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Disparities in cervical cancer survival in the United States by race and stage at diagnosis: An analysis of 138,883 women diagnosed between 2001 and 2014 (CONCORD-3)

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Abstract

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Declaration of Competing Interest

The authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ygyno.2021.08.015>.

Objective.—During 2000–2014, age-standardized five-year net survival for cervical cancer was 63–64% in the United States. Using data from CONCORD-3, we analyzed cervical cancer survival trends by race, stage and period of diagnosis.

Methods.—Data from 41 state-wide population-based cancer registries on 138,883 women diagnosed with cervical cancer during 2001–2014 were available. Vital status was followed up until December 31, 2014. We estimated age-standardized five-year net survival, by race (Black or White), stage and calendar period of diagnosis (2001–2003, 2004–2008, 2009–2014) in each state, and for all participating states combined.

Results.—White women were most commonly diagnosed with localized tumors (45–50%). However, for Black women, localized tumors were the most common stage (43.0%) only during 2001–2003. A smaller proportion of Black women received cancer-directed surgery than White women.

For all stages combined, five-year survival decreased between 2001–2003 and 2009–2014 for both White (64.7% to 63.0%) and Black (56.7% to 55.8%) women. For localized and regional tumors, survival increased over the same period for both White (by 2–3%) and Black women (by 5%). Survival did not change for Black women diagnosed with distant tumors but increased by around 2% for White women.

Conclusions.—Despite similar screening coverage for both Black and White women and improvements in stage-specific survival, Black women still have poorer survival than White women. This may be partially explained by inequities in access to optimal treatment. The results from this study highlight the continuing need to address the disparity in cervical cancer survival between White and Black women in the United States.

Keywords

Cervical cancer; Survival; Inequalities; Cancer stage; Race

1. Introduction

Cervical cancer incidence and mortality have declined steadily over the past few decades due to the introduction of and improvements in routine screening programs in the United States [1]. During 1999–2015, age-standardized annual incidence rates of invasive cervical cancer decreased on average by 1.6% per year, though the speed of decline varied by age, race/ethnic group and geographical region. The largest decline was for women aged 20–24 years, while incidence was stable for women aged 35–39 years [1]. In 2017, Black women had one of the highest annual incidence rates of cervical cancer, with 8.3 new cases per 100,000 women, despite experiencing the largest decline in incidence during 1999–2015. The annual incidence rate for White women was 7.3 per 100,000 women [1,2].

The CONCORD program established global surveillance of cancer survival trends in 2015 [3]. The third cycle of the CONCORD program included data for more than 37.5 million cancer patients diagnosed during 2000–2014 in the populations covered by 322 population-based cancer registries from 71 countries worldwide. CONCORD-3 revealed wide international variations in age-standardized 5-year net survival from cervical cancer,

tumors of the cervix during the same time period, only the first record was included. Benign and *in situ* tumors were excluded.

We defined three calendar periods of diagnosis (2001–2003, 2004–2008 and 2009–2014) to monitor trends in survival over time and to account for changes in data collection methods for SEER Summary Stage 2000, which occurred from January 1, 2004 [10].

We estimated age-standardized five-year net survival by race (Black or White), SEER Summary Stage 2000 and calendar period in each state, and for all participating states combined, using the Pohar Perme estimator [11]. Net survival is the probability of a cancer patient to survive their cancer up to a given time since diagnosis, e.g. one or five years, after controlling for competing risks of death (background mortality), which are higher in older adults. To account for the differences in background mortality between states, racial groups and over time, we used life tables of all-cause mortality that were specific to each county, single year of age, sex, calendar year, socio-economic status and race (all races combined, Black, and White).

We categorized stage at diagnosis according to SEER Summary Stage 2000 [12] (localized, regional, distant and unknown). Stage data were available for all three calendar periods for all states except Washington, which did not submit any data for 2009–2014.

We used the cohort approach to estimate net survival for women diagnosed during 2001–2003 and 2004–2008, because at least five years of follow-up data were available for all women by the end of 2014. The cohort of patients is defined by the year or calendar period of diagnosis (e.g., 2001–2003), and followed for the same length of time (e.g., 5 years). The cohort approach is considered the gold standard for survival estimation as all patients included in the analysis can be followed for the full duration of the survival analysis [13,14]. For women diagnosed during 2009–2014, we used the complete approach, because five years of follow-up data were not available for all women. The complete approach can be used to estimate survival for patients who have been diagnosed more recently but who have not had the opportunity to be followed up for the full amount of time by the end of the study (in this case, December 31, 2014). The follow-up time for women diagnosed during 2009–2014, therefore, varies between one and five years [10].

