Breast and Colorectal Cancer Survival Disparities in Southeastern Wisconsin

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ABSTRACT

Background: Cancer health disparities by race, ethnicity, socioeconomic status, and geography are a top public health priority. Breast and colorectal cancer, in particular, have been shown to exhibit significant disparities and contribute a large proportion of morbidity and mortality from cancer. In addition, breast and colorectal cancer offer targets for prevention and control, including nutrition, physical activity, screening, and effective treatments to prolong and enhance the quality of survival. However, despite the investment of significant time and resources over many years, breast and colorectal cancer disparities persist, and in some cases, may be growing.

Methods: This paper examines breast and colorectal cancer survival disparities in an 8-county region in southeastern Wisconsin, including the City of Milwaukee. Cox proportional hazards models were used to examine survival trends, and a new adaptation of adaptive spatial filtering—a disease mapping method—was used to examine spatial patterns of survival.

Results: Disparities by race and ethnicity are revealed, and spatial analyses identify specific areas within the study region that have lower than expected survival rates.

Conclusions: Cancer control efforts in southeastern Wisconsin should focus on black/African American and Hispanic/Latina women to reduce breast cancer survival disparities, and black/African American populations to reduce colorectal cancer disparities. Evidence indicates that targeted interventions may be needed to serve populations in the Milwaukee and Kenosha metropolitan areas, as well as areas of Walworth, Ozaukee, and Waukesha counties.

INTRODUCTION

Approximately 30,000 Wisconsin residents are diagnosed with cancer each year, and over 11,000 die from cancer.[1] Cancer

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health disparities by race, ethnicity, socioeconomic status, and geography are a top public health priority. Breast and colorectal cancer, in particular, have been shown to exhibit significant racial and ethnic disparities, contribute a large proportion of morbidity and mortality from cancer, and offer targets for prevention and control, including nutrition, physical activity, screening, and effective treatments to prolong and enhance the quality of survival. However, despite the investment of significant time and resources over many years, breast and colorectal cancer disparities persist and in some cases may be growing.

African Americans in Wisconsin have higher age-adjusted incidence and mortality rates per 100,000 from colorectal cancer,[1] and although African American women are less likely to be diagnosed with breast cancer than white women in Wisconsin, they are more likely to succumb to the disease.[2] Nearly 90% of African Americans in Wisconsin live in southeastern Wisconsin counties, with almost 70% living in Milwaukee County, mostly in the City of Milwaukee.[3]

Milwaukee has been called one of the most segregated cities in America.[4] Local historian John Gurda has examined the process by which segregation and urban decline took root in Milwaukee,[5] describing the processes of migration and disinvestment in Milwaukee's urban core. Disinvestment was accompanied by decreasing home values and discriminatory housing policies that resulted in long-term entrenched poverty and residential racial segregation in the city. Interconnections among race, place, and socioeconomic status are now well established in Milwaukee, and spatial patterns of socioeconomic status are correlated with a range of adverse disease outcomes.[6-8]

Table. Multivariate Cox Proportional Hazards Regression (HR) Models Predicting All Causes and Cancer Specific Breast and Colorectal Cancer Survival

	Breast (All Causes)	Breast (Cancer Specific)	Colorectal (All Causes)	Colorectal (Cancer Specific)
Race and Ethnicity	HR	HR	HR	HR
White	Referent	Referent	Referent	Referent
Black/African American	1.55[a]	1.55[a]	1.21[a]	1.18[a]
Hispanic/Latino	1.60[a]	1.54[a]	0.75	0.83
American Indian/Alaska Native	1.40	0.85	1.17	1.41
Asian/Pacific Islander	1.23	1.08	1.23	1.15
Other/Unknown	0.85	0.72	1.90[a]	2.01[a]

[a] P-value < 0.05.

