Prostate Cancer Deaths and Incident Cases Among American Indian/Alaska Native Men, 1999–2009

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Objectives. We linked databases to improve identification of American Indians/Alaska Natives (AI/ANs) in determining prostate cancer death and incidence rates.

Methods. We linked prostate cancer mortality and incidence data with Indian Health Service (IHS) patient records; analyses focused on residents of IHS Contract Health Service Delivery Area (CHSDA) counties. We calculated age-adjusted incidence and death rates for AI/AN and White men for 1999 to 2009; men of Hispanic origin were excluded.

Results. Prostate cancer death rates were higher for AI/AN men than for White men. Death rates declined for White men (–3.0% per year) but not for AI/AN men. AI/AN men had lower prostate cancer incidence rates than White men. Incidence rates declined among Whites (–2.2% per year) and AI/ANs (–1.9% per year).

Conclusions. AI/AN men had higher prostate cancer death rates and lower prostate cancer incidence rates than White men. Disparities in accessing health care could contribute to mortality differences, and incidence differences could be related to lower prostate-specific antigen testing rates among AI/AN men. (*Am J Public Health.* 2014;104:S439–S445. doi:10.2105/AJPH.2013.301690)

Prostate cancer is the most frequently diagnosed visceral cancer and the second leading cause of cancer death among men in the United States.[1] However, the cancer burden for American Indian/Alaska Native (AI/AN) men appears to be less than for most other racial/ethnic groups. According to 2010 US Cancer Statistics data,[1] AI/AN men have the second lowest incidence rate of prostate cancer (66.8/100 000) and the 2nd lowest death rate (15.2/100 000) in the United States. The lifetime risks of prostate cancer diagnosis and death among AI/AN men are 7.59% and 2.20%, respectively.[2] By contrast, the overall US lifetime risks of prostate cancer diagnosis and death are 16.15% and 2.75%, respectively.

Estimating cancer death and incidence rates for AI/AN men has, however, been problematic because race is often misclassified in vital statistics and cancer registries.[3,4] The most accurate death and incidence rates are based on Indian Health Service (IHS) Contract Health Services Delivery Area (CHSDA) counties, which generally contain federally recognized tribal lands or are adjacent to tribal lands.[5–7] However, even though some analyses using data from the Surveillance, Epidemiology, and End Results (SEER) Program and the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR) have been limited to CHSDA counties,[8] potential race misclassification still exists. Consequently, IHS registration records have previously been linked with NPCR and SEER registries to more accurately identify AI/AN race in calculating cancer incidence statistics.[9]

In this report, we updated prostate cancer incidence data and provided the first prostate cancer mortality data based on the improved AI/AN classification using linkages between IHS and (1) cancer registry and (2) National Death Index and National Vital Statistics System public use mortality data files.[6,10] We compared age-adjusted and age-specific prostate cancer death and incidence rates between AI/AN men and White men from 1999 to 2009.

METHODS

Detailed methods for generating the analytic death files are described elsewhere in this supplement.[6] Methods for compiling and analyzing incidence data have been published elsewhere.[5,10] A brief description follows.

Population Estimates

We used bridged single-race population estimates developed by the US Census Bureau and the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS)—and adjusted for the population shifts because of Hurricanes Katrina and Rita in 2005—as denominators in calculating death and incidence rates.[11,12] The bridged single-race data make the post-2000 race/ethnicity population estimates comparable to the pre-2000 race/ethnicity estimates, enabling us to report a combined rate spanning 2000 as well as to analyze trends.

Race for AI/AN deaths in this report is assigned as reported elsewhere in this supplement.[6] Briefly, AI/AN race combines NCHS race classification based on the death certificate with information derived from data linkages between the IHS patient registration database and the National Death Index. During preliminary analyses, it was discovered that the updated bridged intercensal population estimates significantly overestimated AI/AN persons of Hispanic origin.[13] Therefore, to avoid underestimating mortality and incidence in AI/AN persons, analyses were limited to non-Hispanic AI/AN persons. Non-Hispanic Whites were chosen as the most homogeneous referent group. Henceforth, we omit the qualifying term "non-Hispanic" when discussing both groups (non-Hispanic AI/AN persons are referred to as AI/AN persons and non-Hispanic Whites are referred to simply as White).