We produced survival estimates for 5 age groups (15–44, 45–54, 55–64, 65–74 and 75–99 years) and obtained age-standardized estimates for all ages combined using the International Cancer Survival Standard (ICSS) weights [15].

Funnel plots of age-standardized net survival were produced for each calendar period. The funnel plots show how much each race- and state-specific estimate varies from the US pooled estimate (“target” estimate), given the precision of each estimate. The pooled US estimate for all races combined, represented by the horizontal line, is the “target” estimate for this analysis. It was not possible to produce robust age-standardized estimates for all three calendar periods of diagnosis for every state and race combination, thus data from 35 states were included for White women and data from 15 states for Black women.

3. Results

For all races combined, there was a decrease in the proportion of women diagnosed with localized tumors from 50.1% during 2001–2003 to 43.3% during 2009–2014 (Table 1). Consistently, the proportion of regional tumors increased from 32.4% in 2001–2003 to 36.5% in 2009–2014, and from 9.5% in 2001–2003 to 14.3% in 2009–2014 for distant tumors. The proportion of unknown stage tumors decreased from 8.1% in 2001–2003 to 5.9% in 2009–2014.

The distribution of stage at diagnosis was more favorable for White women than Black women in each calendar period of diagnosis. For White women, localized tumors were the most common in each calendar period (51.4%, 47.2% and 44.7% for 2001–2003, 2004–2008 and 2009–2014, respectively). For Black women, localized tumors were the most common from 2001 to 2003 (43.0%), while regional tumors were the most common during 2004–2008 (40.5%) and 2009–2014 (40.1%). The proportions of distant and unknown stage were consistently higher in Black women than in White women in all time periods (1.7%, 2.5% and 3.0% higher in 2001–2003, 2004–2008 and 2009–2014, respectively for distant tumors and 1.2%, 1.4% and 1.0% for tumors of unknown stage).

Age-standardized five-year net survival for all stages and races combined fell slightly from 64.0% (95% CI: 63.4–64.7) in 2001–2003 to 62.4% (61.8–63.1) in 2009–2014 (Table 2).

For all stages combined, survival decreased over time for both White and Black women. For White women, survival decreased slightly from 64.7% (95% CI: 63.9–65.4) in 2001–2003 to 63.0% (62.2–63.7) in 2009–2014. A similar decrease was seen for Black women, with survival decreasing from 56.7% (55.1–58.3) in 2001–2003 to 55.8% (54.3–57.4) in 2009–2014 (Table 2).

Survival was consistently higher in White women than in Black women in each calendar period of diagnosis. However, the disparity in survival between White and Black women may be narrowing over time – in absolute terms, survival was 8.0% higher for White women diagnosed during 2001–2003, but only 7.2% higher for White women diagnosed during 2009–2014. Fig. 1 provides a visual representation of the geographic variation in age-standardized 5-year net survival by race for each calendar period of diagnosis. The funnel plots show that for most states, survival is lower for Black women than for White women, with the survival for Black women falling below the pooled estimate for the United States for most states in each calendar period of diagnosis. The funnel plots also demonstrate that the geographic range in survival is wide for both Black and White women (Supplementary Table 1 and Supplementary Fig. 1). The difference in survival between Black and White women is wide, systematic and persistent over time.

For all races combined, stage-specific survival was highest for women diagnosed during 2009–2014 for all stages, except tumors of unknown stage (Table 2). There were consistent improvements in survival for localized and regional tumors for all races combined, with survival increasing from 84.7% (95% CI: 83.7–85.7) in 2001–2003 to 86.9% (85.6–88.2) in 2009–2014 for localized tumors and from 53.1% (52.0–54.2) in 2001–2003 to 56.4% (55.3–57.5) in 2009–2014 for regional tumors. Survival from distant-stage tumors decreased

slightly from 17.1% (15.7–18.5) in 2001–2003 to 16.3% (15.3–17.3) in 2004–2008, but then increased to 18.7% (17.4–20.0) in 2009–2014 (Fig. 2).

