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Racial and geographical disparities in oesophageal cancer incidence, mortality and county-level risk factors in the state of Mississippi between 2003 and 2019: a descriptive analysis

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Abstract

Background—Oesophageal cancer is one of the most aggressive cancers. The aim was to describe the disparities in oesophageal cancer incidence and mortality, and county-level factors in the state of Mississippi from 2003 to 2019 by sex, race, and geolocation.

Methods—This study used data from the Mississippi Cancer Registry, linked to county-level data from the Behavioral Risk Factor Surveillance System, the American Community Survey, and the Institutes for Health Metrics and Evaluation. We estimated age-standardised incidence (crude ASR) and mortality rates (crude AMR), mortality–incidence rate ratio and average annual percent change (AAPC) in rates by sex, race, and geolocation, using the Joinpoint Software V.5.0. We further calculated relative risks for oesophageal cancer using age-adjusted quasi-Poisson regression for each county-level factor including smoking, obesity, college degree completion, unemployment rate and median household income ranking within the state.

Results—Between 2003 and 2019, a total of 2737 oesophageal cancer cases and 2259 oesophageal cancer deaths occurred in Mississippi. Black men had the greatest reduction in oesophageal cancer incidence and mortality despite high rates (crude ASR_{2019}=10.5, crude AMR_{2019}=7.3 per 100 000; $AAPC_{incidence}$=−3.7%, p<0.001 and $AAPC_{mortality}$=−4.9%, p<0.001). The reduction was largely driven by decreases in the non-Delta region ($AAPC_{incidence}$=−4.2%, p<0.001), while incidence rate remained high among Black men in the Delta region (crude ASR_{2019}=15.4 per 100 000, $AAPC_{incidence}$=−1.8%, p=0.3). The rates among White men were relatively stable (crude ASR_{2019}=8.5, crude AMR_{2019}=7.6 per 100 000; $AAPC_{incidence}$=0.18%, p=0.7, $AAPC_{mortality}$=−0.4%, p=0.6). County-level smoking prevalence (in quartile, p=0.02) was significantly associated with oesophageal cancer incidence.

Discussion—This study highlights the importance of targeted interventions to address the persistent high incidence rate of oesophageal cancer among Black men in the Delta region.

INTRODUCTION

Oesophageal cancer is an aggressive malignancy and has one of the lowest 5-year survival rates (20%) in the USA.[1 2] In 2022, an estimated 20 640 newly diagnosed oesophageal cancer cases and 16 410 deaths occurred in the USA.[1] Oesophageal squamous cell carcinoma (ESCC) and adenocarcinoma (EAC) are the two major histological types. ESCC is the predominant subtype among African American/Black people, while EAC is more prevalent among White population where the age-standardised incidence rate was more than three times higher than the Black population.[3] Cigarette smoking is a common shared risk factor for the two subtypes, but other major risk factors differ by subtype, including heavy alcohol intake for ESCC and obesity and gastro-oesophageal reflux disease for EAC.[4 5] Disparities in the incidence of oesophageal cancer may be attributed to variations in the prevalence of associated risk factors across different population groups.[4] In addition, despite substantial therapeutic improvements for both EAC and ESCC in recent years, there have been less significant improvements in survival observed for patients with ESCC,

contributing to disparities in mortality.[6] Socioeconomic status is another important driver of racial disparities in cancer,[7] including oesophageal cancer.

Compared with other US states, Mississippi has the highest percentage of Black population and is among the most pronounced degree of health and healthcare racial inequities.[8] In 2020, African American/Black people and non-Hispanic White people accounted for 94% of the state's population, representing 1.1 and 1.7 million individuals, respectively.[8] A large proportion of the state's Black population reside in the Mississippi Delta region, a rural area with high poverty and limited healthcare access. The Mississippi Delta region is the distinctive northwest section of Mississippi. In the 19th century, the Delta region emerged as a pivotal centre for plantation production, making it an integral player in the agricultural economy of the Southern USA. Despite its agricultural productivity, the Delta has faced persistent poverty and healthcare disparities. Factors include racial inequality, a lack of diverse economic opportunities, and limited access to education and healthcare due to racism and racial segregation.[8 9] Using data from the Mississippi Cancer Registry, we aimed to describe trends of oesophageal cancer incidence and mortality among the Black and White population in Mississippi from 2003 to 2019. We further stratified estimates by the Delta and non-Delta region. To explore potential risk factors, we estimated the association of oesophageal cancer incidence in relation to county-level factors of smoking, obesity, college degree completion, unemployment rate and median household income ranking within the state.

