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A Decade of Breast Cancer in Ontario: Survival Differences Between First Nations and Non-First Nations Women

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ABSTRACT

Background: Breast cancer is the most common cancer among women in Canada, with rising incidence in First Nations (FN) women. This study confirms persistent survival disparities between FN and non-FN women, with updated findings over an extended follow-up period.

Methods: Data from the Ontario Cancer Registry, linked to the Indian Registration System, included 282 FN and 670 frequency matched non-FN women diagnosed with invasive breast cancer from 1995-2004. Survival outcomes were assessed up to 2019, analyzing 10-year survival rates by cancer stage and other factors.

Results: Unadjusted Kaplan-Meier curves showed lower 10-year survival rates for FN women (76%) compared to non-FN women (87%) for stage I breast cancer. After adjusting for age, comorbidity, detection method, and surgery severity, no significant difference in mortality hazard was found. Among FN women diagnosed with stage I breast cancer, diabetes (HR = 3.10, 95% CI = 1.09-8.81) and chemotherapy (HR = 4.05, 95% CI = 1.46-11.20) were associated with increased mortality hazard, while hormonal therapy was associated with reduced mortality hazard (HR = 0.38, 95% CI = 0.14-0.996). Among FN women with advanced-stage breast cancer (stages II-IV), diabetes (HR = 1.74, 95% CI = 1.02-2.98) and radiotherapy (HR = 1.88, 95% CI = 1.07-3.29) were associated with increased mortality hazard.

Conclusion: Disparities in survival rates between FN and non-FN women may be influenced by factors such as age, comorbidity, detection method, and surgery type. This study shows encouraging improvement over time and advocates for actionable changes to close the survival gap and enhance treatment outcomes for FN women.

INTRODUCTION

Breast cancer is Canada's second most common cancer and the leading cancer among women, with 1 in 8 women diagnosed with this condition in their lifetime.[1,2] The incidence rate of breast cancer among women in Canada increased annually by 1.9% from 1984 to 1991.[3] Since then, it has slightly declined by an average of 0.1% per year, due to enhanced screening and treatment advancements, resulting in a stable trend for almost three decades.[1,3] However, within Ontario, breast cancer rates among First Nations women, initially lower, have gradually increased, now closely aligning with the incidence rates observed in other women in Ontario.[4]

Despite similar incidence rates, significant survival disparities persist between First Nations and

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non-First Nations women. Studies show that First Nations women are more likely to be diagnosed at a later stage and have higher mortality rates compared to other populations.[5–7] These disparities are often attributed to limited access to early detection and screening programs, cultural barriers, and socioeconomic factors. Additionally, comorbidities, particularly diabetes, contribute to poorer outcomes, with diabetes increasing the risk of cancer in Indigenous populations.[6,8] Treatment disparities, particularly in the use of chemotherapy and radiotherapy, have also been shown to influence survival outcomes.[9,10] These findings highlight the necessity for further analysis to better understand the disparities, while emphasizing the need for a holistic healthcare approach that addresses both cancer and prevalent comorbidities, alongside the unique cultural and geographic challenges faced by First Nations women.

The present study builds upon earlier work that compared cohorts of First Nations and non-First Nations women who were diagnosed with breast cancer between 1995 and 2004 in Ontario and explored the determinants of breast cancer survival.[7,11] Previous research found that survival was more than three times poorer for First Nations women diagnosed at stage I, and the risk of death after a stage I diagnosis was about five times higher for those with a comorbidity other than diabetes.[7,11,12] For First Nations women with diabetes, the hazard of death was more than five times greater compared to those without comorbidities.[7] The current analysis utilizes more contemporary outcome data and an extended follow-up period to assess if breast cancer survival rates have changed over time, while exploring the influence of factors like prognosis, treatment and socio-economic conditions on breast cancer survival.

The primary objectives of this study are to compare the 10-year survival distribution by stage at breast cancer diagnosis between First Nations and non-First Nations women in Ontario, and to examine the potential influence of other factors on survival by stage within First Nations women. By examining a more recent time period of breast cancer survival among First Nations women, this study aims to assess the effectiveness of the cancer care system in Ontario and identify areas where disparities persist or improvements have been made.