For localized and regional tumors, race- and stage-specific survival increased over time for both White and Black women (Fig. 3). While for both stages White women had consistently higher survival for each calendar period of diagnosis, the improvements over time were greater for Black women. Five-year survival from localized tumors increased in absolute terms by 5.0% over time for Black women (78.6%, 95% CI: 76.0–81.1 in 2001–2003 to 83.6%, 80.8–86.5 in 2009–2014), but only by 1.5% for White women (85.4%, 84.2–86.5 in 2001–2003 to 86.9%, 85.4–88.5 in 2009–2014). For regional tumors, survival increased 4.9% over time for Black women and 3.1% for White women. For distant tumors, however, survival did not change over time for Black women (13.8%, 10.8–16.8 in 2001–2003 and 13.7%, 11.2–16.2 in 2009–2014), but increased by 1.9% for White women. Survival for unknown stage tumors decreased for White women by 5.1% but increased slightly for Black women by 0.9%. The disparity in survival between White and Black women, thus, appears to narrow over time for localized tumors (from 6.8% in 2001–2003 to 3.3% in 2009–2014), regional tumors (from 6.8% in 2001–2003 to 5.0% in 2009–2014) and tumors of unknown stage (from 8.6% in 2001–2003 to 2.6% in 2009–2014), but widens for distant stage tumors (from 3.6% in 2001–2003 to 5.6% in 2009–2014).

The planned first course of treatments (cancer-directed surgery, radiotherapy and/or systemic therapy) differed between White and Black women. For localized tumors, for which surgery is a common treatment, 84.2% of White women received cancer-directed surgery, while only 74.3% of Black women did so (Table 3). For regional and distant tumors, higher proportions of White women received surgery (36.0% and 19.1%, respectively) than Black women (26.8% and 15.1%, respectively).

A slightly higher proportion of Black women diagnosed with a regional tumor received radiotherapy (76.6% vs. 74.7% for White women), while a slightly higher proportion of White women received systemic therapy (71.8% vs. 68.9% for Black women). For distant tumors, for which systemic therapy is the standard treatment, there were large differences between White and Black women. For White women diagnosed with distant tumors, 64.6% received systemic therapy, compared with only 57.7% of Black women.

4. Discussion

This study included high-quality data from 41 population-based state registries covering 85% of the US population. Net survival estimates were produced using the same robust methods for each state, and life tables of background mortality that were specific to single year of age, race/ethnicity, county, county-level socioeconomic status and the calendar year of death. The results from this study on cervical cancer survival show a continuation of a slight decline in survival for both Black and White women over time, but it also highlights the continuing need to address the disparity in survival between Black and White women.

The distribution of stage at diagnosis changed over time, with more women diagnosed with regional and distant tumors in 2009–2014 than had been diagnosed at advanced stages in

2001–2003. There has been improvement in the reporting of stage at diagnosis, in that the proportion of tumors of unknown stage decreased by 2.2%. During 2001–2003, most cancer registries in the United States coded SEER Summary Stage 2000 directly from the medical record. However, starting from January 1, 2004, all registries derived SEER Summary Stage 2000 using the Collaborative Staging System [12,16]. However, Black women were diagnosed at more advanced stages than White women, regardless of the calendar period of diagnosis.

For women diagnosed during 2001–2014, age-standardized 5-year net survival from cervical cancer for all races combined remained relatively stable over time, showing a slight decrease from 64% to 62%. There were persistent racial differences in survival for all stages of diagnosis combined and at each specific stage. Survival for Black women was around 7–8% lower than for White women for all stages combined, with little improvement over time.

Stage at diagnosis is an important predictor of survival from cervical cancer, but the unfavorable stage distribution for Black women does not fully account for the differences in survival for all stages combined. The disparity in stage-specific survival between Black and White women appears to have narrowed slightly for localized, regional and tumors of unknown stage, but has widened for distant stage tumors. Despite greater improvements in survival for Black women with localized and regional tumors and tumors of unknown stage than for White women, Black women still have lower stage-specific survival for each stage.

Lower cervical cancer survival for Black women than White women is thus a combination of a higher proportion of tumors that are diagnosed at a more advanced stage and persistently lower survival at each stage of disease.