To reduce the cancer burden in Wisconsin and reduce cancer disparities, a focus on southeastern Wisconsin is of clear importance. Because of the availability of screening tests and the advantage of early stage diagnosis, as well as the availability of therapies to lengthen survival, this proposed work focuses on disparities in breast and colorectal cancer survival in southeastern Wisconsin to provide actionable evidence to guide future cancer control efforts in the region.

METHODS

Study Area

The study area is defined as 8 counties in southeastern Wisconsin (Milwaukee, Jefferson, Kenosha, Ozaukee, Racine, Walworth, Washington, and Waukesha counties). Overall, the population of this area is 14% black/African American, 10% Hispanic/Latino, 72% white, and ~5% other minorities. The City of Milwaukee is the metropolitan center of this region with approximately 595,000 residents, of whom 39% are black/African American, 17% are Hispanic/Latino, and 38% are white, in addition to other racial and ethnic minority populations.

Data and Analysis

Incidence data were obtained from the Wisconsin Cancer Reporting System (WCRS) for the years 2002-2011 for invasive breast and colorectal cancers for the study area. This study was authorized by the institutional review board and approved by the Wisconsin Department of Health Services (DHS) Research Review Board for the release of cancer data for the purpose of cancer prevention and control as defined in Wis Stat. 255.04(3)(c). WCRS is a population-based tumor registry in the Office of Health Informatics, Division of Public Health, in DHS. Guided by statutory mandate, it collects, manages, and analyzes cancer data on Wisconsin residents newly diagnosed with pre-invasive and invasive cancers.[9] Cases are reported by hospitals, physicians, and clinics, including important data such as demographic data, tumor characteristics, and treatment. WCRS registry records are linked with the Wi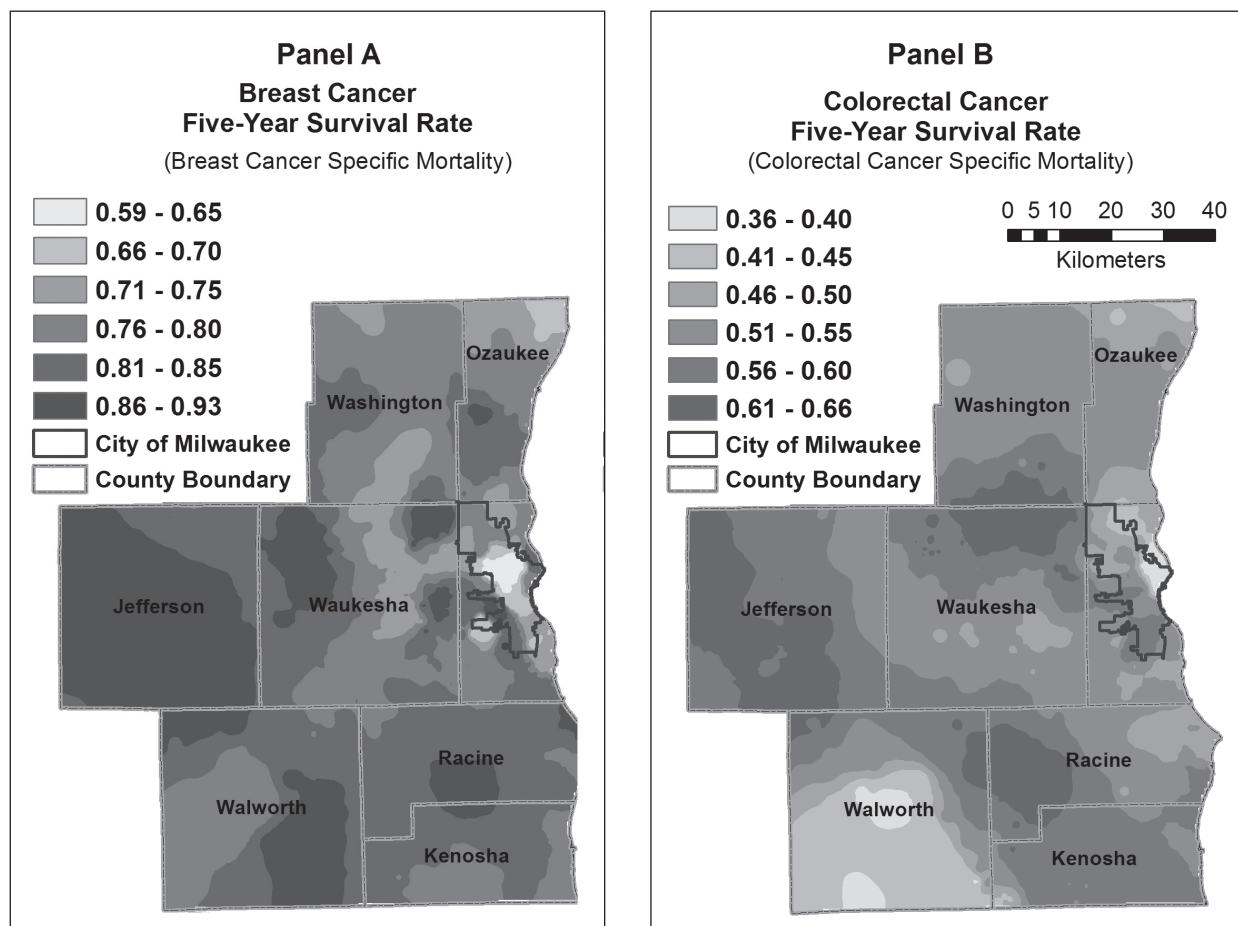sconsin Vital Records resident death file on a yearly basis, providing the date and cause of death. Those registry records not matched to the Wisconsin resident death file are then sent to the National Center for Health Statistics for National Death Index (NDI) linkage. Records linked to the NDI also include the date and cause of death.

