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Prostate Cancer Incidence Among American Indian and Alaska Native Men, US, 1999–2004

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An Update on Cancer in American Indians and Alaska Natives, 1999–2004

Supplement to ***Cancer***

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BACKGROUND. American Indian and Alaska Native (AI/AN) men experience lower incidence of prostate cancer than other race/ethnic populations in the US, but racial misclassification of AI/AN men threatens the validity of these estimates. To the authors' knowledge, little is known concerning prostate-specific antigen (PSA) testing in AI/AN men.

METHODS. The authors linked cancer registry data with Indian Health Service enrollment records to improve race classification. Analyses comparing cancer incidence rates and stage at diagnosis for AI/AN and non-Hispanic white (NHW) men for 6 geographic regions focused on counties known to have less race misclassification. The authors also used Behavioral Risk Factors Surveillance System data to characterize PSA testing in AI/AN men.

RESULTS. Prostate cancer incidence rates were generally lower in AI/AN than in NHW men for all regions combined (rate ratio of 0.68). However, regional variation was noted among AI/AN men, with incidence rates (per 100,000 population) ranging from 65.7 in the Southwest to 174.5 on the Northern Plains. The rate of distant stage disease was somewhat higher among AI/AN (7.8) than NHW (6.2) men. Nationally, AI/AN men were less likely than NHW men to have undergone recent PSA testing (48.4% vs 58.0%), with prominent regional variation in screening rates noted.

CONCLUSIONS. Prostate cancer incidence rates and the proportion of men with recent PSA testing were lower for AI/AN men than for NHW men. However, incident rates and rate of distant stage varied by region more for AI/AN than for NHW. Further research is needed among AI/AN men to evaluate strategies for better understanding the causes of the regional variation in prostate cancer incidence. ***Cancer*** **2008;113(5 suppl):1203–12.** *Published 2008 by the American Cancer Society.**

KEYWORDS: prostate cancer, cancer, incidence, American Indian, Alaska Native, misclassification, National Program of Cancer Registries (NPCR), Surveillance, Epidemiology, End Results (SEER), US, health disparity.

Prostate cancer is an important health issue for men in the US,[1] including American Indian/Alaska Native (AI/AN) men.[2] It is the second-leading cause of cancer death for men of all races combined and for AI/AN men.[3] Largely because of race misclassification, the accuracy of prostate cancer incidence and stage data among AI/AN men has been uncertain; prior publications on the subject focused on specific geographic regions[4,5] and thus were not generalizable to other AI/AN populations. Furthermore, the association between can-

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cer incidence and prostate-specific antigen (PSA) testing among AI/AN men has not been well described.

The purpose of the current study was to better estimate prostate cancer incidence and stage at diagnosis in AI/AN men, using techniques to minimize race misclassification. We present these data by geographic region and for all regions combined. We also described patterns of PSA testing among AI/AN men, identified the demographic and behavioral factors associated with testing, and evaluated ecologic associations of PSA testing with prostate cancer incidence.

MATERIALS AND METHODS

Detailed descriptions of the data sources and methods used for this analysis are found elsewhere in this supplement.[6]

Cancer Cases

We identified cancer cases using data collected by the National Program of Cancer Registries of the Centers for Disease Control and Prevention (CDC) and the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute (NCI).[7] Registries coded primary cancer site and histology data according to the third edition of the International Classification of Diseases for Oncology (ICD-O).[8] We used data regarding invasive cancers (ICD-O-3 C619) to calculate incidence rates. Included cases are from state registries that agreed to participate in this project and met the US Cancer Statistics standards for high-quality data.[7]

We classified race by combining information from 2 sources: 1) data linkages with Indian Health Service (IHS) patient registration records and 2) the multiple race fields in cancer registry records. The IHS provides medical services to AI/AN persons who are members, or descendents of members, of federally recognized tribes. To reduce race misclassification, states linked all case records with the IHS patient registration database to identify AI/AN cases misclassified as some other racial group. Further details about coding rules for multiple races are described elsewhere in this supplement.[6]

To further improve race classification, we focused analyses on Contract Health Service Delivery Area (CHSDA) counties (Fig. 1), which generally contain federally recognized tribal lands or are adjacent to tribal lands. The proportions of AI/AN in relation to total population are higher in CHSDA counties than in non-CHSDA counties, and data indicate less race misclassification for AI/AN in these counties.[9] Approximately 56% of the US AI/AN population resides in CHSDA counties. This proportion varies by IHS region: Alaska: 100%; East: 13.1%; Northern Plains: 59.0%; Southern Plains: 64.1%; Pacific Coast: 55.6%; and Southwest: 87.5% (in each region, the proportion of AI/AN in CHSDA counties to AI/AN in all counties.) In addition, our analyses stratified incidence rates by IHS regions (Alaska, Pacific Coast, Northern Plains, Southern Plains, Southwest, and East) to evaluate the geographic variation of cancer incidence in the AI/AN population (Fig. 1). Additional details concerning CHSDA and IHS are provided elsewhere.[6]