Disparities in access to treatment for cervical cancer may explain differences in survival between White and Black women. In the US Military Health Care System, a health care system with equal access to care, there was no difference in treatment received, or in survival, between Black and White women [17]. Given the difference in the proportion of White and Black women receiving cancer-directed surgery for localized or regional tumors, lower stage-specific survival for Black women in the US population may be partially explained by lack of optimal treatment. Treatment data may be under-ascertained in cancer registry data, particularly for radiotherapy and, to a lesser extent, systemic therapy [18,19], but the percentage of patients for whom receipt of radiotherapy was unknown was less than 15% overall, and higher for White women. For systemic therapy, the percentage of women with unknown receipt of treatment was less than 10%, but slightly higher for Black women.

While the proportion of women aged 21–65 years screened for cervical cancer in the United States is around 80%, this is still below the Healthy People 2020 target of 93% and there are disparities in screening for racial and ethnic minority groups [6,7]. The proportions of Black and White women screened are similar, however, there are disparities in follow-up treatment for Black women [20]. Screening is recommended every 3 or 5 years, depending on the woman's age and the screening test used, until age 65 years. Although annual cervical cancer screening was withdrawn as a formal recommendation in 2003 by the USPSTF, it remains a common practice in the United States [21]. Preference for annual screening

may deter some women from seeking screening, especially if they are uninsured. Insurance status is an important factor in receiving routine cervical cancer screening, regardless of race/ethnicity [22]. While routine screening is not recommended for women aged 65 years or older who have been screened previously and have had negative results, many older women are not being screened adequately. Given that the incidence rate of cervical cancer generally increases until 85 years, inadequate screening of older women – many of whom may be at higher risk or have no screening history – may contribute to poor cervical cancer survival for older women [23].

Data for women of other racial groups than White and Black were included in the data submissions, and estimates for all races and stages combined, but we could not produce robust survival estimates for non-Black or non-White races or ethnicities individually due to small numbers for women from these groups. Thus, there may be other racial disparities in cervical cancer survival that are unmeasured in this study.

Population-based cancer survival has been used routinely as a measure to assess the health care system's deficits in managing the cancer burden equitably. Despite similar screening coverage for both Black and White women and improvements in stage-specific survival, Black women continue to have poorer survival than White women. This may be partially explained by inequities in access to adequate treatment. The results from this study highlight the continuing need to address the disparity in cervical cancer survival between White and Black women in the United States. Monitoring and updating the trends in cervical cancer survival by stage and race can inform the development of public health initiatives to eliminate racial disparities and improve cervical cancer survival for all women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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HIGHLIGHTS

- Slight decline in cervical cancer survival for both Black and White women.
- Black women have poorer survival from cervical cancer than White women.
- Black women have lower stage-specific survival than White women.