METHODS

Study Cohorts

The original study cohorts were included from a population-based cancer registry, the Ontario Cancer Registry (OCR), which holds all cancers diagnosed in Ontario residents since 1964.[13] The OCR comprises patient information including date of birth, sex, postal code at diagnosis, date and cause of death, and tumor characteristics; however, it does not contain any data on First Nations, Inuit or Métis identity. To identify a cohort of First Nations women in Ontario, the Indian Registration System (IRS) was used, which encompasses First Nations individuals with status (those registered under the Indian Act of Canada). This group, identified between 1968 and 1991, included roughly 141,000 people.[14] These individuals were subsequently linked to the OCR to track cancer incidence and survival outcomes. The cohort of First Nations women identified through the IRS was linked to breast cancer diagnoses made between 1995 and 2004, as well as to the mortality database extending through 2007, enabling the tracking of cancer incidence and survival rates among this population. The number of non-First Nations women included in the study was based on the final number of First Nations women whose medical charts were abstracted; since there was a large pool of non-First Nation women to draw on, we more than doubled that sample (Figure 1). First Nations women included in the study were those diagnosed with breast cancer and seen at a Regional Cancer Program (RCP) in Ontario—specialized centers that deliver all cancer radiotherapy in the province. RCP files contained detailed patient records, including diagnostic and treatment details for additional care received at other institutions. The Regional Cancer Centres (RCCs) attended were The Ottawa Hospital Cancer Centre, Northeast Cancer Centre (Sudbury), Odette Cancer Centre (Toronto), Juravinski Cancer Centre (Hamilton), Cancer Centre of Southeastern Ontario (Kingston), London Regional Cancer Program, Princess Margaret Cancer Centre (Toronto), Regional Cancer Care Northwest (Thunder Bay), and Windsor Regional Cancer Centre.

Updated Linkage

The original cohort was re-linked to the OCR up to December 31, 2019, to obtain the most recent data on survival, cause of death, and subsequent cancer diagnoses at the time of linkage. The OCR is not static, and case information can be updated over time. Therefore, we excluded women whose breast cancer diagnoses occurred outside of the study period.

Description of Study Variables

Personal and Demographic Characteristics

The most up-to-date data were extracted from medical charts at the RCPs including age at diagnosis and period of diagnosis (both validated by re-linkage to the OCR), and the RCP location attended by each patient. Personal factors abstracted encompassed Body Mass Index (BMI), calculated as weight in kilograms divided by height in meters squared and

categorized into normal (BMI<25kg/m²), overweight (BMI 25-29.9kg/m²), and obese (BMI≥30kg/m²); smoking status was consolidated into 'ever smokers' and 'never smokers' to account for the potential impact of both current and former active cigarette smoking and family history considered first-degree relatives with breast or ovarian cancer.

Additionally, comorbidity included concurrent health conditions at diagnosis, categorized as no comorbidity, diabetes, or other conditions. The comorbidity variable included 17 health conditions as specified in the Charlson index, chosen for their potential to influence mortality risk, treatment adherence, or procedural and drug contraindications.[15] The urban or rural residency and income quintile of each patient were determined using their postal code at diagnosis, as referenced from the Postal Code Conversion File (PCCF+). The distance to the RCC was computed using the straight-line distance from a woman's residence to the RCC, categorized as 'close,' 'moderate,' and 'far.' The categorization was based on distance tertiles specific to First Nations women, with northern women categorized as close (0-118 km), moderate (118-267 km), and far (267+ km), and southern women as close (0-30 km), moderate (30-81 km), and far (81+ km).

Breast Cancer Tumor Characteristics and Treatment

Breast cancer was defined as a diagnosis of primary invasive breast cancer, encompassing any histological type. The method of cancer detection was categorized as 'screened' for cases identified through routine mammography outside or within the Ontario Breast Screening Program,[16] and as 'symptomatic' when detected by the patient, a physician, or other healthcare professionals. Stages of breast cancer were classified using the American Joint Committee on Cancer TNM scheme, categorized as stage I, stage II, and stages III–IV. For the purposes of this analysis, the stage at diagnosis was aggregated into a binary variable, categorizing as stage I and stages II+. The TNM classification scheme, expressing the anatomical extent of the disease, included T (extent of the primary tumor), N (regional lymph node involvement), and M (distant metastasis).[17] The treatment variable assessed whether women received stage- and age-appropriate treatments, as defined by guidelines developed by the Physician's Data Query system, which align care with the disease stage and patient characteristics.

Detailed records of treatment modalities such as radiotherapy, chemotherapy, hormonal therapy, and surgeries were used to determine stage- and age-appropriate treatment for each case. This included whether a woman underwent a mastectomy or a lumpectomy plus radiotherapy, based on guidelines from the Physician's Data Query. Moreover, the severity of surgery was defined by the intensity of surgical procedures, distinguishing between more intensive surgeries like mastectomies and less intensive ones such as lumpectomies or breast-conserving treatments.

Follow-Up Diagnoses and Vital Status

With the re-linkage of the cohort to the OCR, more recent data on subsequent cancer diagnoses (both breast and other cancers), vital status and cause of death were obtained up to 2019. The cause of death was categorized as death from any cause, breast cancer-specific death, or non-breast cancer-specific death.