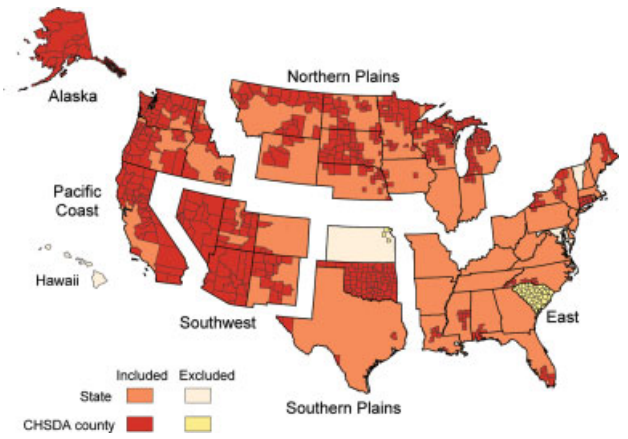

FIGURE 1. State and Contract Health Service Delivery Area (CHSDA) counties used in cancer incidence analyses for the American Indian and Alaska Native population are shown by Region.

Stage of disease data spanned changes in SEER summary stage coding. Stage was coded according to SEER Summary Stage 1977 rules for diagnosis years 1999 to 2000 and according to SEER summary stage 2000 rules for diagnosis years 2001 to 2003; collaborative stage data, first reported for 2004, were not available for analysis. We reported stage data for 2001 to 2003 because of significant changes in coding local and regional stage disease between the 2 staging systems.[10,11]

Population Estimates

The NCI makes further refinements to population estimates produced by the CDC and the Census Bureau regarding race and county geographic codes; the estimates for the period 1999 to 2004 were used as denominators for the rate calculations in this report.[12]

PSA Testing and Demographic, Health, and Socioeconomic Indicators

We used data from the Behavioral Risk Factor Surveillance System (BRFSS) to characterize PSA testing in the AI/AN and NHW populations and to evaluate

TABLE 1
Prostate Cancer Incidence by Indian Health Service Region for American Indians/Alaska Natives[a] and Non-Hispanic Whites, US, 1999-2004

	CHSDA Counties						All Counties					
IHS Region	AI/AN Count	AI/AN Rate[b]	95% CI for AI/AN Rate	NHW Rate[b]	Rate Ratio (AI/AN:NHW)	95% CI for Rate Ratio	AI/AN Count	AI/AN Rate[b]	95% CI for AI/AN Rate	NHW Rate[b]	Rate Ratio (AI/AN:NHW)	95% CI for Rate Ratio
Northern Plains	499	174.5	157.8-192.4	162.2	1.08	0.97-1.19	651	133.6	122.2-145.7	161.7	0.83[c]	0.76-0.90
Alaska[d]	124	78.3	63.7-95.0	180.7	0.43[c]	0.35-0.53	124	78.3	63.7-95.0	180.7	0.43[c]	0.35-0.53
Southern Plains	834	156.7	145.7-168.3	146.5	1.07	0.99-1.15	930	126.6	118.1-135.6	147.8	0.86[c]	0.80-0.92
Pacific Coast	447	83.2	74.9-92.0	160.8	0.52[c]	0.47-0.57	586	60.6	55.4-66.2	161.6	0.38[c]	0.34-0.41
East	114	83.9	68.1-102.0	155.9	0.54[c]	0.44-0.65	646	63.8	58.6-69.3	149.7	0.43[c]	0.39-0.46
Southwest	457	65.7	59.5-72.2	133.8	0.49[c]	0.44-0.54	492	63.6	57.8-69.7	146.9	0.43[c]	0.39-0.47
Total	2475	105.6	101.2-110.1	154.4	0.68[c]	0.66-0.71	3429	83.5	80.5-86.6	153.4	0.54[c]	0.52-0.56

IHS indicates Indian Health Service; CHSDA, Contract Health Service Delivery Areas; AI/AN, American Indian/Alaska Native; 95% CI, 95% confidence interval; NHW, non-Hispanic white.