Death Records

Each state compiles death certificate data that are sent to the NCHS to be edited for consistency and stripped of personal identifiers. The NCHS provides these data in electronic format to the research community as part of the National Vital Statistics System.[14] The data include underlying and multiple cause-of-death fields, state of residence, age, sex, race, and ethnicity. NCHS applies a bridging algorithm nearly identical to that used by the US Census

Bureau to assign a single race to decedents whose death certificate reports multiple races.[15] Race coding for AI/AN deaths in this article combined NCHS race classification based on the death certificate with information derived from data linkages between the IHS patient registration database and the National Death Index to identify AI/AN deaths misclassified as non-AI/AN.[6] After this linkage, a flag indicating a positive link to IHS was added to the National Vital Statistics System mortality file as an additional indicator of AI/AN ancestry.

We coded the underlying cause of death for the period 1999 to 2009 according to the *International Classification of Diseases, Tenth Revision* (*ICD-10*)[16] using the *ICD-10* code C61. We compared rates among AI/ANs with those of Whites, a population that provides more homogeneity across regions.

Incidence Data

We identified incident cancer cases using data collected by the NPCR and SEER programs.[1,17] Registries coded primary cancer site and histology data according to the *International Classification of Diseases for Oncology, Third Edition* (*ICD-O-3*).[18] We used data regarding invasive cancers (*ICD-O-3* code C619) to calculate incidence rates. Included cases are from state registries that met the US Cancer Statistics standards for high-quality data.[19] To identify AI/AN cancer cases misclassified as other races, central cancer registries linked cancer registry records with IHS patient registration files as previously described.[5]

Geographic Coverage

Although we report cancer death and incidence data for all states meeting cancer registry quality criteria (referred to as "all counties"), we generally restricted analyses to IHS CHSDA or Tribal Service Delivery Area counties (henceforth referred to as CHSDA counties). The 637 CHSDA counties generally contain federally recognized tribal reservations or off-reservation trusts or are adjacent to them. The IHS uses CHSDA residence to determine eligibility for services not directly available in the IHS. Linkage studies have indicated less misclassification of race for AI/AN persons in these counties than in non-CHSDA counties.[5–7] The CHSDA counties also have higher proportions of AI/AN persons in relation to total population than do non-CHSDA counties, with 64% of the US AI/AN population residing in CHSDA-designated counties (representing 20% of the 3141 counties in the United States). Although less geographically representative, analyses restricted to CHSDA counties are presented for death and incidence rates in this report for the purpose of offering improved accuracy in interpreting cancer statistics for AI/AN persons.

We completed analyses for all regions combined and by individual IHS region: Northern Plains, Alaska, Southern Plains, Southwest, Pacific Coast, and East. Additional information about CHSDA counties and IHS regions, including population coverage, are provided elsewhere (Table 1).[6] Identical or similar regional analyses have been used for other health-related publications focusing on AI/AN persons.[4,20,21]

Statistical Methods

Death and incidence records were combined with the population estimates to create analytic files.[6] We used SEER*Stat 8.0.2 software[22] to directly age adjust all death and incidence rates to the 2000 US standard population; rates are expressed per 100 000 population (Census P25-1130). We used 5 age groups (< 50 years, 50–59 years, 60–69 years, 70–79 years, and ≥ 80 years) to describe age-specific death and incidence rates. Our data are not comparable to published death and incidence rates adjusted using a different standard population.

TABLE 1—Age-Adjusted Prostate Cancer Death Rates for American Indians/Alaska Natives Compared With Whites, All Ages, by Counties and IHS Regions: United States, 1999–2009

	CHSDA Counties					All Counties				
IHS Region	AI/AN Count	AI/AN Rate[a]	White Count	White Rate[a]	AI/AN:White RR[b] (95% CI)	AI/AN Count	AI/AN Rate	White Count	White Rate	AI/AN:White RR[b] (95% CI)
Northern Plains	160	41.2	10 697	26.7	1.55* (1.29, 1.83)	208	34.9	47 684	25.6	1.37* (1.16, 1.59)
Alaska	43	22.7	274	24.3	0.93 (0.64, 1.31)	43	22.7	274	24.3	0.93 (0.64, 1.31)
Southern Plains	236	31.3	3656	24.0	1.30* (1.13, 1.50)	275	28.1	18 455	23.3	1.20* (1.05, 1.37)
Southwest	217	22.4	8906	24.5	0.92 (0.79, 1.05)	231	22.4	13 860	24.9	0.90 (0.78, 1.03)
Pacific Coast	150	26.4	20 235	26.9	0.98 (0.81, 1.16)	212	23.8	36 745	26.1	0.91 (0.78, 1.06)
East	47	23.0	17 911	23.4	0.98 (0.70, 1.32)	253	20.1	134 794	23.5	0.86* (0.74, 0.98)
Total	853	27.6	61 679	25.2	1.09* (1.02, 1.17)	1222	24.7	251 812	24.3	1.01 (0.95, 1.08)