Statistical Analysis

The Pearson's chi-square test was used to compare the distribution of demographic and personal factors, tumor characteristics and treatment, and vital status between First Nations and non-First Nations women. In addition to the Pearson's chi-square test for categorical variables, t-tests were used to compare continuous variable frequencies between groups. Survival time for each woman was calculated from the date of diagnosis until the earliest of the following events: death from any cause, a subsequent cancer diagnosis, or 10 years after the initial breast cancer diagnosis, with a maximum follow-up date of December 31, 2019. The stage at breast cancer diagnosis was aggregated into a binary variable (i.e., stage I and stages II+) and Kaplan-Meier curves were created to compare the 10-year survival distribution by stage between First Nations and non-First Nations women. The effect of First Nations status on stage-specific 10-year all-cause survival was assessed using a Cox Proportional Hazards regression model. This model was adjusted for age (i.e., <50/ ≥50), comorbidity (i.e., no/other/diabetes), method of detection (i.e., screen detected/non-screen detected), and severity of surgery (i.e., least severe/most severe), following the results of the stepwise selection within SAS 9.4. The proportional hazards assumption was tested and confirmed to ensure it was not violated, validating our use of the Cox regression models for the 10-year survival all-cause mortality analysis (Figure 2). To examine the determinants of survival among First Nations women, a Cox Proportional Hazards model for each factor was developed and stratified by stage at breast cancer diagnosis and adjusted categorically for age, comorbidity, method of detection, and severity of surgery. Log-rank tests were used to determine possible differences between the survival curves of

First Nations and non-First Nations women for each of the two stage categories.

RESULTS

This selection process resulted in a final cohort comprising 282 First Nations women and 670 non-First Nations women, all of whom were diagnosed with an invasive breast cancer and had attended one of the designated RCPs in Ontario (Figure 1). The overall follow-up time for First Nations women was significantly shorter compared to that of non-First Nations women (12.5 and 13.9 years respectively, P=0.0091.