[a] AI/AN race is reported by National Program of Cancer Registries and Surveillance, Epidemiology, and End Results registries or through linkage with the IHS patient registration database. AI/AN persons of Hispanic origin are included.

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

[c] Rate ratio is statistically significant ($P<.05$).

[d] Rates and rate ratios for Alaska in the CHSDA Counties section is the same as those in the All Counties section because all counties in Alaska are CHSDA counties.

Years of data and registries used: 1999 to 2004 (41 states and DC; *indicates states with at least 1 county designated as CHSDA): Alaska,* Alabama,* Arkansas, Arizona,* California,* Colorado,* Connecticut,* District of Columbia, Delaware, Florida,* Georgia, Hawaii, Iowa,* Idaho,* Illinois, Indiana,* Kentucky, Louisiana,* Massachusetts,* Maine,* Michigan,* Minnesota,* Missouri, Montana,* North Carolina,* Nebraska,* New Hampshire, New Jersey, New Mexico,* Nevada,* New York,* Ohio, Oklahoma,* Oregon,* Pennsylvania,* Rhode Island,* Texas,* Utah,* Washington,* Wisconsin,* West Virginia, and Wyoming*; 1999 and 2002 to 2004: North Dakota*; 2001 to 2004: South Dakota*; 2003 to 2004: Mississippi* and Virginia; 2004: Tennessee.

Percent regional coverage of AI/AN in CHSDA counties to AI/AN in all counties: Alaska: 100%; East: 13.1%; Northern Plains: 59.0%; Southern Plains: 64.1%; Pacific Coast: 55.6%; Southwest: 87.5%.

the influence of demographic, health, and socioeconomic factors on PSA testing. BRFSS is a cross-sectional telephone survey conducted by all state health departments and the District of Columbia. PSA testing questions were part of the BRFSS core module in 2001, 2002, 2004, and 2006. Respondents were asked if they had ever had a PSA test and the time since their last test. BRFSS data presented here include data from all counties of the 50 states and the District of Columbia (ie, are not limited to CHSDA counties). More detailed methodology regarding the BRFSS has been published in this supplement and elsewhere.[13,14]

Statistical Analyses

Two sets of basic descriptive statistics are provided for AI/AN and NHW men: 1) data from CHSDA counties in all states that meet quality criteria and 2) data from all counties in all states that meet cancer registry data quality criteria (referred to as 'All Counties'). In addition, CHSDA and All Counties data are provided for each IHS region. The results described in the text refer to persons who resided in CHSDA counties, unless otherwise noted. Additional information regarding cases and population coverage is available elsewhere in this supplement.[6]

For AI/AN and NHW populations, prostate cancer incidence rates are expressed per 100,000 and age-adjusted to the 2000 US standard population using 19 age groups (Census P25-1130). In addition, we performed a stratified analysis by 4 age groups (<50, 50-64, 65-74, and 75 + years) based on screening recommendations,[15] and the provision of Medicare benefits for those aged ≥65 years. Age-group specific rates are also age-adjusted within each age category. Stage-specific rates and percent distributions of stage of disease at diagnosis are also age-adjusted. Age-adjusted rates were generated using SEER*Stat Software (version 6.3.6).[16] For all analyses, exact counts were suppressed when the category of interest contained 5 or fewer cases.

Using the age-adjusted incidence rates, standardized rate ratios (RRs) were calculated for AI/AN men using NHW rates for comparison. Confidence intervals (CIs) for age-adjusted rates and standardized RRs were calculated based on methods described by Tiwari et al[17] using SEER*Stat 6.3.6.[16]

We report the proportions and 95% CIs for PSA testing within the last year for all male AI/AN and NHW BRFSS respondents aged 50 to 75 years, overall and stratified by region. We also report the proportions and 95% CIs of those with recent PSA testing by key demographic, socioeconomic, and health behavior factors. The BRFSS data presented herein are not restricted to CHSDA counties.