Note. AI/AN = American Indian/Alaska Native; CHSDA = Contract Health Service Delivery Areas; CI = confidence interval; IHS = Indian Health Service; RR = rate ratio; SEER = Surveillance, Epidemiology, and End Results Program. Analyses are limited to people of non-Hispanic origin. AI/AN race is reported from death certificates or through linkage with the IHS patient registration database. IHS regions are defined as follows: Alaska[c]; Northern Plains (IL, IN,[c] IA,[c] MI,[c] MN,[c] MT,[c] NE,[c] ND,[c] SD,[c] WI,[c] WY[c]); Southern Plains (OK,[c] KS,[c] TX[c]); Southwest (AZ,[c] CO,[c] NV,[c] NM,[c] UT[c]); Pacific Coast (CA,[c] ID,[c] OR,[c] WA,[c] HI); and East (AL,[c] AR, CT,[c] DE, FL,[c] GA, KY, LA,[c] ME,[c] MD, MA,[c] MS,[c] MO, NH, NJ, NY,[c] NC,[c] OH, PA,[c] RI,[c] SC,[c] TN, VT, VA, WV, DC).

Source. AI/AN Mortality Database (1990–2009). Data are based on National Vital Statistics System amended with IHS linked records.

[a]Rates are per 100 000 persons and are age adjusted to the 2000 US standard population (11 age groups; Census P25-1130).

[b]RRs were calculated in SEER*Stat before rounding of rates and may not equal RRs calculated from rates presented in table.

[c]Identifies states with at least 1 county designated as CHSDA. Percentage regional coverage of AI/AN persons in CHSDA counties to AI/AN persons in all counties: Northern Plains = 64.8%; Alaska = 100%; Southern Plains = 76.3%; Southwest = 91.3%; Pacific Coast = 71.3%; East = 18.2%; total US = 64.2%.

*$P < .05$.

TABLE 2—Age-Specific Prostate Cancer Death Rates for American Indians/Alaska Natives Compared With Whites, CHSDA Counties by IHS Regions: United States, 1999–2009

Age Range and IHS Region	AI/AN Count	AI/AN Rate[a]	White Count	White Rate[a]	AI/AN:White RR[b] (95% CI)
Aged < 50 y					
Northern Plains	[c]	[c]	30	0.1	[c]
Alaska	[c]	[c]	[c]	[c]	[c]
Southern Plains	[c]	0.1	16	0.1	0.63 (0.02, 3.69)
Southwest	[c]	0.2	26	0.1	1.98 (0.38, 6.07)
Pacific Coast	[c]	4.8	613	5.6	0.86 (0.37, 1.70)
East	[c]	[c]	48	0.1	[c]
Total	[c]	0.1	733	0.1	1.16 (0.42, 2.50)
Aged 50–59 y					
Northern Plains	13	10.6	311	5.3	2.01* (1.06, 3.48)
Alaska	[c]	7.3	15	3.7	1.96 (0.47, 6.17)
Southern Plains	13	7.5	118	5.4	1.38 (0.71, 2.45)
Southwest	14	6.5	259	5.2	1.25 (0.67, 2.13)
Pacific Coast	[c]	0.2	63	0.1	1.81 (0.21, 6.57)
East	[c]	4.8	464	4.4	1.09 (0.22, 3.21)
Total	55	6.9	1230	5.1	1.36* (1.02, 1.78)
Aged 60–69 y					
Northern Plains	32	50.2	1144	31.5	1.60* (1.08, 2.27)
Alaska	[c]	14.2	47	27.9	0.51 (0.13, 1.38)
Southern Plains	45	46.0	435	29.5	1.56* (1.12, 2.12)
Southwest	33	28.6	1105	31.1	0.92 (0.63, 1.30)
Pacific Coast	31	34.6	2218	33.7	1.03 (0.69, 1.47)
East	[c]	25.1	1943	28.8	0.87 (0.37, 1.72)
Total	153	35.9	6892	31.1	1.15 (0.98, 1.35)
Aged 70–79 y					
Northern Plains	51	195.0	3208	130.7	1.49* (1.10, 1.97)
Alaska	10	69.6	98	132.6	0.52 (0.24, 1.01)
Southern Plains	90	181.0	1216	124.7	1.45* (1.16, 1.80)
Southwest	72	120.6	2845	117.4	1.03 (0.80, 1.30)
Pacific Coast	44	120.7	5959	135.3	0.89 (0.64, 1.20)
East	13	95.9	5334	114.1	0.84 (0.44, 1.44)
Total	280	139.7	18 660	124.4	1.12 (0.99, 1.27)