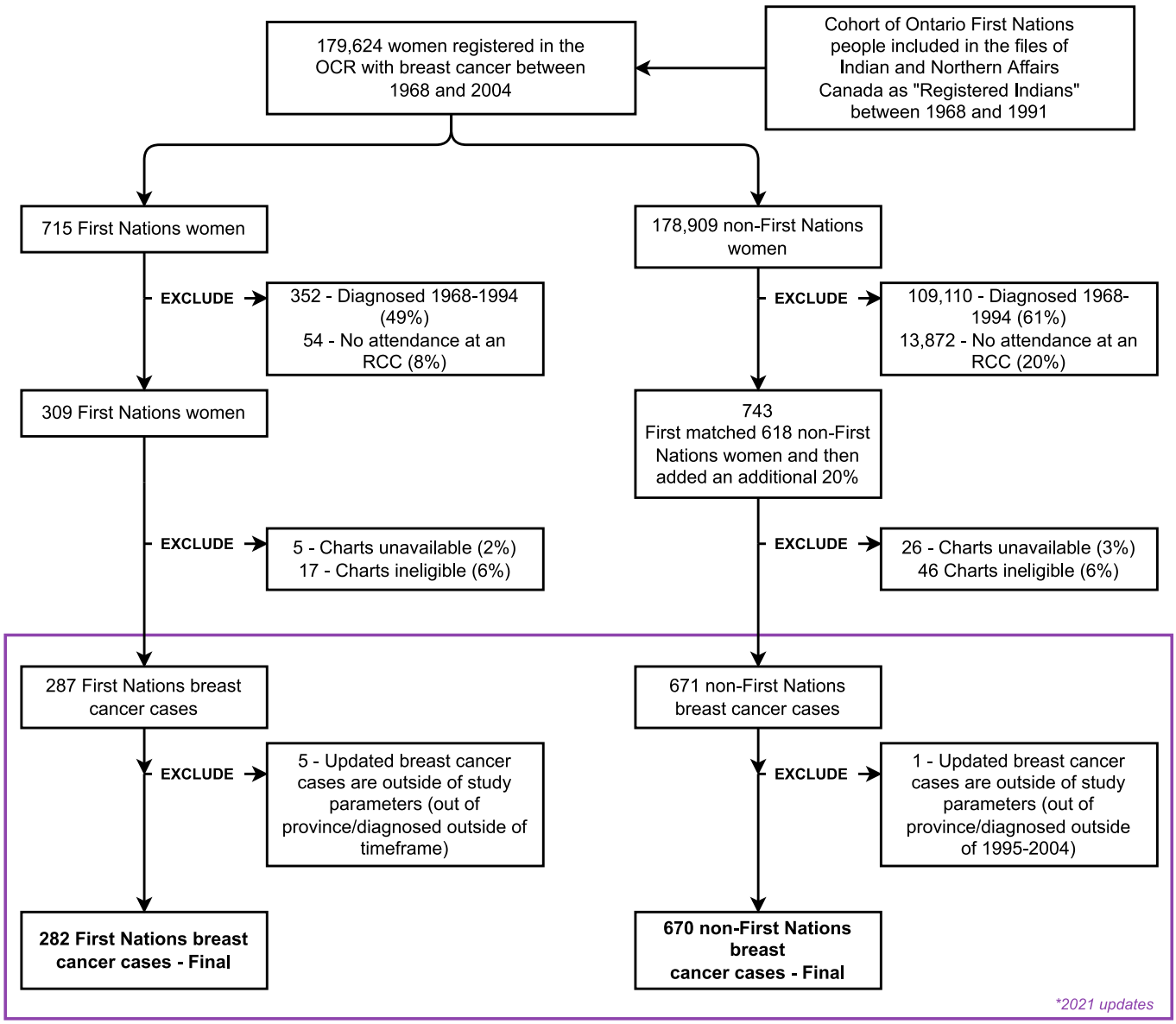

Figure 1. Cohort Creation Flow Chart and Eligibility Criteria

There was a significant difference in the method of detection, with 22% of First Nations women's breast cancers being screen detected, compared to 29% among non-First Nations women (P=0.0187). Additionally, First Nations women were more frequently diagnosed at later stages of breast cancer (stage II-IV) than non-First Nations women (P=0.0065).

First Nations women had a significantly longer time to diagnosis for subsequent cancers compared to non-First Nations women, with a mean of 10 years versus 7.6 years for non-breast cancers (P=0.0256) and 12 years versus 9.8 years for any cancer (P=0.0278).

Table 1. Characteristics and breast cancer risk factors among First Nations and non-First Nations women

Variables	First Nations women	Non-First Nations women	P-Value
Demographic and Personal Factors	N= 282 (%)	N= 670 (%)	
Age at diagnosis, years			
15-49	102 (36)	242 (36)	0.988
50+	180 (64)	428 (64)	
Mean (SD)	55.3 (12.7)	57.1 (13.9)	0.053
Period of diagnosis			
1995-1999	133 (47)	317 (47)	0.966
2000-2004	149 (53)	353 (53)	
Regional Cancer Program (RCP) attended			
The Ottawa Hospital Cancer Centre (Ottawa)	17 (6)	51 (8)	0.945
Northeast Cancer Centre (Sudbury)	61 (22)	141 (21)	
Odette Cancer Centre (Toronto)	16 (6)	33 (5)	
Juravinski Cancer Centre (Hamilton)	53 (19)	117 (18)	
Cancer Centre of Southeastern Ontario (Kingston)	34 (12)	78 (12)	
London Regional Cancer Program (London)	23 (8)	57 (9)	
Princess Margaret Cancer Centre (Toronto)	18 (6)	32 (5)	
Regional Cancer Care Northwest (Thunder Bay)	58 (21)	156 (23)	
Windsor Regional Cancer Centre (Windsor)	≤6 (1)	≤6 (1)	
Follow-up time, years (earliest of subsequent cancer diagnosis, death or December 31, 2019)*			
Mean (SD)	12.53 (7.54)	13.92 (7.26)	0.0091
Distance to RCP – in thirds*			
Close – 0-14km	53 (19)	266 (40)	<0.0001
Moderate – 15-99km	97 (34)	217 (32)	
Far – 100+km	132 (47)	187 (28)	
Distance to RCP – in thirds by North and South RCPs*			
Close – North=0-117km, South=0-29km	85 (30)	344 (51)	<0.0001
Moderate – North=118-266km, South=30-80km	101 (36)	200 (30)	
Far – North =267+km, South=81+km	96 (34)	126 (19)	
BMI*			
Normal weight	42 (17)	205 (37.21)	<0.0001
Overweight	82 (33.33)	188 (34.12)	
Obese	122 (49.59)	158 (28.68)	
Unknown	36	119	
Smoking status*			
Never smoker	77 (31.05)	295 (50.95)	<0.0001
Ever smoker	171 (68.95)	284 (49.05)	
Unknown	34	91	
Residence*			
Urban	131 (46.45)	524 (78.33)	<0.0001
Rural	151 (54.55)	145 (21.67)	
Unknown	0	1	
Income quintile*			
1 – Lowest	74 (30.83)	135 (20.39)	0.0203
2	44 (18.33)	134 (20.24)	
3	42 (17.50)	118 (17.82)	
4	38 (15.83)	130 (19.64)	
5 – Highest	42 (17.50)	145 (21.90)	
Unknown	42	8	
Any comorbidity*			
No	176 (63.54)	533 (81.87)	<0.0001
Other	32 (11.55)	71 (10.91)	
Diabetes	69 (24.91)	47 (7.22)	
Unknown	5	19	
Family history of breast or ovarian cancer			