MATERIALS AND METHODS

Oesophageal cancer was defined using the International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3 codes): C15.0–C15.9, excluding histology 9050–9055, 9140, 9590–9993. We extracted the annual number of invasive oesophageal cancer cases, deaths and corresponding population data from the Mississippi Cancer Registry for sex (men/women), race (Black population/White population), geolocations (Delta/non-Delta), and county during the period of 2003–2019.[10] Online supplemental table 1 presents a map and a breakdown of the 82 counties in the state of Mississippi, including 18 counties in the Delta region. Given Desoto County's notably high per capita income ranking in Mississippi, we excluded it from the analysis of the Delta region and incorporated it into the non-Delta region. This adjustment aligns with common practice in order to facilitate a more precise estimation of health disparities between the Delta and non-Delta regions in Mississippi. We retrieved county-level risk factor data from the Behavioral Risk Factor Surveillance System, American Community Survey, and Institutes for Health Metrics and Evaluation (online supplemental table 2).[11–13] Outcome data were linked to exposure data at county level for risk factor analysis.

We estimated the age-standardised oesophageal cancer incidence rate (crude ASR) and mortality rate (crude AMR), respectively, stratified by sex, race, and Delta region using the US population in 2000 for standardisation. We further calculated mortality–incidence rate ratio (MIR) as a population-based indicator of survival. We then estimated the trend of ASR and AMR by sex, race, and geolocation using the weighted Bayesian information criterion model in the Joinpoint Software V.5.0.[14 15] We also estimated the average

annual percent change (AAPC) in rates.[15] Finally, we assessed the association of five county-level risk factors (in quartiles) based on prior literature of oesophageal cancer risk and data availability, including prevalence of smoking and obesity (body mass index ≥30), and population with a college degree (%), unemployment rate (%), and median household income ranking within the state. We examined the association between the county-level variables and county Delta status, using an age-adjusted multivariate quasi-Poisson regression. Regrettably, due to data availability, racial-group stratification of the analysis by Delta status, was not feasible, though we conducted additional sensitivity analysis adjusting for county Delta status in the regression analysis.

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guideline.

Patient and public involvement

This study was conducted with the support of Mississippi Cancer Registry staff and management groups. The feedback from patient and public involvement at an early stage was essential in determining the study design and analysis.

RESULTS

During 2003—2019, a total of 2737 oesophageal cancer cases and 2259 oesophageal cancer deaths occurred in Mississippi. Black people accounted for 37% (n=1014) of cases and 35% (n=797) of deaths, and White people accounted for 62% (n=1701) and 64% (n=1444), respectively. In 2019, Black men had higher incidence of oesophageal cancer (crude ASR_{2019}=10.5, crude AMR_{2019}=7.3 per 100 000) than their White counterparts (crude ASR_{2019}=8.5, crude AMR_{2019}=7.6 per 100 000) (table 1). Rates were generally low among women regardless of race. Despite high rates, Black men had the greatest reduction in incidence and mortality ($AAPC_{incidence}$=−3.7% per year, p<0.001; and $AAPC_{mortality}$=−4.9% oer year, p<0.001, figure 1). By contrast, the rates of White men were relatively stable ($AAPC_{incidence}$=0.2% per year, p=0.7; and $AAPC_{mortality}$=−0.4% per year, p=0.6) (figure 1). The MIR improved substantially among Black people from 1.1 in 2003 to 0.7 in 2019 among men and 1.5 in 2003 to 0.5 in 2019 among women. Among White people, MIR remained relatively stable for men but improved from 1.1 in 2003 to 0.7 in 2019 for women (table 1).

Trends varied when stratifying estimates by Delta versus non-Delta region. During 2003–2019, Black people accounted for 69% (n=287) of oesophageal cancer cases and 64% (n=226) of death in the Delta region and 31% (n=727) and 30% (n=571) in non-Delta region, while White people accounted for 31% (n=130) of cases and 36% (n=126) of deaths in the Delta region and 68% (n=1565) and 69% (n=1248) in non-Delta region. In Delta region, oesophageal cancer incidence remained high among Black men (crude ASR_{2019}=15.4 per 100 000). While there was a slight declining trend, it was not statistically significant ($AAPC_{incidence}$=−1.8% per year, p=0.3), yet mortality rate declined consistently across this time frame ($AAPC_{mortality}$=−5.4% per year, p=0.01) (table 1 and figure 2). By contrast, in the non-Delta region, both incidence and mortality rate decreased significantly among Black men ($AAPC_{incidence}$=−4.2% per year, p<0.001; $AAPC_{mortality}$=−4.6% per year,

p=0.002), while incidence rate increased slightly among White men ($AAPC_{incidence}$=0.3% per year, p=0.6; $AAPC_{mortality}$=−0.4% per year, p=0.6) (table 1). Notably, we observed a reduction in the Black–White disparity in ASR and AMR in the non-Delta region, with rates becoming comparable between Black men and White men after 2016 (figure 2). Estimates for women were unstable due to small numbers.