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We also used the age-adjusted death and incidence rates to calculate standardized rate ratios (RRs) for comparing rates among AI/AN persons with rates among Whites. We considered *P* values less than .05 to be statistically significant. Calculated RRs based on data presented in the tables may not correspond to RRs reported by SEER*Stat because of rounding. We calculated confidence intervals for RRs on the basis of methods described by Tiwari et al.[23] We assessed temporal changes in annual age-adjusted death and age-adjusted incidence rates from 1999 to 2009 with joinpoint regression techniques[24] using statistical software developed by the National Cancer Institute (Joinpoint, version 3.5.2, Bethesda, MD).[25]

RESULTS

Overall, all-counties data showed significantly higher age-adjusted prostate cancer death rates for AI/AN men compared with White men in the Northern and Southern Plains, but a significantly lower death rate in the East (Table 1). In CHSDA counties, age-adjusted prostate cancer death rates declined significantly from 1999 to 2009 for White men (–3.0% per year) but remained stable for AI/AN men (–0.3% per year; data not shown). The following death rate results are based only on data from CHSDA counties.

Total age-adjusted prostate cancer death rates based on combined 1999 to 2009 data were higher for AI/AN men than for White men (Table 1). Prostate cancer death rates in AI/AN men varied substantially by IHS region, ranging from 22.4 in the Southwest to 41.2 in the Northern Plains. By contrast, the prostate cancer death rates for White men varied only from 23.4 in the East to 26.9 in the Pacific Coast. Prostate cancer death rates for AI/AN men significantly exceeded those for White men in the Northern and Southern Plains regions.

Total age-specific prostate cancer death rates from 1999 to 2009 were similar for AI/AN men and White men in all age groups except for the 50 to 59 years age group, in which AI/AN men had higher rates (Table 2). However, we found some significant regional differences in age-specific death rates (Table 2). Compared with White men, prostate cancer death rates were consistently significantly higher in Northern Plains AI/AN men aged 50 years and older and in Southern Plains AI/AN men aged 60 to 79 years.

Overall, age-adjusted prostate cancer incidence rates in all counties were consistently significantly lower for AI/AN men than for White men for all regions, except the Southern Plains. In CHSDA counties, age-adjusted prostate cancer incidence rates significantly declined from 1999 to 2009 for White men (–2.2% per year) and AI/AN men (–1.9% per year). The following incidence rate results are based only on data from CHSDA counties.

Age-adjusted prostate cancer incidence rates for AI/AN men diagnosed between 1999 and 2009 varied by IHS region, ranging from 81.3 in the Southwest to 164.1 in the Northern Plains (Table 3). Regional variation was considerably less for White men, ranging from 132.1 in the Southwest to 165.4 in Alaska. Prostate cancer incidence rates were significantly higher for AI/AN men than for White men in the Southern Plains, similar in the Northern Plains, and significantly lower in the other regions (Table 3).

TABLE 2—*Continued*

Aged ≥ 80 y					
Northern Plains	64	759.4	6012	481.6	1.58* (1.20, 2.03)
Alaska	25	532.7	113	442.4	1.20 (0.74, 1.89)
Southern Plains	87	511.3	1878	417.4	1.22 (0.97, 1.52)
Southwest	95	378.5	4677	441.0	0.86 (0.69, 1.05)
Pacific Coast	65	503.4	11 383	474.1	1.07 (0.82, 1.36)
East	23	460.0	10 123	420.5	1.09 (0.69, 1.64)
Total	359	491.0	34 186	450.3	1.09 (0.98, 1.21)