No	179 (69.92)	391 (63.89)	0.0878
Yes	77 (30.08)	221 (36.11)	
Unknown	26	58	
Tumor characteristics and treatment			
Method of detection*			
Symptomatic	211 (77.29)	450 (69.66)	0.0187
Screen detected	62 (22.71)	196 (30.34)	
Unknown	9	24	
TNM stage*			
Stage I	94 (33.81)	283 (42)	0.0065
Stage II+	184 (66.19)	366 (55)	
Unknown	4	21	
Estrogen/progesterone receptor status			
Neither positive	65 (25)	143 (24.78)	0.8689
Estrogen receptor positive	187 (71.92)	412 (71.4)	
Progesterone receptor positive	8 (3.08)	22 (3.81)	
Unknown	22	93	
Subsequent breast cancer			
No	264 (94)	619 (92)	0.504
Yes	18 (6)	51 (8)	
Time to subsequent breast cancer, years			
Mean (SD)	14 (4.6)	16.1 (4.4)	0.0873
Subsequent non-breast cancer			
No	247 (88)	583 (87)	0.809
Yes	35 (12)	87 (13)	
Time to subsequent non-breast cancer, years*			
Mean (SD)	7.6 (5.9)	10.3 (6)	0.0256
Subsequent cancer (any)			
No	230 (82)	543 (81)	0.853
Yes	52 (18)	127 (19)	
Time to subsequent cancer (any), years*			
Mean (SD)	9.8 (6.3)	12.1 (6.2)	0.0278
Radiotherapy*			
No	91 (32.62)	168 (25.42)	0.024
Yes	188 (67.38)	493 (74.58)	
Unknown	3	9	
Chemotherapy			
No	140 (50)	341 (51)	0.651
Yes	141 (50)	322 (49)	
Unknown	1	7	
Hormonal therapy			
No	129 (46)	308 (46)	0.877
Yes	152 (54)	355 (54)	
Unknown	1	7	
Surgery*			
Least	174 (62)	487 (73)	0.0008
Most	108 (38)	183 (27)	
Stage- and age-appropriate treatment			
No	68 (24)	146 (25)	0.516
Yes	210 (76)	503 (75)	
Unknown	4	21	
Vital status (up to 2019)			
Vital status			
Alive	124 (44)	329 (49)	0.148
Deceased	158 (56)	341 (51)	
Cause of death			
Breast cancer	82 (52)	169 (51)	0.932
Other cancer	19 (12)	40 (12)	
Other	57 (36)	127 (37)	
Unknown	0	5	

Note. Significant at P <0.05(*). Although described, unknown categories were not included in the chi-square/t-test.