We did not observe a significant association between county Delta status and county-level smoking prevalence (p=0.44), obesity (p=0.10), population with a college degree (p=0.71) and unemployment rate (p=0.05). Median household income ranking within the state was significantly associated with county Delta status where the mean of the median household income ranking was significantly lower in the Delta region than non-Delta region (p=0.001). County-level risk factor analyses suggested an association between smoking prevalence (in quartile, p=0.02) in relation to oesophageal cancer incidence. Compared with counties with a smoking prevalence of 22% or lower, the risk of oesophageal cancer was 11% higher in counties with a smoking prevalence greater than 28% (figure 3 and online supplemental table 3). Nevertheless, when considering county-level smoking prevalence as a numerical factor, we did not observe a significant association with oesophageal cancer incidence (p=0.07). In addition, unemployment rate, college degree completion, the median household income, and obesity prevalence were not statistically significantly associated with cancer incidence. The results of sensitivity analysis adjusting for Delta status were consistent with the main analysis (online supplemental table 4).

DISCUSSION

During 2003–2019, oesophageal cancer incidence decreased substantially among Black Mississippians, coupled with marked improvement in mortality. We noted a reduction in the Black–White disparity in oesophageal cancer mortality in Mississippi. This result was consistent with a recent nationwide analysis of cancer mortality among Black people in the USA.[16] In addition, in the non-Delta region, oesophageal cancer incidence and mortality rates were comparable between Black men and White men after 2016. The decreases observed in the current study appeared to be driven, in part, by decreasing incidence and mortality among Black people in the non-Delta region. In contrast, in the Delta region, we observed limited improvement in oesophageal cancer incidence among this group, potentially due to factors linked to structural barriers[9] and socioenvironmental factors.

Historically, Black people residing in the Delta region have been exposed disproportionately to adverse socioenvironmental conditions and experience greater barriers to healthcare compared with other groups.[17] Furthermore, our risk factor analysis found a significant association between county-level smoking prevalence and oesophageal cancer, highlighting the importance of continuous intervention to reduce the risk. Incidence rates of ESCC have been decreasing in the USA, primarily attributed to a decrease in cigarette smoking.[18] However, due to data availability, we were unable to assess the impact of county-level smoking prevalence on distinct types of oesophageal cancer. Additionally, we could not stratify the risk factor analysis by racial groups within different county Delta statuses. Further investigations are warranted to delineate the trends of smoking prevalence among racial groups in both Delta and non-Delta regions and its association with ESCC and EAC.

The declining oesophageal cancer mortality rate among Black individuals in Mississippi, observed in both the Delta and non-Delta regions, can be attributed to multiple critical factors. Notably, improved access to screening, early detection and advancements in treatment have played a significant role in reducing cancer mortality in this population. Additionally, public health initiatives targeting risk factors such as smoking and excessive alcohol consumption may have further contributed to this positive trend.

Lack of improvement in oesophageal cancer among White people is concerning. In the current study, we observed non-significant increases in oesophageal cancer mortality in White Mississippians. In 2019, White men had the highest oesophageal cancer mortality compared with other groups, potentially attributable to increasing obesity-related EAC.[19]

The main limitations of the study include unstable estimates for women due to small numbers, and a lack of analysis of other racial and ethnic groups due to very small number of cases. Obesity has differential associations with ESCC and EAC, making that exposure particularly difficult to assess.[4] Lack of histological type and information on treating hospital volume are other limitations of the study, which restrict the interpretation of study results.

CONCLUSIONS

In this descriptive study of Mississippi, we observed substantial reduction in oesophageal cancer incidence and mortality among Black people from 2003 to 2019. However, Black men residing in the Mississippi Delta have disproportionately higher incidence rates, suggesting that targeted efforts are required to address structural and socioenvironmental factors underlying this disparity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Disparities in oesophageal cancer are longstanding yet understudied. Despite recent improvement, outcomes of oesophageal cancer remain persistently poorer among certain groups in the USA.