RESULTS

In CHSDA and All Counties, the prostate cancer incidence rate for all regions combined for AI/AN men was lower than the rate for NHW men (Table 1). The

TABLE 2
Prostate Cancer Invasive Incidence Rates[a] and Rate Ratios[b] by Age and Indian Health Service Region for American Indians/Alaska Natives[c] and Non-Hispanic Whites, CHSDA Counties, US, 1999 to 2004

	<50 Years				50-64 Years				65-74 Years				75+ Years			
IHS Region	AI/AN Rate[a]	NHW Rate[a]	RR[b]	95% CI	AI/AN Rate[a]	NHW Rate[a]	RR[b]	95% CI	AI/AN Rate[a]	NHW Rate[a]	RR[b]	95% CI	AI/AN Rate[a]	NHW Rate[a]	RR[b]	95% CI
CHSDA counties																
Northern Plains	5.1	4.3	1.19	0.73-1.81	257.6	303.4	0.85[b]	0.73-0.98	893.7	953.3	0.94	0.80-1.09	1212.6	839.5	1.44[b]	1.19-1.74
Alaska	2.0	4.6	0.43	0.11-1.11	162.1	313.7	0.52[b]	0.39-0.68	297.5	1043.1	0.29[b]	0.20-0.40	545.3	1017.3	0.54[b]	0.35-0.80
Southern Plains	2.3	3.6	0.63	0.33-1.08	237.6	249.6	0.95	0.84-1.08	879.5	830.7	1.06	0.94-1.18	1016.7	854.6	1.19[b]	1.03-1.37
Pacific Coast	1.6	4.2	0.39[c]	0.20-0.67	133.8	305.2	0.44[c]	0.37-0.51	521.4	929.9	0.56[c]	0.48-0.65	455.8	838.7	0.54[c]	0.43-0.68
East	2.9	4.6	0.64	0.21-1.46	172.5	301.5	0.57[c]	0.43-0.75	399.5	901.9	0.44[c]	0.30-0.62	489.4	792.6	0.62[c]	0.39-0.92
Southwest	0.9	4.0	0.24[c]	0.10-0.46	92.8	273.4	0.34[c]	0.28-0.40	358.8	769.0	0.47[c]	0.40-0.54	453.8	648.8	0.70[c]	0.58-0.83
Total CHSDA	2.1	4.2	0.51[c]	0.39-0.65	165.2	295.1	0.56[c]	0.52-0.60	578.1	892.5	0.65[c]	0.61-0.69	681.1	798.6	0.85[c]	0.79-0.92

Source: Cancer registries in the National Program of Cancer Registries of the Centers for Disease Control and Prevention and/or the Surveillance, Epidemiology, and End Results program of the National Cancer Institute.

IHS indicates Indian Health Service; CHDSA, Contract Health Service Delivery Areas; AI/AN, American Indian/Alaska Native; NHW, non-Hispanic white; RR, rate ratio.

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

[b] Rate ratios are calculated in SEER*Stat prior to rounding of rates and may not equal rate ratios calculated from rates presented in the table.

[c] Rate ratio is statistically significant ($P<.05$).

Years of data and registries used: 1999 to 2004 (41 states and DC; *indicates states with at least 1 county designated as CHSDA): Alaska,* Alabama,* Arkansas, Arizona,* California,* Colorado,* Connecticut,* District of Columbia, Delaware, Florida,* Georgia, Hawaii, Iowa,* Idaho,* Illinois, Indiana,* Kentucky, Louisiana,* Massachusetts,* Maine,* Michigan,* Minnesota,* Missouri, Montana,* North Carolina,* Nebraska,* New Hampshire, New Jersey, New Mexico,* Nevada,* New York,* Ohio, Oklahoma,* Oregon,* Pennsylvania,* Rhode Island,* Texas,* Utah,* Washington,* Wisconsin,* West Virginia, and Wyoming*; 1999 and 2002 to 2004: North Dakota*; 2001 to 2004: South Dakota*; 2003 to 2004: Mississippi* and Virginia; 2004: Tennessee.

rate of prostate cancer in AI/AN men residing in CHSDA counties was higher than the AI/AN rate for All Counties for 5 of 6 regions and for all regions combined. Little variation was noted between CHSDA and All Counties for NHW men. AI/AN incidence rates in CHSDA counties varied widely by region and ranged from 65.7 (per 100,000 males) in the Southwest to 174.5 in the Northern Plains, whereas NHW rates ranged from 133.8 in the Southwest to 180.7 in Alaska. AI/AN rates were highest in the Plains regions, where they were similar to NHW men, but nearly 2-fold or more higher than the rates for AI/AN men in the remaining regions.

When examined by age group, among those residing in CHSDA counties, AI/AN men in the 50 years to 64 years and 65 years to 74 years age groups had lower incidence rates compared with NHW men, except in the Northern and Southern Plains, in which the rates were similar (Table 2). For the age group $\geq$75 years, AI/AN men in the Northern Plains and Southern Plains had higher incidence rates than NHW men (RR of 1.44 [95% CI, 1.19-1.74] and RR of 1.19 [95% CI, 1.03-1.37], respectively).

