenous peoples worldwide: A systematic review of challenges and opportunities. *Health Promot J Austr* 2025;36:e70001. doi:10.1002/hpja.70001
48. Ellison LK, Elias B, Carmina M, et al. Examining cancer stage at diagnosis and other factors among First Nations and non-Indigenous adults in Canada, 2010-2015: A retrospective cohort study using the 2006 Canadian Census Health and Environment Cohort (CanCHEC). In press 2025.
49. Kshirsagar AV, Zeitler EM, Weaver A, et al. Environmental exposures and kidney disease. *Kidney360* 2022;3:2174-82. doi:10.34067/KID.0007962021
50. Cryderman D, Letourneau L, Miller F, et al. An ecological and human biomonitoring investigation of mercury contamination at the Aamjiwnaang First Nation. *EcoHealth* 2016;13:784-95. doi:10.1007/s10393-016-1162-4
51. Lucier KJ, Schuster-Wallace CJ, Skead D, et al. "Is there anything good about a water advisory?": An exploration of the consequences of drinking water advisories in an indigenous community. *BMC Public Health* 2020;20:1704. doi:10.1186/s12889-020-09825-9

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Acknowledgements
Thank you to Sadaf Ullah who conducted the literature searches for this study. We extend our sincere appreciation to the Joint Ontario Indigenous Health Committee (comprised of representatives from Political Territorial Organizations and provincial First Nations, Inuit, Métis and urban Indigenous organizations) for their support in advancing this research. We thank Carmina Ng (Statistics Canada) for her contributions to the project.

FIGURES AND TABLES

Table 1. Demographic characteristics at census date (May 16, 2006) among First Nations and non-Indigenous adults.

	Non-Indigenous n=3 032 990[*]	**First Nations n=165 650**[*]	**p**
	%†	%†	
Sex			<0.0001
Female	51.6	53.9	
Male	48.4	46.1	
Age			<0.0001
Mean (years)	46	39	
<25	20.1	30.2	
30−39	17.9	23.2	
40−49	21.8	22.3	
50−59	18.2	13.7	
60−69	11	6.8	
70+	11	3.8	
Region of residence			<0.0001
Atlantic provinces	9.7	5.9	
Ontario	51.5	24	
Manitoba	4.2	16.5	
Saskatchewan	3.6	14	
Alberta	13.4	15.1	
British Columbia	17.5	20.8	
Territories	0.2	3.7	
Income quintile			<0.0001
1 – Lowest	19.2	48.5	
2	19.9	20.9	
3	20.1	‡	
4	20.2	10.1	
5 – Highest	20.4	6.4	
Unknown	0.1	‡	
Urban/rural status			<0.0001
Rural	18.4	52	
Urban	81.6	48	
Band membership			<0.0001
No	‡	5.3	
Yes	‡	94.7	
Residence on-reserve			<0.0001
No	99.9	56.2	
Yes	0.1	43.8	

[*] Counts are unweighted. According to Statistics Canada confidentiality rules, counts have been randomly rounded up or down by a multiple of 5. The total value may not match the individual

values because totals and subtotals are rounded independently. [†]Percentages are based on weighted counts provided by Statistics Canada. [‡]Counts suppressed due to small counts or residual small counts.

Table 2. Age-standardized kidney cancer incidence (2006−2015) and mortality (2006−2019), per 100 000 person years, among First Nations and non-Indigenous cohort members, relative risk, and 95% confidence intervals, by sex, age, and region

	Women				**Men**				**Both sexes**			
	n*	**NI ASIR†**	**FN ASIR†**	**RR‡ (95% CI)**	**n***	**NI ASIR†**	**FN ASIR†**	**RR‡ (95% CI)**	**n***	**NI ASIR†**	**FN ASIR†**	**RR‡ (95% CI)**
Total	160	8.7	15.7	**1.84 (1.40−2.40)**	280	15.7	31.4	**2.09 (1.69−2.58)**	445	12.0	22.6	**1.99 (1.68−2.35)**
Age group												
18−49	30	2.3	3.7	1.53 (0.81−2.91)	70	4.0	12.4	**3.15 (2.17−4.59)**	95	3.1	7.7	**2.50 (1.81−3.45)**
50−69	95	19.1	37.8	**2.06 (1.46−2.91)**	160	36.4	61.9	**1.76 (1.31−2.38)**	250	27.6	48.6	**1.88 (1.50−2.36)**
70+	45	36.4	58.5	1.59 (0.88−2.85)	55	60.4	116.7	**1.90 (1.15−3.16)**	95	46.7	81.6	**1.76 (1.20−2.58)**
Region of residence												
Atlantic provinces	20	13.4	21.1	1.62 (0.64−4.06)	25	19.2	35.0	2.05 (0.94−4.45)	40	16.1	27.5	**1.85 (1.02−3.34)**
Ontario	45	8.6	14.4	1.68 (0.98−2.90)	80	15.9	42.5	**2.77 (1.95−3.94)**	125	12.0	26.6	**2.33 (1.74−3.13)**
Manitoba	35	8.6	15.8	1.99 (0.98−4.05)	85	16.0	54.4	**3.71 (2.41−5.73)**	120	12.2	33.6	**3.03 (2.10−4.38)**
Saskatchewan	20	10.2	23.5	**2.32 (1.19−4.53)**	40	15.6	29.8	1.83 (0.94−3.55)	60	12.8	26.3	**2.04 (1.28−3.27)**
Alberta	20	8.7	17.4	1.91 (0.94−3.89)	25	15.9	18.5	1.12 (0.51−2.45)	40	12.2	17.9	1.45 (0.86−2.45)
British Columbia	20	6.1	10.5	1.69 (0.84−3.41)	20	12.8	11.4	0.94 (0.45−1.96)	40	9.3	10.8	1.22 (0.74−2.03)
Territories	*	*	*	*	*	*	*	*	20	11.8	20.0	1.79 (0.62−5.19)

Mortality		**NI ASMR** †	**FN ASMR** †			**NI ASMR** †	**FN ASMR** †			**NI ASMR** †	**FN ASMR** †	
Any cause	9675	317.2	733.0	**2.29 (2.21−2.36)**	11 785	486.2	1021.7	**2.21 (2.14−2.28)**	21 545	394.9	860.3	**2.24 (2.19−2.29)**
Cancer	1530	80.7	116.0	**1.45 (1.34−1.57)**	1500	105.4	131.0	**1.27 (1.16−1.39)**	3035	91.5	121.8	**1.37 (1.29−1.45)**
Kidney cancer	35	1.0	2.4	**2.24 (1.26−3.98)**	85	2.6	5.6	**2.07 (1.34−3.17)**	120	1.8	3.7	**2.12 (1.50−2.99)**

[*] Number of unweighted cancer cases in FNs. Counts randomly rounded to base 5 according to Statistics Canada Research rules. As such, when data are summed, the total value may not match the individual values because totals and subtotals are rounded independently. [†] Age-standardized to the 1960 World Standard Population (with the exception of age group, where crude age-specific rates are presented). [‡] Adjusting for age and sex (where applicable). Bold text represents a statistically significant difference. CI: confidence interval; FN ASIRL FNs age-standardized incidence rate; FN ASMR: First Nations age-standardized mortality rate; NI ASIR=non-Indigenous age-standardized incidence rate; NI ASMR: non-Indigenous age-standardized mortality rate; RR: relative risk.