ICD-O-3 codes were used to define breast and colorectal cancer, based on the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) coding guidelines for breast and colorectal cancers. Two subsets were created to represent all individuals who had an initial diagnosis of invasive breast (n = 11,411) or colorectal (n = 7286) cancer during 2002-2011. Descriptive statistics were calculated for each subset, Cox proportional hazards models were used to examine survival trends by race and ethnicity (white/Caucasian, black/African American, Hispanic/Latino, Indigenous, Asian Pacific Islander, Other/Unknown) while adjusting for age (5-year age groups), stage of disease at diagnosis (localized, regional, distant, and unstaged, based on SEER Summary 2000 stage), marital status (single, married, separated, divorced, widowed, unknown) and sex (for colorectal cancer only). Analyses examined both overall mortality and cancer-specific mortality.

Geographic identifiers available from WCRS included the ZIP code and county of residence at the time of diagnosis. Records were geocoded by project staff to ZIP Code Tabulation Area (ZCTA) centers.[10] A new adaptation of adaptive spatial filtering—a disease mapping method—was used to examine spatial patterns of survival. Adaptive spatial filtering (ASF)[11-16] is a disease mapping method designed to overcome problems with traditional disease maps that rely on administrative boundaries (eg, county), such as the small numbers problem and the modifiable areal unit problem.[17-20] In ASF, a grid is placed over the study area, and for each grid point, a rate is calculated by using a circular filter that expands, based on a threshold specified by the user, to obtain data from multiple locations until it obtains enough observations to calculate a stable rate. The result is a map that displays disease rates as a continuous surface. Until recently, the ASF method only had been used to calculate incidence and mortality rates using age standardization procedures. Here, we extend this method to present 5-year survival rates continuously across geographic space. Cancer data were aggregated by ZIP code, and Census Block Group centroids were employed as the analysis grid. Data from counties bordering the study area was incorporated into these spatial analyses to mitigate the influence of border effects on resultant spatial patterns; maps were cropped to the study area boundary.