WHAT THIS STUDY ADDS

⇒ In this serial cross-sectional study of oesophageal cancer in Mississippi, Black people had substantial reduction in state-wide cancer incidence coupled with marked improvement in mortality from 2003 to 2019. This was primarily driven by decreases in incidence and mortality among Black men in the non-Delta region. In contrast, in the Delta region, oesophageal cancer incidence remained high among Black men.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ From 2003 to 2019, there was a significant decrease in oesophageal cancer incidence and mortality among Black Mississippians. However, Black men living in the Mississippi Delta still experienced a disproportionately higher incidence rate. This might be attributed to factors associated with structural barriers and socioeconomic status. Targeted efforts are required to address structural and socioenvironmental factors underlying the disparity.

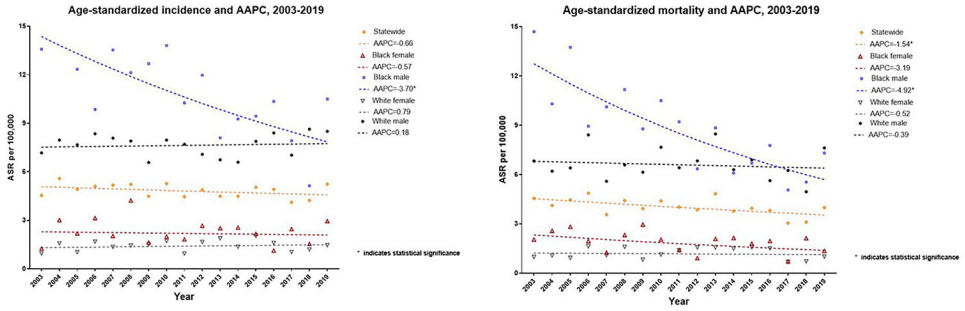

Figure 1.

Trends of age-standardised incidence and mortality, by race and sex, Mississippi, 2003–2019. AAPC, average annual percent change; ASR, age-standardised incidence rate.

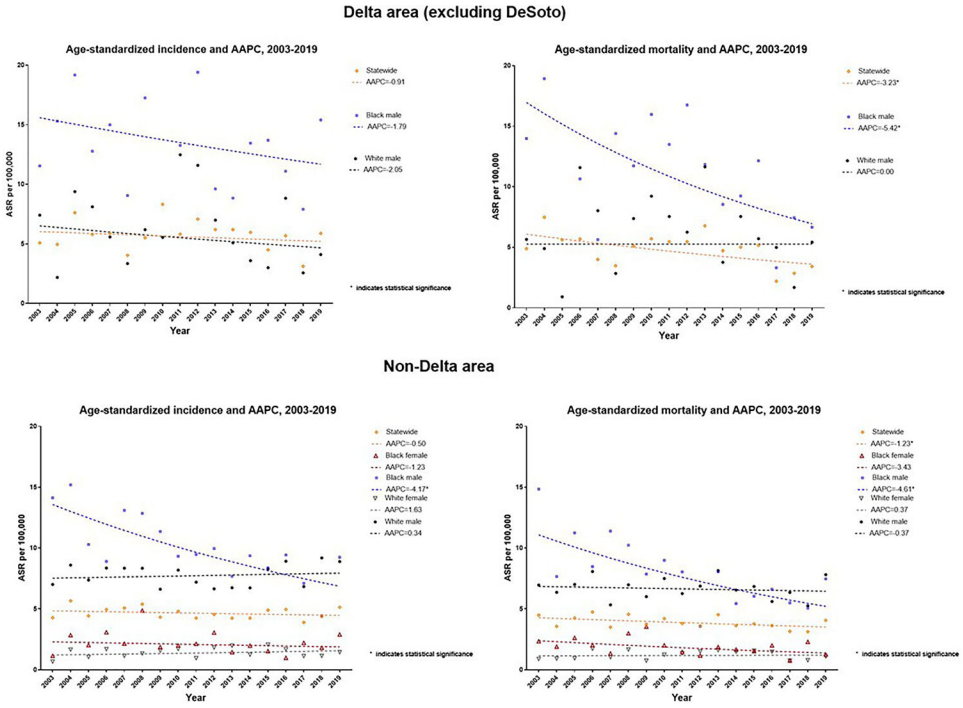

Figure 2.

Trends of age-standardised incidence and mortality, by race and sex, stratified by Delta and non-Delta region, Mississippi, 2003–2019. AAPC, average annual per cent change; ASR, age-standardised incidence rate.