For AI/AN males, 67.5% of prostate cancers were diagnosed at the localized stage versus 76.4% for NHW men (Table 3). Conversely, for AI/AN men, 7.4% of prostate cancers were diagnosed at the distant stage compared with 4.0% for NHW men; the differences in incidence rates of late state disease were not as marked (7.8 vs 6.2) and were mostly because of a high rate among AI/AN in the Northern Plains. The distributions of cancers diagnosed at the regional stage were similar between AI/AN and NHW men. Finally, the percentage of unstaged cancers was greater in AI/AN men (16.0%) than in NHW men (10.0%).

Table 4 presents the prevalence in the 50 states and the District of Columbia and by region of PSA testing by demographics and measures of socioeconomic status and access to care. For all regions combined, the prevalence of recent PSA testing was higher for NHW than for AI/AN men (58.0% and 48.4%, respectively). AI/AN men in the Southern Plains had the highest prevalence (54.9%), whereas those in Alaska had the lowest (28.7%). Overall, increasing age was associated with a higher prevalence of recent PSA testing for NHW and AI/AN men. However, among AI/AN men, there was no consistent relation noted between age and testing within regions. Having healthcare coverage; having higher levels of both educational attainment and income; being current with colorectal cancer screening; being married; reporting excellent, very good, or good health status; being a nonsmoker; and being employed or retired were all

TABLE 3
Prostate Cancer Invasive Incidence Counts, Rates,[a] and Age-Adjusted Percent Distributions by Stage at Diagnosis[b] and Indian Health Service Region for American Indians/Alaska Natives and Non-Hispanic Whites, US, 2001 to 2003, CHSDA Counties

	Localized				Regional				Distant				Unstaged				All			
IHS Region	Count	Rate[a]	95% CI	Cases, %[c]	Count	Rate[a]	95% CI	Cases, %[c]	Count	Rate[a]	95% CI	Cases, %[c]	Count	Rate[a]	95% CI	Cases, %[c]	Count	Rate[a]	95% CI	Cases, %[c]
American Indian/Alaska Native																				
Northern Plains	191	110.2	93.8-128.3	64.0	27	16.0	9.9-24.0	9.3	17	13.4	7.2-21.9	7.8	38	32.7	22.3-45.7	19.0	273	172.2	150.2-196.2	100
Alaska	52	62.9	45.1-84.7	72.4	5	4.3	1.4-10.5	4.9	4	7.7	1.6-19.8	8.9	9	12.1	4.6-24.3	13.9	70	86.9	65.1-113.0	100
Southern Plains	322	111.9	99.4-125.4	71.3	34	10.7	7.4-15.1	6.8	24	9.8	6.1-14.6	6.2	59	24.6	18.4-32.0	15.7	439	157.0	141.9-173.2	100
Pacific Coast	158	58.4	48.9-68.9	68.8	34	10.4	6.9-14.8	12.2	15	6.1	3.1-10.4	7.2	20	10.0	5.9-15.6	11.8	227	84.9	73.2-97.7	100
East	36	48.1	32.9-67.4	68.0	6	7.2	2.4-16.1	10.2	1	1.3	0.0-7.2	1.8	8	14.2	5.7-27.8	20.1	51	70.7	51.4-94.3	100
Southwest	150	40.8	34.3-48.1	61.3	32	7.6	5.1-10.8	11.4	24	6.9	4.3-10.3	10.4	33	11.3	7.7-15.9	17.0	239	66.6	58.0-75.9	100
Total CHSDA	909	71.6	66.7-76.6	67.5	138	9.8	8.1-11.7	9.2	85	7.8	6.1-9.7	7.4	167	17.0	14.3-19.9	16.0	1,299	106.1	100.0-112.4	100
Non-Hispanic White																				
Northern Plains	14,412	121.8	119.8-123.8	74.4	1893	15.6	14.9-16.3	9.5	671	6.0	5.6-6.5	3.7	2266	20.2	19.4-21.1	12.3	19,242	163.7	161.3-166.0	100
Alaska	605	123.5	112.8-135.0	66.0	78	12.8	9.9-16.3	6.8	25	7.8	4.6-12.0	4.2	157	43.0	35.7-51.2	23.0	865	187.2	173.2-201.8	100
Southern Plains	4,996	109.3	106.3-112.4	73.4	535	11.4	10.5-12.5	7.7	327	7.8	7.0-8.7	5.2	827	20.3	19.0-21.8	13.6	6,685	149.0	145.4-152.6	100
Pacific Coast	26,750	124.5	123.0-126.0	77.7	4232	19.1	18.5-19.6	11.9	1498	7.2	6.8-7.6	4.5	1908	9.5	9.1-9.9	5.9	34,388	160.3	158.6-162.0	100
East	18,798	126.3	124.5-128.1	78.6	1732	11.5	10.9-12.0	7.2	808	5.6	5.2-6.0	3.5	2506	17.3	16.6-18.0	10.8	23,844	160.6	158.6-162.7	100
Southwest	10,752	101.3	99.4-103.3	74.1	1444	13.3	12.6-14.0	9.7	418	4.2	3.8-4.7	3.1	1746	17.9	17.0-18.8	13.1	14,360	136.7	134.5-139.0	100
Total CHSDA	76,313	119.4	118.5-120.2	76.4	9914	15.1	14.8-15.4	9.7	3747	6.2	6.0-6.4	4.0	9410	15.6	15.3-16.0	10.0	99,384	156.3	155.3-157.3	100