Note. AI/AN = American Indian/Alaska Native; CHSDA = Contract Health Service Delivery Areas; CI = confidence interval; IHS = Indian Health Service; RR = rate ratio; SEER = Surveillance, Epidemiology, and End Results Program. Analyses are limited to people of non-Hispanic origin. AI/AN race is reported from death certificates or through linkage with the IHS patient registration database. IHS regions are defined as follows: Alaska[d]; Northern Plains (IL, IN,[d] IA,[d] MI,[d] MN,[d] MT,[d] NE,[d] ND,[d] SD,[d] WI,[d] WY[d]); Southern Plains (OK,[d] KS,[d] TX[d]); Southwest (AZ,[d] CO,[d] NV,[d] NM,[d] UT[d]); Pacific Coast (CA,[d] ID,[d] OR,[d] WA,[d] HI); and East (AL,[d] AR, CT,[d] DE, FL,[d] GA, KY, LA,[d] ME,[d] MD, MA,[d] MS,[d] MO, NH, NJ, NY,[d] NC,[d] OH, PA,[d] RI,[d] SC,[d] TN, VT, VA, WV, DC).
Source. AI/AN Mortality Database (1990–2009). Data are based on National Vital Statistics System amended with IHS linked records.
[a]Rates are per 100 000 persons and are age adjusted to the 2000 US standard population (11 age groups; Census P25-1130).
[b]RR were calculated in SEER*Stat before rounding of rates and may not equal RRs calculated from rates presented in table.
[c]Counts less than 10 are suppressed.
[d]Identifies states with at least 1 county designated as CHSDA. Percentage regional coverage of AI/AN persons in CHSDA counties to AI/AN persons in all counties: Northern Plains = 64.8%; Alaska = 100%; Southern Plains = 76.3%; Southwest = 91.3%; Pacific Coast = 71.3%; East = 18.2%; total US = 64.2%.
*$P < .05$.

Total age-specific prostate cancer incidence rates were significantly lower in AI/AN men than White men aged 79 years and younger, but higher among men aged 80 years and older (Table 4). The difference between older men was driven by the significantly higher AI/AN to White prostate cancer incidence RRs in the Northern Plains and Southern Plains.

DISCUSSION

When considering data only from CHSDA counties, we observed that total age-adjusted prostate cancer death rates were significantly higher for AI/AN men than for White men; AI/AN men had significantly higher death rates in the Northern and Southern Plains. Unlike trends in rates for White men, prostate cancer death rates for AI/AN men did not decline significantly from 1999 to 2009. Age-adjusted prostate cancer incidence rates significantly declined for both races/ethnicities. We observed significant age-specific differences in prostate cancer death rates between AI/AN men and White men only in the 50 to 59 years age group, in which AI/AN men had higher rates. Total age-adjusted prostate cancer incidence rates were significantly lower for AI/AN men than for White men, and they were consistently lower in all IHS regions except the Northern and Southern Plains. Total age-specific prostate cancer incidence rates were lower in AI/AN men compared with

TABLE 3—Age-Adjusted Prostate Cancer Incidence Rates, by IHS Regions for American Indians/Alaska Natives Compared With Whites, All Ages, by Counties and IHS regions: United States, 1999–2009

	CHSDA Counties					All Counties				
IHS Region	AI/AN Count	AI/AN Rate[a]	White Count	White Rate[a]	AI/AN:White RR[b] (95% CI)	AI/AN Count	AI/AN Rate[a]	White Count	White Rate[a]	AI/AN:White RR[b] (95% CI)
Northern Plains	1018	164.1	69 361	155.5	1.06 (0.98, 1.13)	1364	136.8	327 893	156.6	0.87* (0.82, 0.93)
Alaska	263	83.0	3190	165.4	0.50* (0.43, 0.58)	263	83.0	3190	165.4	0.50* (0.43, 0.58)
Southern Plains	1740	170.8	26 074	146.2	1.17* (1.11, 1.23)	1987	144.7	138 305	146.9	0.99 (0.94, 1.03)
Southwest	993	81.3	57 192	132.1	0.62* (0.58, 0.66)	1065	80.5	96 386	142.9	0.56* (0.53, 0.60)
Pacific Coast	987	113.6	129 182	153.9	0.74* (0.69, 0.79)	1301	97.7	242 674	154.8	0.63* (0.59, 0.67)
East	301	97.1	131 918	155.8	0.62* (0.55, 0.71)	1423	73.2	934 826	147.5	0.50* (0.47, 0.53)
Total	5302	121.2	416 917	150.8	0.80* (0.78, 0.83)	7403	102.2	1 743 274	149.8	0.68* (0.67, 0.70)