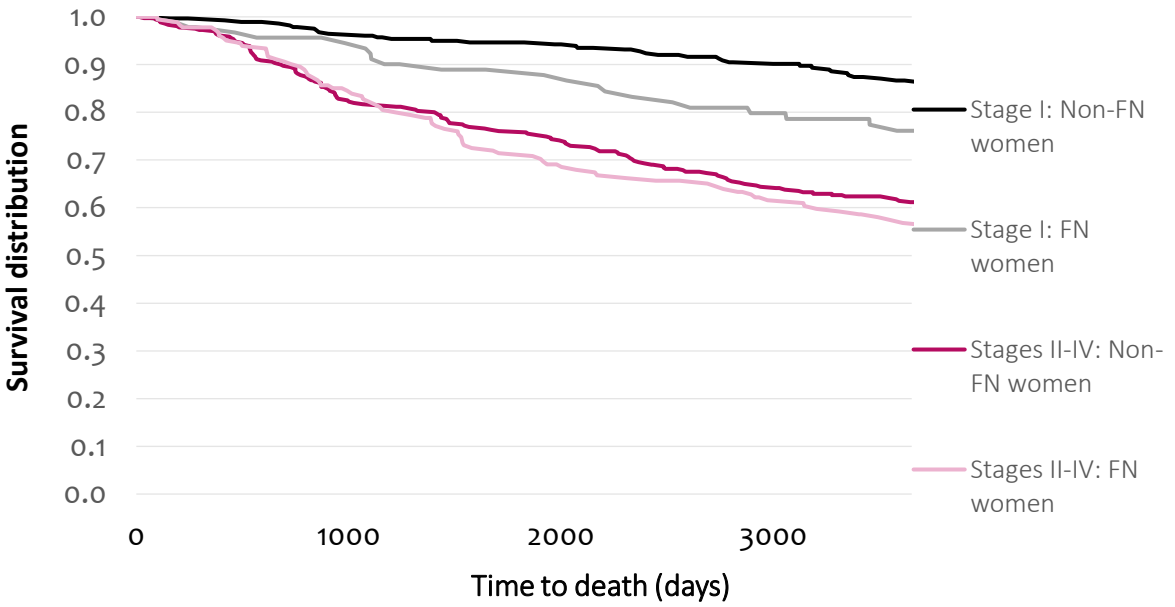

Figure 2. 10-year survival distribution (all-cause) stratified by stage at breast cancer diagnosis (stages I, II-IV) comparing First Nations and non-First Nations women – censored on subsequent cancers

Table 2. Annual number of women at risk of death after breast cancer diagnosis, by stage and First Nations status

Year	0	1	2	3	4	5	6	7	8	9	10
Stage I											
Non-FN women	283	282	278	272	268	265	262	257	249	239	232
FN women	366	355	325	296	286	276	260	244	231	223	216
Stage II-IV											
Non-FN women	94	91	89	88	82	81	78	74	72	71	68
FN women	184	180	166	150	139	129	121	117	109	104	98

Treatment differences were apparent, with First Nations women significantly more likely to undergo intensive surgery, such as mastectomies (38% vs. 27%, P=0.0008), and less likely to receive radiotherapy (67% vs. 75%, p=0.024), compared to non-First Nations women. However, the rates of stage- and age-appropriate treatments were similar across both groups (76% vs. 75%, P=0.516) (Table 1).

Among First Nations women diagnosed with a stage I breast cancer, comorbidities other than diabetes (HR = 3.95, 95% CI = 1.20-12.97) and diabetes (HR = 3.10, 95% CI = 1.09-8.81) significantly increased mortality hazard (Table 4). Chemotherapy was also associated with increased mortality in this group (HR = 4.05, 95% CI = 1.46-11.20), while hormonal therapy was associated with reduced mortality (HR = 0.38, 95% CI = 0.14-0.996). Among First Nations women diagnosed with advanced breast cancer (stages II+), diabetes (HR = 1.74, 95% CI = 1.02-2.98) and radiotherapy (HR = 1.88, 95% CI = 1.07-3.29) were associated with increased mortality hazard.

Table 3. 10-year univariable Hazards Ratios and 95% CIs for First Nations status and demographic, clinical, and treatment factors by stage at diagnosis (stages I, II-IV)

Adjusted model	HR (95% CI)	
	Stage I	Stage II-IV
First Nations status		
Non-First Nations	1.00	1.00
First Nations	1.26 (0.69-2.33)	1.05 (0.78-1.41)
Comorbidity		
No	1.00	1.00
Other	2.92 (1.42-6.01)*	1.90 (1.28-2.83)*
Diabetes	3.55 (1.75-7.22)*	1.62 (1.09-2.41)*
Age group		
15-49	1.00	1.00
50+	2.11 (0.95-4.68)	1.28 (0.94-1.74)
Method of detection		
Symptomatic	1.00	1.00
Screen detected	0.90 (0.52-1.56)	0.72 (0.48-1.09)
Surgery severity		
Least	1.00	1.00
Most	1.02 (0.52-1.98)	1.49 (1.12-1.97)*

DISCUSSION

The present study builds upon the foundational work of Sheppard *et al.*, by utilizing an updated cohort with more recent data, providing a contemporary perspective to assess how survival outcomes have evolved over a longer period.[7] The results of the current study align with and extend previous research by revealing a positive trend in long-term survival for First Nations women, but highlight gaps that still need attention within the breast cancer community.

After adjusting for age, period of diagnosis, and RCP location, we observed persistent survival differences between First Nations and non-First Nations women. The results of our analyses suggest that these disparities could be influenced by factors such as the higher prevalence of comorbidities, particularly diabetes, among First Nations women, as well as differences in treatment modalities received. Socioeconomic challenges, including income disparities and geographic barriers, may further exacerbate these survival differences by limiting access to timely and comprehensive cancer care. Additionally, cultural and systemic factors could play a role in treatment adherence and healthcare experiences. The findings reinforce the complexity of breast cancer survival among First Nations women, emphasizing that disparities are rooted in factors such as healthcare access, comorbidity prevalence, socioeconomic status, and treatment differences.

These findings highlight the need for culturally tailored healthcare strategies and policies that address both medical and social determinants of health to reduce disparities and improve outcomes for First Nations women.

Our results mark a significant shift in the survival outcomes for First Nations women with breast cancer, particularly in early-stage disease.