Source: Cancer registries in the National Program of Cancer Registries of the Centers for Disease Control and Prevention and/or the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute.

CHSDA indicates Contract Health Service Delivery Areas; IHS, Indian Health Service; 95% CI, 95% confidence interval.

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

[b] Based on SEER Summary Stage 2000.

[c] Percent stage distribution is age-adjusted to the 2000 US standard population and may not add to 100.0% due to rounding.

Years of data and registries used: 1999 to 2004 (41 states and DC; *indicates states with at least 1 county designated as CHSDA): Alaska,* Alabama,* Arkansas, Arizona,* California,* Colorado,* Connecticut,* District of Columbia, Delaware, Florida,* Georgia, Hawaii, Iowa,* Idaho,* Illinois, Indiana,* Kentucky, Louisiana,* Massachusetts,* Maine,* Michigan,* Minnesota,* Missouri, Montana,* North Carolina,* Nebraska,* New Hampshire, New Jersey, New Mexico,* Nevada,* New York,* Ohio, Oklahoma,* Oregon,* Pennsylvania,* Rhode Island,* Texas,* Utah,* Washington,* Wisconsin,* West Virginia, and Wyoming*; 1999 and 2002 to 2004: North Dakota*; 2001 to 2004: South Dakota*; 2003 to 2004: Mississippi* and Virginia; 2004: Tennessee.

TABLE 4
Percentage of American Indian/Alaska Native and Non-Hispanic White Men Aged 50 to 75 Years Who Have Had Prostate-Specific Antigen Testing Within the Previous Year, by Health and Socioeconomic Indicators and by Indian Health Service Region; Behavioral Risk Factor Surveillance System, 2001, 2002, 2004, and 2006[a]