Note. AI/AN = American Indian/Alaska Native; CHSDA = Contract Health Service Delivery Area; CI = confidence interval; IHS = Indian Health Service; NPCR = National Program of Cancer Registries; RR = rate ratio; SEER = Surveillance, Epidemiology, and End Results Program. Analyses are limited to people of non-Hispanic origin. AI/AN race is reported by NPCR and SEER registries or through linkage with the IHS patient registration database. IHS regions are defined as follows: Alaska[c]; Northern Plains (IL, IN,[c] IA,[c] MI,[c] MN,[c] MT,[c] NE,[c] ND,[c] SD,[c] WI,[c] WY[c]); Southern Plains (OK,[c] KS,[c] TX[c]); Southwest (AZ,[c] CO,[c] NV,[c] NM,[c] UT[c]); Pacific Coast (CA,[c] ID,[c] OR,[c] WA,[c] HI); and East (AL,[c] AR, CT,[c] DE, FL,[c] GA, KY, LA,[c] ME,[c] MD, MA,[c] MS,[c] MO, NH, NJ, NY,[c] NC,[c] OH, PA,[c] RI,[c] SC,[c] TN, VT, VA, WV, DC).
Source. Data are from population-based cancer registries that participate in the NPCR or the SEER Program and meet criteria for high data quality. Years of data and registries used: 1999–2009 (43 states): AK, AL, AZ, CA, CO, CT, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MT, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, TX, UT, VT, WA, WV, WY; 1999–2008: WI; 1999–2001 and 2003–2009: DC; 2001–2009: AR, NC, SD; 2002–2009: VA; and 2003–2009: MS, TN.
[a]Rates are per 100 000 persons and are age adjusted to the 2000 US standard population (19 age groups; Census P25-1130).
[b]RRs are calculated in SEER*Stat before rounding of rates and may not equal rate ratios calculated from rates presented in table.
[c]Identifies states with at least 1 county designated as CHSDA. Percentage regional coverage of AI/AN persons in CHSDA counties to AI/AN persons in all counties: Northern Plains = 64.8%; Alaska = 100%; Southern Plains = 76.3%; Southwest = 91.3%; Pacific Coast = 71.3%; East = 18.2%; total US = 64.2%.
*$P < .05$.

TABLE 4—Age-Specific Prostate Cancer Incidence Rates for American Indians/Alaska Natives Compared With Whites, CHSDA Counties by IHS region: United States, 1999–2009

Age Range and IHS Region	AI/AN Count	AI/AN Rate[a]	White Count	White Rate	AI/AN:White RR[b] (95% CI)
Aged < 50 y					
Northern Plains	36	4.3	1536	4.7	0.91 (0.64, 1.26)
Alaska	13	3.4	134	5.7	0.60 (0.31, 1.06)
Southern Plains	33	4.3	503	4.7	0.71* (0.48, 1.00)
Southwest	22	1.5	1150	4.5	0.33* (0.20, 0.49)
Pacific Coast	34	3.3	2585	4.4	0.76 (0.52, 1.06)
East	12	3.0	3170	5.3	0.54* (0.28, 0.94)
Total	150	2.9	9078	4.8	0.60* (0.50, 0.70)
Aged 50–59 y					
Northern Plains	223	186.9	12 611	216.8	0.86* (0.75, 0.98)
Alaska	61	111.6	819	202.5	0.55* (0.42, 0.72)
Southern Plains	318	182.2	3894	179.1	1.02 (0.90, 1.14)
Southwest	147	68.6	9531	192.6	0.36* (0.30, 0.42)
Pacific Coast	211	125.7	22 722	206.9	0.61* (0.53, 0.70)
East	62	100.7	23 969	229.1	0.44* (0.34, 0.56)
Total	1022	128.9	73 456	211.4	0.61* (0.57, 0.65)
Aged 60–69 y					
Northern Plains	402	637.5	25 078	679.7	0.93 (0.84, 1.02)
Alaska	98	334.3	1248	713.2	0.47* (0.38, 0.58)
Southern Plains	637	643.0	8868	600.2	1.07 (0.99, 1.16)
Southwest	347	297.1	21 855	613.9	0.48* (0.43, 0.54)
Pacific Coast	361	407.8	45 821	689.2	0.59* (0.53, 0.66)
East	112	279.2	47 191	694.9	0.49* (0.40, 0.59)
Total	1957	455.2	150 061	673.0	0.68* (0.65, 0.71)
Aged 70–79 y					
Northern Plains	287	1040.5	22 557	917.8	1.13* (1.00, 1.28)
Alaska	64	431.6	778	1023.4	0.42 (0.32, 0.55)
Southern Plains	555	1094.6	8830	894.4	1.22* (1.12, 1.33)
Southwest	317	512.6	18 241	741.0	0.69* (0.62, 0.77)
Pacific Coast	287	730.7	40 609	918.2	0.80* (0.71, 0.90)
East	94	546.5	42 791	913.9	0.74* (0.60, 0.91)
Total	1604	770.5	133 806	886.9	0.87* (0.83, 0.91)

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White men for age groups younger than 80 years, but higher in older men. AI/AN men in the Northern and Southern Plains consistently had a higher burden of prostate cancer incidence and mortality than White men and AI/AN men in other regions.