In contrast, our earlier findings indicated a significant threefold higher risk of death after a stage I breast cancer 5 years after diagnosis (the current 10-year analysis presents a more encouraging scenario).[7] The absence of a significant rise in mortality for stage I breast cancer among First Nations women over a decade indicates a favorable change in the survival trends, reflecting improvements in treatment and healthcare access for First Nations women

However, while these results are a positive indication of progress, it is crucial to recognize that the journey towards completely bridging the survival gap between First Nations and non-First Nations women is ongoing.

The existing literature has shown that there are stage-specific breast cancer survival disparities between First Nations and non-First Nations women.

Table 4. 10-year adjusted HRs and 95% CIs of demographic, personal, tumor and treatment factors in First Nations women by stage at diagnosis (stages I, II-IV)

Adjusted model	First Nations women - HR (95% CI)	
	Stage I	Stage II-IV
Body Mass Index (BMI)		
Normal	1.00	1.00
Overweight	1.21 (0.32-4.49)	0.56 (0.24-1.32)
Obese	0.99 (0.28-3.50)	0.62 (0.29-1.33)
Smoking status		
Never smoker	1.00	1.00
Ever smoker	1.85 (0.50-6.79)	1.02 (0.58-1.80)
Comorbidity		
No	1.00	1.00
Other	3.95 (1.20-12.97)*	0.97 (0.41-2.3)
Diabetes	3.10 (1.09-8.81)*	1.74(1.02-2.98)*
Distance to RCP		
Close	1.00	1.00
Medium	1.35 (0.41-4.44)	1.02 (0.56-1.87)
Far	1.36 (0.42-4.42)	1.04 (0.58-1.89)
Method of detection		
Symptomatic	1.00	1.00
Screen detected	2.29 (0.90-5.81)	0.71 (0.34-1.52)
Surgery severity		
Least	1.00	1.00
Most	1.24 (0.47-3.30)	1.42 (0.89-2.27)
Age group		
15-49	1.00	1.00
50+	1.27 (0.33-4.82)	1.16 (0.70-1.92)
Income quintile		
1 - Lowest	6.41 (0.79-51.87)	1.34 (0.57-3.12)
2	3.53 (0.28-44.05)	1.67 (0.71-3.91)
3	NA	2.12 (0.88-5.14)
4	7.12 (0.82-61.49)	1.03 (0.35-3.01)
5 - Highest	1.00	1.00
Radiotherapy		
No	1.00	1.00
Yes	0.53 (0.15-1.80)	1.88 (1.07-3.29)*
Chemotherapy		
No	1.00	1.00
Yes	4.05 (1.46-11.20)*	1.05 (0.61-1.81)
Hormonal therapy		
No	1.00	1.00
Yes	0.38 (0.14-0.996)*	0.69 (0.42-1.14)
Stage- and age-appropriate treatment		
No	0.60 (0.15-2.35)	1.13 (0.67-1.90)
Yes	1.00	1.00

Note. Significant results marked with (*). Adjusted for age, comorbidity, method of detection, and severity of surgery.

One study reported a significant disparity in breast cancer stage at diagnosis for First Nations women in Manitoba, with a higher likelihood of being diagnosed at later stages compared to other people in this province.[5] Similarly, another study reported that First Nations people in Canada are more likely to be diagnosed with cancer at later stages compared to non-Indigenous people in Canada, leading to significantly lower survival rates.[18] Advanced-stage cancers often require more aggressive treatments, which may not be as effective as early-stage interventions, thereby influencing overall survival rates negatively. This late-stage diagnosis can be attributed to various factors including limited access to early detection and screening programs, cultural barriers, and socioeconomic factors.[5]

The current findings that comorbidities, particularly diabetes, significantly increase the mortality hazard among First Nations women with breast cancer is consistent with the results observed in the original and subsequent analyses.[7,19] Furthermore, a study focusing on indigenous cancer patients in Australia demonstrated that those with diabetes faced a significant survival disadvantage compared to their non-diabetic counterparts.[8] This was attributed to a higher incidence of non-cancer deaths, more advanced cancer stages at diagnosis, reduced access to cancer treatment, and a greater prevalence of other comorbidities. These observations align with situations in Manitoba, where diabetes has been shown to increase the risk of several cancers in Indigenous populations.[6]

To address these challenges, strategies such as improved diabetes screening, management, and access to culturally appropriate care are essential.[20,21] Community-based, culturally-tailored interventions, including the use of tools like the FORGE AHEAD clinical readiness consultation, can help ensure that diabetes care is integrated effectively within local First Nations communities.[22] These initiatives, combined with efforts to address social determinants of health such as food insecurity and limited access to care,[23,24] are critical to improving survival outcomes for First Nations women with breast cancer and diabetes.