	US NHW		US AI/AN		Northern Plains[b]		Alaska[c]		Southern Plains[d]		Pacific Coast[e]		East[f]		Southwest[g]	
	%[h]	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Total	58.0	(57.6-58.5)	48.4	(43.0-53.7)	44.9	(35.5-54.7)	28.7	(19.4-40.2)	54.9	(44.3-65.0)	49.0	(35.2-62.9)	49.7	(42.9-56.6)	41.5	(33.7-49.7)
Age group, y																
50-54	41.8	(40.9-42.8)	43.3	(34.1-53.1)	32.6	(18.7-50.5)	22.3	(10.2-42.0)	[i]		52.9	(29.6-75.1)	42.9	(30.6-56.1)	21.6	(14.2-31.6)
55-64	56.7	(55.9-57.4)	49.9	(42.1-57.8)	55.5	(41.0-69.2)	35.1	(23.4-48.9)	55.4	(42.9-67.3)	45.1	(26.2-65.5)	51.0	(41.3-60.7)	43.3	(30.6-57.0)
65-75	69.2	(68.4-69.9)	51.0	(41.8-60.1)	43.3	(28.6-59.3)	[i]		52.7	(35.7-69.1)	66.6	(47.9-81.2)	51.6	(39.5-63.5)	54.0	(39.4-68.0)
Healthcare coverage																
Yes	59.7	(59.2-60.2)	50.1	(44.4-55.8)	44.7	(35.2-54.5)	33.2	(22.8-45.4)	57.3	(45.9-67.9)	50.4	(36.0-64.8)	52.6	(45.0-60.0)	41.8	(33.7-50.4)
No	32.8	(30.1-35.6)	36.6	(24.1-51.2)	43.2	(21.9-67.3)	[i]		[i]		[i]		31.5	(18.7-48.0)	34.0	(16.2-57.9)
Education																
≤High school graduate	51.1	(50.4-51.9)	43.6	(36.4-51.1)	42.8	(30.9-55.7)	26.3	(16.5-39.3)	47.1	(32.4-62.4)	48.6	(29.3-68.3)	43.7	(34.6-53.2)	32.5	(22.7-44.2)
Some college/technical school	58.4	(57.4-59.3)	54.3	(44.1-64.2)	47.0	(31.0-63.8)	[i]		68.5	(53.0-80.8)	41.1	(24.3-60.3)	61.1	(48.4-72.5)	51.8	(38.4-64.9)
College graduate	64.2	(63.4-64.9)	54.8	(43.0-66.2)	51.4	(33.4-69.0)	[i]		57.9	(40.8-73.3)	51.7	(27.1-75.5)	54.9	(41.6-67.6)	59.7	(44.4-73.3)
Annual household income																
<$35K	48.4	(47.5-49.3)	45.1	(37.7-52.7)	35.7	(24.4-48.8)	21.2	(10.7-37.6)	49.8	(34.9-64.7)	52.9	(35.0-70.1)	44.0	(35.1-53.2)	34.3	(25.8-44.0)
$35K-<$75K	59.8	(59.0-60.5)	51.2	(40.7-61.7)	55.2	(43.7-66.2)	[i]		77.0	(61.8-87.4)	35.2	(16.9-59.3)	62.8	(49.2-74.6)	44.8	(29.3-61.3)
≥$75K	65.8	(64.8-66.8)	56.4	(43.4-68.6)	[i]		[i]		[i]		[i]		46.8	(31.8-62.4)	[i]	
Unknown	58.2	(56.7-59.6)	54.5	(41.0-67.3)	81.0	(61.1-92.0)	[i]		[i]		[i]		48.8	(33.5-64.4)	[i]	
Colorectal cancer screening[j]																
Yes	72.3	(71.8-72.9)	65.6	(57.4-72.9)	76.2	(64.1-85.2)	41.8	(27.0-58.3)	65.8	(50.9-78.2)	62.0	(39.2-80.4)	66.1	(55.7-75.1)	66.4	(53.5-77.2)
No	40.9	(40.2-41.7)	33.3	(27.3-39.9)	28.9	(20.4-39.3)	16.4	(9.2-27.5)	47.7	(34.0-61.8)	37.8	(24.9-52.7)	29.2	(21.8-38.0)	26.3	(17.7-37.0)
Marital status																
Married	60.3	(59.8-60.8)	54.9	(48.5-61.2)	50.7	(38.1-63.2)	37.6	(24.8-52.5)	56.7	(44.1-68.5)	57.1	(40.0-72.7)	57.2	(48.9-65.0)	45.2	(35.9-54.9)
Not married	49.6	(48.7-50.6)	38.8	(31.3-46.8)	33.6	(23.3-45.7)	13.5	(7.5-23.3)	50.4	(35.2-65.6)	43.4	(30.7-57.1)	38.0	(28.7-48.2)	32.2	(19.8-47.8)
Health status																
Excellent, very good, good	58.8	(58.3-59.3)	48.4	(42.1-54.8)	50.9	(39.3-62.5)	32.4	(21.2-46.0)	57.7	(44.6-69.7)	44.0	(26.6-63.0)	48.4	(39.8-57.0)	41.9	(32.5-51.8)
Fair, poor	55.1	(54.1-56.1)	48.7	(39.8-57.6)	36.7	(24.0-51.6)	19.9	(9.1-38.3)	44.5	(32.8-56.9)	53.2	(32.7-72.6)	52.5	(42.3-62.4)	39.3	(28.6-51.1)
Smoker[k]																
Current	46.2	(45.0-47.4)	38.4	(29.6-48.0)	35.0	(22.9-49.4)	21.9	(12.1-36.5)	48.4	(32.6-64.5)	26.1	(14.2-43.1)	43.8	(31.1-57.4)	47.0	(29.3-65.5)
Nonsmoker (former and never)	60.4	(59.9-60.9)	52.8	(46.4-59.1)	51.3	(38.9-63.4)	29.9	(19.1-43.7)	54.8	(43.1-66.0)	54.9	(38.5-70.3)	54.1	(45.6-62.3)	38.9	(30.6-48.0)
Employment																
Employed	57.3	(56.5-58.1)	49.3	(41.3-57.3)	45.1	(31.4-59.5)	33.5	(19.4-51.5)	55.2	(37.0-72.0)	42.4	(26.9-59.6)	49.5	(39.3-59.7)	42.3	(27.4-58.6)
Unemployed	47.3	(44.9-49.6)	46.6	(35.1-58.5)	53.7	(37.7-69.0)	8.7	(4.1-17.6)	43.9	(28.2-61.0)	[i]		54.2	(40.5-67.3)	18.4	(9.0-33.7)
Homemaker/student/retired	62.9	(61.8-64.1)	51.0	(37.3-64.6)	46.4	(30.0-63.6)	52.5	(30.5-73.6)	48.7	(35.9-61.6)	46.6	(20.7-74.5)	63.9	(52.3-74.0)	48.5	(31.8-65.6)