Prostate cancer death rates have declined in the United States by nearly 30% since the early 1990s.[2] Randomized controlled trials of screening have reported mixed results. The American Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial found that screening was not associated with decreased prostate cancer mortality.[26] However, this study had serious methodological flaws, including a high prevalence of baseline screening, a high proportion of prostate-specific antigen (PSA) testing in the control arm, and a low biopsy rate among men with abnormal PSA tests, and could not adequately assess the benefit of screening.[27] Meanwhile, the European Randomized Study of Screening for Prostate Cancer did find that screening reduced the risk of dying from prostate cancer by 20%, though the absolute risk reduction was only about 1 in 1000 after 11 years.[28] Nonetheless, models have estimated that 40% to 75% of the reduction in prostate cancer mortality could be attributed to screening, with treatment improvements accounting for the rest.[29]

The decline in the age-adjusted prostate cancer death rate was significant only for White men, and the total death rate was significantly higher for AI/AN men. These differences could result from AI/AN men having lower PSA testing rates than White men and being more likely to present with distant-stage disease.[9] Advanced-stage cancer has a much poorer prognosis, and disparities in stage at diagnosis could affect mortality comparisons.[2] However, most cancers, even in AI/AN men, are being diagnosed at a localized stage, when receipt of aggressive treatment, particularly radical prostatectomy for men with higher risk cancers, can reduce prostate cancer mortality.[30,31] Interestingly, prostate cancer death and incidence rates were lowest among AI/AN men in Alaska and the Southwest, even though these men have been shown to have the lowest PSA testing rates.[9] This finding suggests that mortality differences, therefore, could potentially arise from barriers to accessing appropriate treatment. The lower prevalence of cancer screenings among AI/AN populations compared with White populations has been cited as a possible marker for lower socioeconomic status and poorer access to health care.[3] However, we were unable to obtain data on either stage-specific treatment or stage-specific survival and could not evaluate this hypothesis. Mortality differences could also be partly attributable to variations in risk factors for poorer prostate cancer survival, such as obesity or tobacco use.[32,33]

The declining prostate cancer incidence rates observed in our study mirror national trends reported by SEER tumor registries.[2] When PSA testing was introduced, the incidence of prostate cancer dramatically increased, peaking in the early 1990s before declining.[2] Part of the decline was because early PSA testing detected a substantial amount of prevalent disease. Subsequent years of screening predominantly identified incident cases. Even though AI/AN men have lower screening rates than White men,[9] the decline in annual percentage of change in prostate cancer incidence was very comparable.

TABLE 4—*Continued*

Aged ≥ 80 y					
Northern Plains	82	956.6	8822	683.8	1.40* (1.10, 1.75)
Alaska	27	547.9	215	796.4	0.69 (0.44, 1.04)
Southern Plains	197	1104.4	3780	802.5	1.38* (1.18, 1.59)
Southwest	160	624.2	6418	570.8	1.09 (0.93, 1.28)
Pacific Coast	94	735.8	17 450	701.5	0.15 (0.84, 1.29)
East	33	644.0	16 273	650.8	0.99 (0.68, 1.40)
Total	593	790.1	52 958	670.1	1.18* (1.08, 1.28)

Note. AI/AN = American Indian/Alaska Native; CHSDA = Contract Health Service Delivery Area; CI = confidence interval; IHS = Indian Health Service; NPCR = National Program of Cancer Registries; SEER = Surveillance, Epidemiology, and End Results Program; RR = rate ratio. Analyses are limited to people of non-Hispanic origin. AI/AN race is reported by NPCR and SEER registries or through linkage with the IHS patient registration database. IHS regions are defined as follows: Alaska[c]; Northern Plains (IL, IN,[c] IA,[c] MI,[c] MN,[c] MT,[c] NE,[c] ND,[c] SD,[c] WI,[c] WY[c]); Southern Plains (OK,[c] KS,[c] TX[c]); Southwest (AZ,[c] CO,[c] NV,[c] NM,[c] UT[c]); Pacific Coast (CA,[c] ID,[c] OR,[c] WA,[c] HI); and East (AL,[c] AR, CT,[c] DE, FL,[c] GA, KY, LA,[c] ME,[c] MD, MA,[c] MS,[c] MO, NH, NJ, NY,[c] NC,[c] OH, PA,[c] RI,[c] SC,[c] TN, VT, VA, WV, DC).