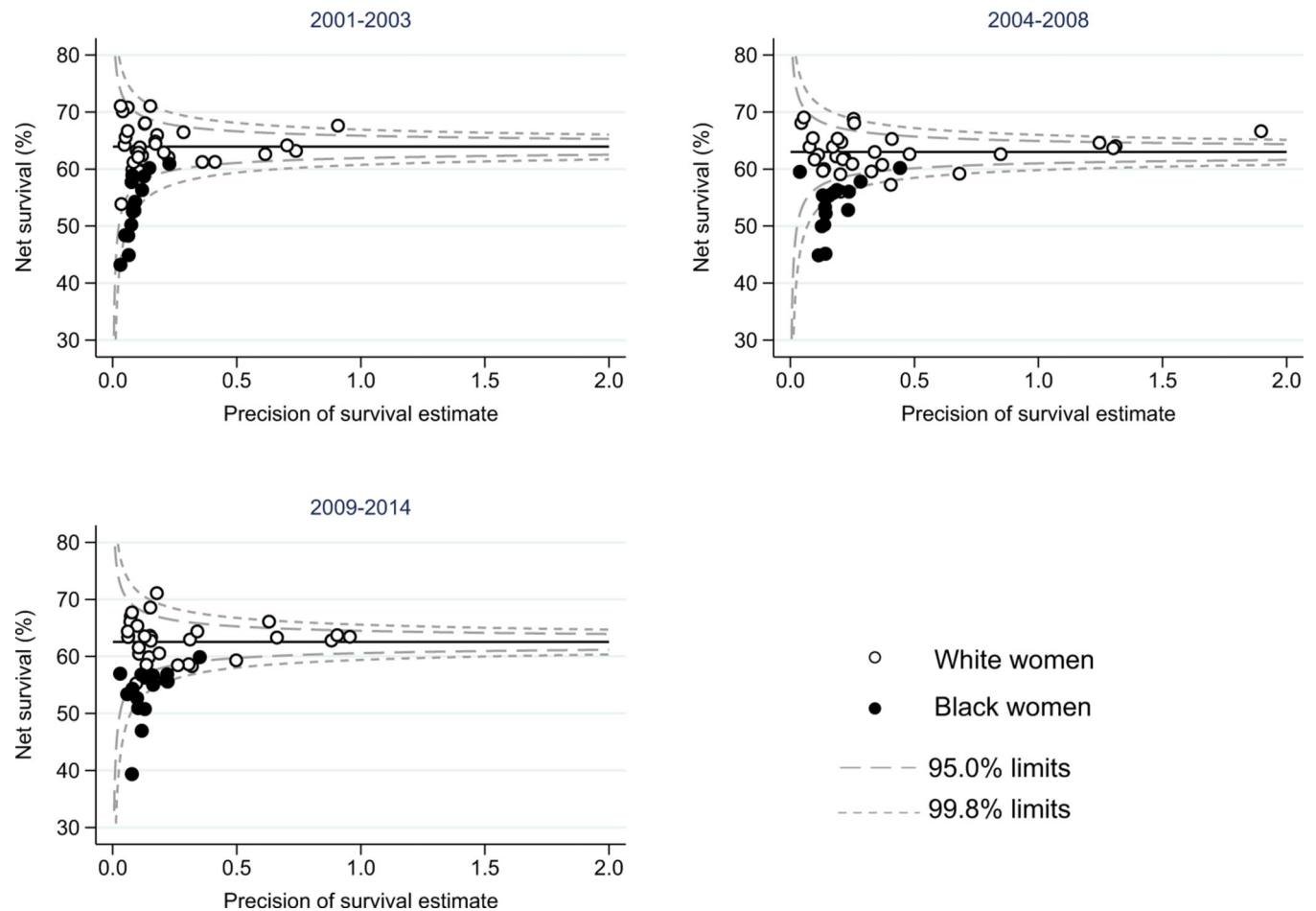


Fig. 1.

Age-standardized five-year net survival (%) for women (aged 15–99 years) diagnosed with cervical cancer during 2001–2014.

The circles in the figure represent state-specific survival estimates. Open circles represent the state-specific estimate for White women and closed circles represent the state-specific estimate for Black women. The pooled (US) survival estimates for each calendar period are shown by the horizontal (solid) line with corresponding 95.0% and 99.8% control limits (dotted lines).

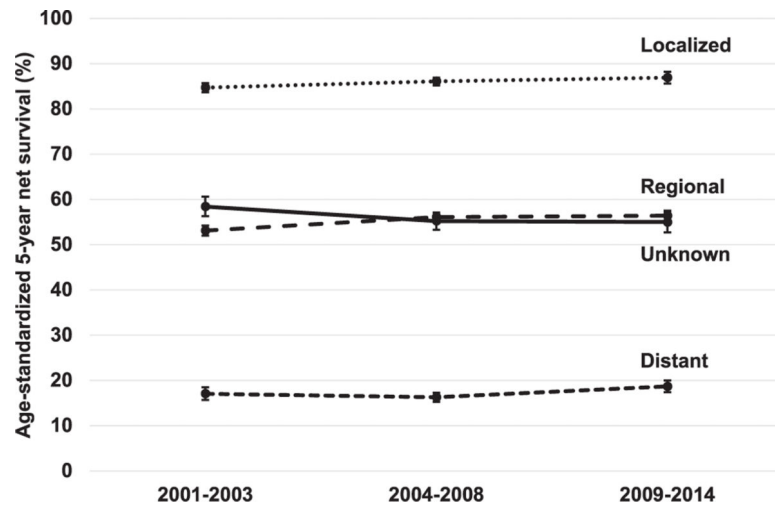


Fig. 2. Trends in age-standardized five-year net survival (%) for women (aged 15–99 years) diagnosed during 2001–2014 with cervical cancer by SEER Summary Stage at diagnosis (all racial groups combined).