Figure 1. Spatial Patterns of Breast and Colorectal Cancer 5-Year Survival (Cancer-Specific Mortality)

Panel A
**Breast Cancer
Five-Year Survival Rate**
(Breast Cancer Specific Mortality)

- 0.59 - 0.65
- 0.66 - 0.70
- 0.71 - 0.75
- 0.76 - 0.80
- 0.81 - 0.85
- 0.86 - 0.93
- City of Milwaukee
- County Boundary

Panel B
**Colorectal Cancer
Five-Year Survival Rate**
(Colorectal Cancer Specific Mortality)

- 0.36 - 0.40
- 0.41 - 0.45
- 0.46 - 0.50
- 0.51 - 0.55
- 0.56 - 0.60
- 0.61 - 0.66
- City of Milwaukee
- County Boundary

0 5 10 20 30 40
Kilometers

RESULTS

Kaplan Meier analyses revealed distinct disparities by race and ethnicity in survival post breast cancer diagnosis. Black women experienced the poorest survival, and white women experienced the best survival. Odds ratios (OR) for race and ethnicity resulting from the Cox proportional hazards analyses for both overall mortality and cancer-specific mortality for breast and colorectal cancer are presented in the Table. Black/African American individuals experience poorer survival than white people for all outcomes examined, with higher hazard ratios for breast cancer than colorectal cancer. Hispanic/Latina women experienced significantly poorer breast cancer survival than white women. Unsurprisingly, older age and later stage at diagnosis were associated with poorer survival for both breast and colorectal cancer. Compared to single individuals, married individuals experienced higher survival for both breast and colorectal cancer, while separated individuals experienced poorer colorectal cancer-specific mortality. Widowed individuals experienced more favorable all-cause mortality when compared to single individuals. Men diagnosed with colorectal cancer experienced poorer all-cause and colorectal cancer-specific mortality, when compared to women.

Figure 1 displays the 5-year survival rates for breast and colorectal cancer as a continuously defined disease surface. Rates represent the proportion of individuals in each local area who are still alive 5 years after diagnosis. Category breaks are set at 5% intervals. Clear spatial patterns emerge, highlighting poorer breast cancer survival rates in the Milwaukee metropolitan area, and colorectal cancer survival disparities in Walworth County and some areas in and around Milwaukee. Areas of Ozaukee and Waukesha counties also exhibit lower survival rates.

To enhance interpretation, Figure 2 presents the 5-year survival rate map for breast cancer in Milwaukee County (Panel A), along with a five-year survival rate map for localized (early stage) breast cancers only (Panel B), and maps that use US Census data to illustrate the poverty rate (Panel C) and the racial and ethnic distribution of populations throughout Milwaukee County (Panel D).