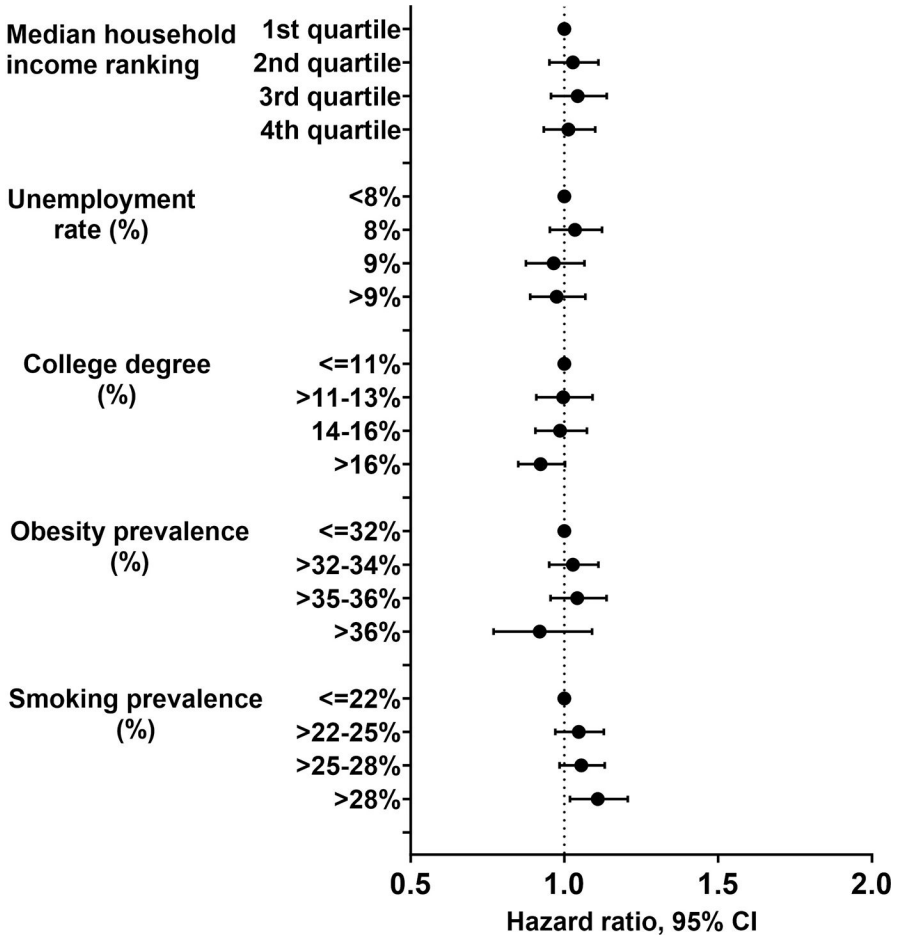

Figure 3.

Multivariate Poisson regression by county-level risk factors in relation to oesophageal cancer, Mississippi, 2003–2019.

Table 1

Age-standardised oesophageal cancer incidence and mortality per 100 000, mortality-incidence rate ratio (MIR) and average annual per cent change in rate (AAPC) by sex and race, Mississippi, 2003–2019

Group	Index	2003	2019	2003–2019	AAPC, %/year
Statewide					
	Cancer cases, #	47	56	795	–
	Deaths, #	48	36	619	–
	Crude incidence (95% CI)	13.6 (9.9 to 18.2)	10.5 (7.7 to 13.9)	10.7 (9.9 to 11.5)	−3.7*
	Crude mortality (95% CI)	14.7 (10.7 to 19.6)	7.3 (4.9 to 10.4)	8.6 (7.9 to 9.4)	−4.9*
Black men	MIR	1.1	0.7	0.8	–
	Cancer cases, #	67	105	1390	–
	Deaths, #	62	90	1179	–
	Crude incidence (95% CI)	7.2 (5.5 to 9.2)	8.5 (6.9 to 10.4)	7.7 (7.3 to 8.1)	0.2
	Crude mortality (95% CI)	6.8 (5.2 to 8.8)	7.6 (6.1 to 9.4)	6.7 (6.3 to 7.1)	−0.4
White men	MIR	0.9	0.9	0.9	–
	Cancer cases, #	6	20	219	–
	Deaths, #	9	10	178	–
	Crude incidence (95% CI)	1.3 (0.5 to 2.7)	3.0 (1.8 to 4.6)	2.3 (2.0, 2.6)	−0.6
	Crude mortality (95% CI)	2.0 (0.9 to 3.8)	1.4 (0.6 to 2.6)	1.9 (1.6 to 2.2)	−3.2
Black women	MIR	1.5	0.5	0.8	–
	Cancer cases, #	11	21	311	–
	Deaths, #	12	15	265	–
	Crude incidence (95% CI)	0.9 (0.5 to 1.7)	1.5 (0.9 to 2.3)	1.5 (1.3 to 1.6)	0.8
	Crude mortality (95% CI)	1.0 (0.5 to 1.8)	1.0 (0.6 to 1.7)	1.2 (1.1 to 1.4)	−0.5
White women	MIR	1.1	0.7	0.8	–
Delta region					
	Cancer cases, #	10	16	231	–
	Deaths, #	11	7	188	–
Black men	Crude incidence (95% CI)	11.5 (5.4 to 21.4)	15.4 (8.5 to 25.8)	14.3 (12.4 to 16.3)	−1.8