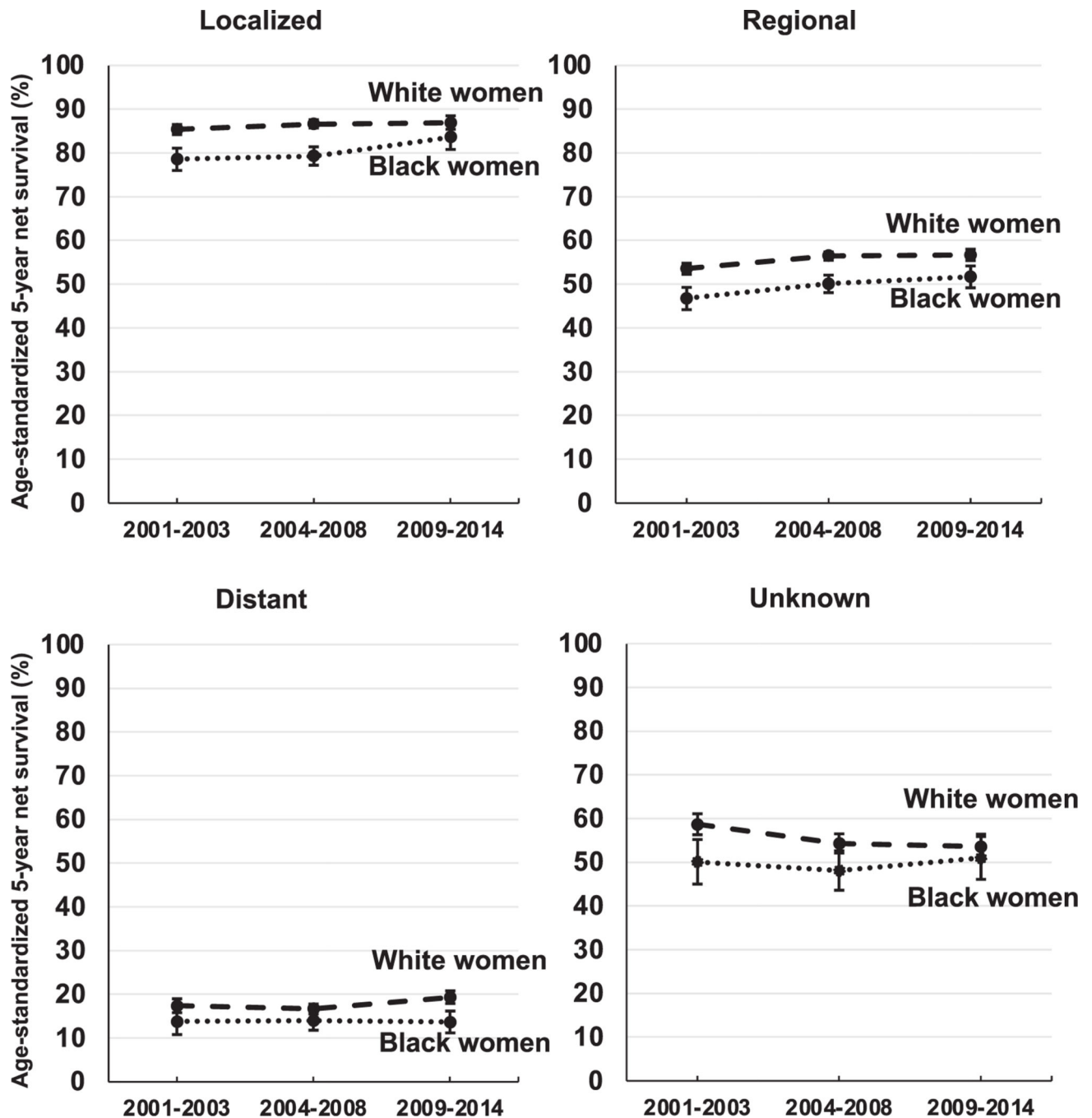


Fig. 3. Trends in age-standardized five-year net survival (%) for Black and White women (aged 15–99 years) diagnosed during 2001–2014 with cervical cancer, by SEER Summary Stage at diagnosis and race.

Number (%) of women (15–99 years) diagnosed with cervical cancer during 2001–2014, by SEER Summary Stage at diagnosis, race and calendar period of diagnosis.