Figure 2. Breast Cancer Survival (5-Year Survival and 5-Year Survival for Women with Localized Tumors, Cancer-Specific Mortality), Poverty and Race/Ethnicity in Milwaukee County
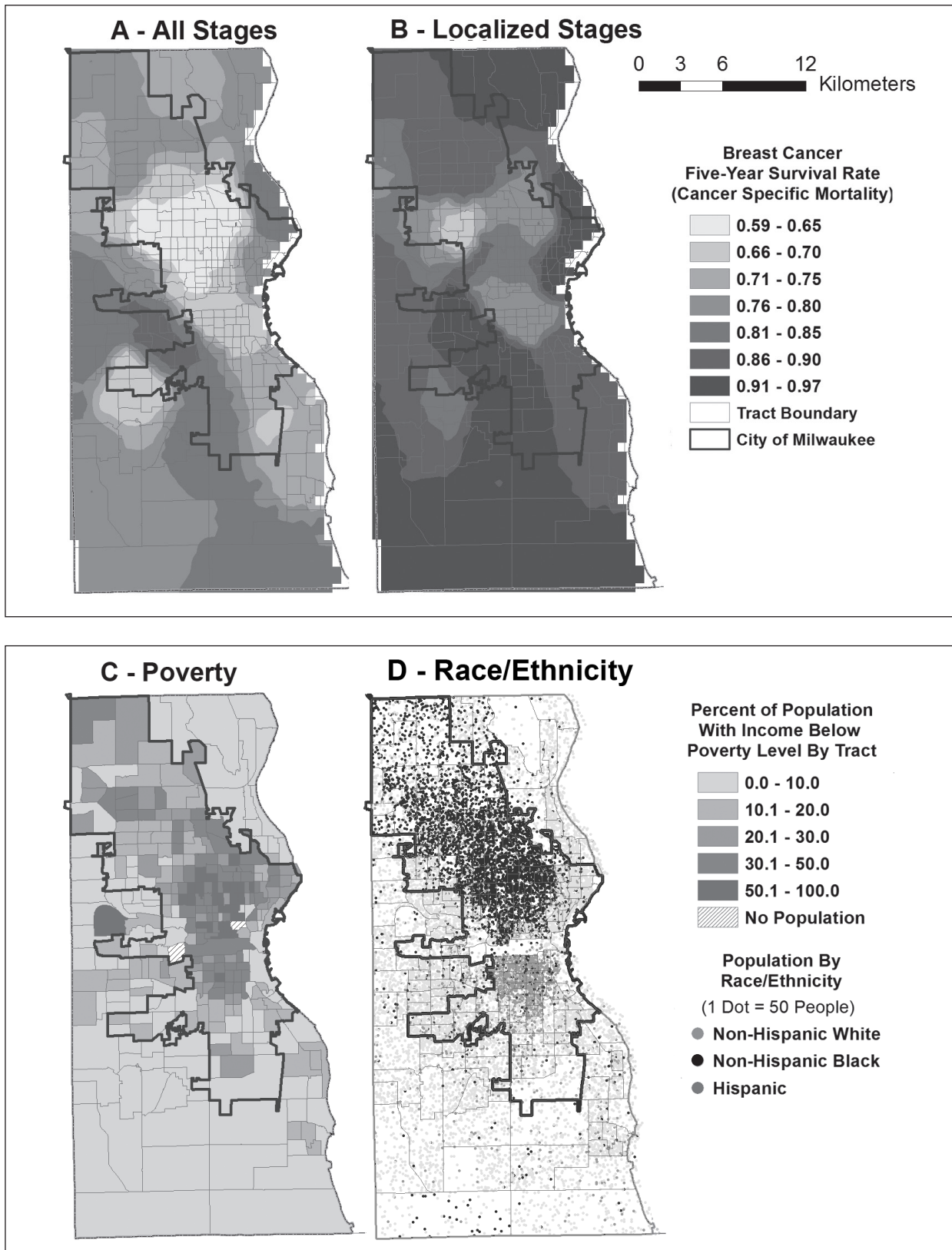
CONCLUSIONS

This study revealed significant cancer survival disparities by race, ethnicity, sex, and geography in southeastern Wisconsin, including through the use of innovative spatial analysis techniques. In particular, black/African American populations exhibit significantly poorer survival trajectories than their white counterparts for both breast and colorectal cancer survival, including both all causes and cancer-specific causes of death (OR = 1.18 to 1.55), indicating a clear need for cancer control measures focused on this population. Further, women of Hispanic/Latina ethnicity have poorer survival for breast cancer than white women for both all causes and cancer-specific mortality (OR = 1.54-1.60). Spatial analyses reveal key regions of the area that exhibit lower breast and colorectal cancer survival rates, including several regions in and around the City of Milwaukee, and several rural areas throughout southeastern Wisconsin. Cancer control efforts should consider these regions as primary targets for cancer control in southeastern Wisconsin. Information on detailed spatial patterns of cancer survival has not been previously available; thus, these findings present new opportunities for the targeting of cancer control efforts.

Limitations of this analysis include the small number of American Indian/Alaska Native individuals in the study, which may have precluded the detection of significant disparities if they do exist. The other/unknown category experienced poorer colorectal cancer survival, but an examination revealed little information regarding the individuals contained by this category, limiting interpretation. Spatial analyses are limited as they present 5-year survival rates, which do not control for covariates. Future work should develop and employ methods that adjust for important confounders, including age and stage at diagnosis.

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