Source. Data are from population-based cancer registries that participate in the NPCR or SEER and meet criteria for high data quality. Years of data and registries used: 1999–2009 (43 states): AK, AL, AZ, CA, CO, CT, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MT, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, TX, UT, VT, WA, WV, WY; 1999–2008: WI; 1999–2001 and 2003–2009: DC; 2001–2009: AR, NC, SD; 2002–2009: VA; 2003–2009: MS, TN.

[a]Rates are per 100 000 persons and are age adjusted to the 2000 US standard population (19 age groups; Census P25-1130).

[b]RRs are calculated in SEER*Stat before rounding of rates and may not equal RRs calculated from rates presented in table.

[c]Identifies states with at least 1 county designated as CHSDA. Percentage regional coverage of AI/AN persons in CHSDA counties to AI/AN persons in all counties: Northern Plains = 64.8%; Alaska = 100%; Southern Plains = 76.3%; Southwest = 91.3%; Pacific Coast = 71.3%; East = 18.2%; total US = 64.2%.

*$P < .05$.

Age-specific prostate cancer incidence rates were substantially lower for AI/AN men compared with White men for men aged younger than 80 years, but slightly higher at older ages. Given that the majority of prostate cancers in the United States are detected by PSA testing, the lower incidence rates among AI/AN men aged younger than 80 years may likely be attributable to their lower testing rates.[3,9] Contemporaneous guidelines issued by major medical organizations during the study time period consistently recommended against screening older men,[34–36] so that men older than 80 years are more likely to present with clinical disease. However, although the RR showed a 14% increased cancer incidence for older AI/AN men, this rate was based on only 587 cancers detected during a 10-year period.

Our study has important strengths. By using techniques to minimize race misclassification, we were able to provide the most accurate and geographically comprehensive data regarding prostate cancer death and incidence rates for AI/AN men. We generally found that age-adjusted prostate cancer death and incidence rates were higher in CHSDA counties than in all counties, because AI/AN persons were more accurately identified in CHSDA counties. The CHSDA and all-counties rates were comparable for Alaska and the Southwest, where the percentage of regional coverage of AI/AN persons in CHSDA counties to all counties exceeded 90%. Previous reports were limited either by focusing on specific geographic regions[37–39] or by using less extensive linkages to determine AI/AN death and incidence rates.[3,4,40]

Our study also has some potential limitations. Although analyses based on CHSDA county data improve identification of AI/AN persons, many AI/AN persons live in non-CHSDA counties. Linkage with IHS patient registration databases improves race classification for AI/AN cases. However, AI/AN men who are not members of the federally recognized tribes are not represented in the IHS registration database—and neither are eligible decedents who never used IHS services. Additionally, substantial variation exists between federally recognized tribes in the proportion of native ancestry required for tribal membership and, therefore, eligibility for IHS services. Whether and how this discrepancy in tribal membership requirements may influence some of our findings is unclear, although our findings are consistent with prior reports. Our study cohort thus does not represent all AI/AN populations in the United States or individual IHS regions, particularly in the East.[6] Important differences could exist in cancer risk and access to care between AI/AN men and White men depending on whether they reside in CHSDA counties. Furthermore, the CHSDA analyses exclude many AI/AN decedents in urban areas that are not part of a CHSDA county. AI/AN residents of urban areas differ from all AI/ANs in poverty level, health care access, and other factors that may influence mortality trends.[41] Although excluding Hispanic AI/AN persons from the analyses reduced the overall AI/AN deaths by less than 5%, it may have disproportionately affected some states.

Although incidence rates declined for both AI/AN men and White men, we did not observe a decline in prostate cancer death rates among AI/AN men, unlike the significant decline seen for White men. AI/AN men had higher death rates than White men but lower incidence rates. Death rates and incidence rates varied markedly by geographic region and age groups, though more so for AI/AN men than for White men. AI/AN men in the Northern and Southern Plains had significantly higher age-adjusted prostate cancer death rates than White men and consistently higher age-specific death rates. Future research should evaluate stage-specific treatment and survival to determine whether regional differences in access to health care, including screening and treatment, can explain differences in death rates. Additional research could address whether differences in death rates are also partly attributable to regional variation in risk factors for poor prognosis, including obesity and smoking.[31,32] ■

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Contributors

R. M. Hoffman, J. Li, J. A. Henderson, U. A. Ajani, and C. Wiggins conceptualized and designed the study, analyzed and interpreted the data, critically revised the article for intellectual content, and gave final approval of the article. R. M. Hoffman and C. Wiggins drafted the article.

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