The differences in breast cancer mortality hazard associated with chemotherapy, radiotherapy, and hormonal therapy in our study echo the findings of previous studies that emphasized disparities in breast cancer treatment and subsequent cancer death among Indigenous and non-Indigenous women.[9] Specifically, the increased mortality hazard associated with radiotherapy in First Nations women with advanced-stage breast cancer and chemotherapy for those with stage I warrants further investigation. It is crucial to note that our study did not assess treatment compliance or factors influencing treatment choice, which could differ between First Nations and non-First Nations women due to geographic disparities and other factors. Given that radiotherapy services are predominantly located in urban centers, First Nations women living in remote or rural areas face additional barriers to accessing these treatments, potentially influencing the observed disparities in survival outcomes.

Our findings also highlight the observation that radiotherapy and hormonal therapy are linked to reduced mortality in stage I breast cancer, aligning with older studies which documented disparities in breast cancer treatment among various racial and ethnic groups.[25] For stages II-IV breast cancer, hormonal therapy showed a reduction in mortality risk, suggesting its potential effectiveness across more advanced stages of cancer. This differential impact of treatment modalities warrants the need for careful consideration of treatment approaches in First Nations women, as also discussed by other researchers[10] who noted disparities in cancer treatment and comorbidity status among Indigenous and non-Indigenous populations.

Moreover, these findings emphasize the complexity of treating breast cancer within diverse populations. The effectiveness and risks associated with radiotherapy[26] demonstrate that long-term risks such as second cancers and cardiovascular diseases must be weighed against the immediate benefits of reduced recurrence and mortality. This decision-making process is further complicated in settings where access to comprehensive cancer care is limited by geographic and systemic barriers.

Given these complexities, future research should focus on examining the intersection of First Nations identity and treatment modalities to better understand and address the unique healthcare challenges faced by these groups. Such studies are crucial for developing tailored strategies that not only improve survival outcomes but also minimize long-term adverse effects, ensuring equitable and effective cancer care for all populations.

Although this study on breast cancer survival among First Nations women in Ontario offers important insights, there were a few limitations. Firstly, the study spans a decade, a period during which medical practices, diagnostic technologies, and treatment protocols likely evolved, potentially affecting the comparability and relevance of the survival outcomes over time. The statistical power of the study might also be limited, particularly in subgroup analyses, due to the sample size of First Nations women. Moreover, while the OCR had limited data on lifestyle factors and environmental exposures, additional risk factors and access to care

variables were obtained from the RCP charts. However, the study may still not fully address other aspects of health behaviors or access to healthcare, which are significant in cancer diagnosis, treatment, and survival. Furthermore, there was a lack of detailed data on whether patients completed the prescribed breast cancer treatments, which is a crucial factor in evaluating treatment effectiveness and survival outcomes. This gap highlights a potential area for future research to better understand the impact of treatment adherence on breast cancer survival among First Nations women.

CONCLUSION

While differences in survival rates between First Nations and non-First Nations women are apparent, they may be influenced by factors such as age, comorbidity, detection method, and surgery type. However, the evolution from the initial examination of these cohorts marks a significant shift in understanding breast cancer survival among First Nations women. Firstly, it supports the persistence of certain challenges, such as the impact of comorbidities, especially diabetes, while also suggesting the need for stage-specific interventions, the specific effects of different treatments and the influence of geographic location on survival outcomes. Notably, our study brings to light an encouraging improvement in survival rates, particularly in early-stage breast cancer among First Nations women, suggesting positive changes in cancer care strategies and healthcare access over time.

In conclusion, these findings underline the importance of continuous surveillance and the need for adaptive cancer care strategies tailored for First Nations women. It is imperative to recognize the nuanced and evolving landscape of factors affecting breast cancer survival to develop effective, culturally sensitive, and holistic approaches that can further enhance outcomes.[27] While acknowledging the strides made, this study reaffirms the commitment to ongoing efforts in research and healthcare practices to sustain and amplify these positive trends in breast cancer survival among First Nations women.

ETHICAL CONSIDERATIONS

This study has received ethical approval from the University of Toronto Research Ethics Board (REB) and was supported by the Joint Ontario Indigenous Health Committee.

DATA AVAILABILITY

Parts of the material underlying this article are based on data and information provided by Ontario Health (Cancer Care Ontario). Ontario Health is prohibited from making the data used in this research publicly accessible if it includes potentially identifiable personal health information and/or personal information as defined in Ontario law, specifically the Personal Health Information Protection Act (PHIPA) and the Freedom of Information and Protection of Privacy Act (FIPPA). Upon request and approval by the Joint Ontario Indigenous Health Committee, data de-identified to a level suitable for public release may be provided.

CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

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