Table 1

Summary Stage 2000	2001–2003						2004–2008						2009–2014					
	All women			White women			All women			White women			All women			White women		
	No.	%		No.	%		No.	%		No.	%		No.	%		No.	%	
Localized	16,605	50.1		13,326	51.4		2269	43.0		24,623	45.9		3217	38.4		22,527	43.3	
Regional	10,731	32.4		8166	31.5		1946	36.9		19,534	36.4		3395	40.5		18,974	36.5	
Distant	3154	9.5		2403	9.3		582	11.0		6291	11.7		1174	14.0		7441	14.3	
Unknown	2678	8.1		2009	7.8		477	9.0		3249	6.1		592	7.1		3076	5.9	
Total	33,168	–		25,904	–		5274	–		53,697	–		8378	–		52,018	–	

Table 2

Age-standardized five-year net survival (NS,%) for women (15–99 years) diagnosed with cervical cancer during 2001–2014 by SEER Summary Stage 2000, race and calendar period of diagnosis.

Summary Stage 2000	2001–2003						2004–2008						2009–2014					
	All women			White women			Black women			All women			White women			Black women		
	No.	95% CI		No.	95% CI		No.	95% CI		No.	95% CI		No.	95% CI		No.	95% CI	
All	64.0	63.4 – 64.7		64.7	63.9 – 65.4		56.7	55.1 – 58.3		63.1	62.6 – 63.6		63.6	63.0 – 64.2		55.5	54.2 – 56.8	
Localized	84.7	83.7 – 85.7		85.4	84.2 – 86.5		78.6	76.0 – 81.1		86.1	85.2 – 86.9		86.6	85.7 – 87.6		79.3	77.2 – 81.4	
Regional	53.1	52.0 – 54.2		53.6	52.3 – 54.8		46.8	44.2 – 49.3		56.1	55.2 – 56.9		56.5	55.5 – 57.4		50.1	48.1 – 52.1	
Distant	17.1	15.7 – 18.5		17.4	15.8 – 19.0		13.8	10.8 – 16.8		163	15.3 – 17.3		16.7	15.5 – 17.8		14.0	11.8 – 16.1	
Unknown	58.4	56.3 – 60.6		58.7	56.3 – 61.1		50.1	45.0 – 55.2		55.2	53.3 – 57.1		54.3	52.1 – 56.5		48.1	43.6 – 52.6	

Table 3

Number (%) of women (15–99 years) diagnosed with cervical cancer during 2001–2014, by SEER Summary Stage at diagnosis, race and treatment.

Treatment type	Localized						Regional						Distant						Unknown																
	All women			Black women			All women			White women			Black women			All women			White women			Black women			All women			White women			Black women				
	No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%						
Cancer-directed surgery																																			
Yes	52,804	82.8		42,691	84.2		6497	74.3		16,920	34.4		13,431	36.0		2392	26.8		3090	18.3		2440	19.1		495	15.1		1748	19.4		1399	21.3		241	14.6
No	9549	15.0		6986	13.8		2006	22.9		31,261	63.5		23,086	62.0		6290	70.4		13,411	79.4		10,043	78.7		2695	82.2		5235	58.1		3760	57.3		1051	63.8
Unknown	1402	2.2		1055	2.1		243	2.8		1058	2.1		741	2.0		255	2.9		385	2.3		275	2.2		89	2.7		2020	22.4		1406	21.4		355	21.6
Radiotherapy																																			
Yes	15,326	24.0		11,659	23.0		2835	32.4		37,088	75.3		27,840	74.7		6842	76.6		9756	57.8		7348	57.6		1886	57.5		1373	15.3		1002	15.3		313	19.0
No	39,547	62.0		31,749	62.6		4808	55.0		5881	11.9		4424	11.9		1078	12.1		4982	29.5		3710	29.1		1019	31.1		4667	51.8		3380	51.5		846	51.4
Unknown	8882	13.9		7324	14.4		1103	12.6		6270	12.7		4994	13.4		1017	11.4		2148	12.7		1700	13.3		374	11.4		2963	32.9		2183	33.3		488	29.6
Systemic therapy																																			
Yes	11,406	17.9		8771	17.3		2037	23.3		35,062	71.2		26,744	71.8		6158	68.9		10,691	63.3		8240	64.6		1891	57.7		1275	14.2		967	14.7		248	15.1
No	46,654	73.2		37,504	73.9		5850	66.9		11,251	22.8		8423	22.6		2123	23.8		5110	30.3		3740	29.3		1144	34.9		4848	53.8		3560	54.2		868	52.7
Unknown	5695	8.9		4457	8.8		859	9.8		2926	5.9		2091	5.6		656	7.3		1085	6.4		778	6.1		244	7.4		2880	32.0		2038	31.0		531	32.2

The bold value is simply to distinguish the percentages from the numbers.