Group	Index	2003	2019	2003–2019	AAPC, %/year
	Crude mortality (95% CI)	14.0 (6.8 to 25.1)	6.7 (2.5 to 14.4)	11.8 (10.1 to 13.7)	−5.4 *
	MIR	1.2	0.4	0.8	–
	Cancer cases, #	7	5	104	–
	Deaths, #	5	6	120	–
	Crude incidence (95% CI)	7.4 (3.0 to 15.8)	4.1 (1.3 to 11.3)	6.3 (5.1 to 7.7)	−2.1 *
	Crude mortality (95% CI)	5.7 (1.8 to 13.6)	5.4 (2.0 to 13.2)	6.2 (5.1 to 7.6)	−0.0
White men	MIR	0.8	1.3	1.0	–
	Cancer cases, #	N/A	5	56	–
	Deaths, #	N/A	N/A	38	–
	Crude incidence (95% CI)	N/A	3.18 (1.0 to 8.0)	2.6 (2.0 to 3.4)	0.2
	Crude mortality (95% CI)	N/A	N/A	1.9 (1.3 to 2.6)	N/A
Black women	MIR	0.6	0.5	0.7	–
White women	Cancer cases, #	N/A	N/A	N/A	–
	Deaths, #	N/A	N/A	N/A	–
	Crude incidence (95% CI)	N/A	N/A	N/A	N/A
	Crude mortality (95% CI)	N/A	N/A	N/A	N/A
	MIR	N/A	N/A	N/A	N/A
Non-delta region					
	Cancer cases, #	37	40	564	–
	Deaths, #	37	29	431	–
	Crude incidence (95% CI)	14.1 (9.8 to 19.6)	9.3 (6.4 to 13.0)	9.7 (8.9 to 10.6)	−4.2 *
	Crude mortality (95% CI)	14.8 (10.3 to 20.6)	7.5 (4.8 to 11.0)	7.7 (7.0 to 8.5)	−4.6 *
Black men	MIR	1.0	0.8	0.8	–
	Cancer cases, #	59	100	1284	–
	Deaths, #	57	84	1007	–
	Crude incidence (95% CI)	7.0 (5.3 to 9.1)	8.9 (7.2 to 10.9)	7.8 (7.4 to 8.3)	0.3
	Crude mortality (95% CI)	7.0 (5.2 to 9.0)	7.8 (6.1 to 9.8)	6.7 (6.3 to 7.1)	−0.4
White men	MIR	1.0	0.9	0.9	–
Black women	Cancer cases, #	N/A	15	163	–

Group	Index	2003	2019	2003–2019	AAPC, %/year
	Deaths, #	8	7	140	–
	Crude incidence (95% CI)	N/A	2.9 (1.6 to 4.9)	2.2 (1.9 to 2.6)	N/A
	Crude mortality (95% CI)	2.3 (1.0 to 4.6)	1.3 (0.5 to 2.7)	1.9 (1.6 to 2.2)	−3.4
	MIR	N/A	0.4	0.9	–
	Cancer cases, #	7	19	281	–
	Deaths, #	10	15	241	–
	Crude incidence (95% CI)	0.7 (0.3 to 1.4)	1.4 (0.9 to 2.3)	1.4 (1.3 to 1.6)	1.6
	Crude mortality (95% CI)	0.9 (0.4 to 1.7)	1.1 (0.6 to 1.9)	1.2 (1.1 to 1.4)	0.4
White women	MIR	1.2	0.8	0.9	–

N/A suggests data not available due to small numbers.

* Indicates statistical significance.