(continued)

TABLE 4
(*continued*)

NHW indicates non-Hispanic white; AI/AN, American Indians/Alaska Natives 95% CI, 95% confidence interval.
[a] Data are from 50 US states and the District of Columbia. Hawaii did not participate in 2004.
[b] AI/AN in Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, and Wyoming.
[c] AI/AN in Alaska.
[d] AI/AN in Kansas, Oklahoma, and Texas.
[e] AI/AN in California, Idaho, Oregon, Washington, and Hawaii.
[f] AI/AN in Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and District of Columbia.
[g] AI/AN in Arizona, Colorado, Nevada, New Mexico, and Utah.
[h] Weighted estimates, age adjusted to 2000 US population.
[i] Estimates are not reportable because n<50.
[j] Fecal occult blood test within 1year or endoscopy within past 5 years.
[k] Smoked at least 100 cigarettes (5 packs) in entire life.

associated with increased PSA testing for NHW and AI/AN men, both nationally and regionally.

DISCUSSION

There are several findings to emphasize from the current study. First, the prostate cancer incidence rate for AI/AN men for all regions combined is lower than for NHW men living in the same counties; however, the rate is higher than reported previously,[18-22] although differences in age standardization of rates may make the comparison difficult. Second, as with other cancer types,[23] AI/AN men demonstrate marked regional variation in prostate cancer incidence rates in comparison with NHW men. Third, our data indicate that AI/AN men experience slightly higher rates and percentages of distant stage disease than NHW men. Finally, our data also demonstrate lower rates of PSA testing in AI/AN men than in NHW men in all regions.

There are several possible explanations for the lower prostate cancer incidence rates noted among AI/AN men. First, PSA screening primarily detects early–stage cancers.[24] Many screen-detected early stage prostate cancers are indolent, non–life-threatening lesions that would not have become clinically apparent in the absence of screening.[25] Therefore, a lower prevalence of prostate cancer screening will result in lower incidence rates.[26] The BRFSS data presented herein demonstrated that PSA screening rates are lower for AI/AN men in every region when compared with NHW men, often markedly so. Much of the difference observed in prostate cancer incidence rates between AI/AN and NHW men may be explained by differences in PSA screening in the population.

Second, an increasing body of evidence points to an inverse correlation between type 2 diabetes mellitus and prostate cancer.[27-33] AI/AN men (and women) have the highest prevalence of type 2 diabetes mellitus of any race/ethnic group in the US.[34–38] Diabetes-related hypoinsulinemia and low androgenicity are hypothesized to reduce the risk for prostate cancer.[39] Other hypotheses for this apparent protective effect include decreased testosterone levels, a common finding in males with type 2 diabetes[32,40,41]; the potential beneficial effects of drugs used to treat diabetes or other conditions[42,43]; and the possible role of renal failure.[44] The role that diabetes may play in prostate cancer in AI/AN men is unclear and is likely to have much less influence on overall rates than PSA screening.

The current study data also demonstrate a striking regional variation in AI/AN prostate cancer incidence

rates, exceeding that noted among NHW men. The rates for AI/AN men living on either the Northern or Southern Plains approach and even surpass those for NHW men, and are approximately double the rates reported for AI/AN men in all other regions. By contrast, the NHW rates reveal at most 35% regional variation. This marked degree of regional variation in prostate cancer rates noted among AI/AN men mirrors that reported for rates of other leading cancer types among both men and women.[3,23,45–47] Although this variation in prostate cancer incidence modestly tracks differences in self-reported BRFSS prevalence of PSA testing among AI/AN men, differences in testing alone are not likely to explain all the variation. For 1 reason, our BRFSS data demonstrate an inconsistent correlation between PSA testing prevalence and prostate cancer incidence, including localized stage disease, among the AI/AN men in our 6 different regions. Beyond the possible effects of screening differences and the few obviously tobacco-related cancers—notably lung and urinary bladder—we really cannot explain this variation noted for multiple cancer types. These data emphasize the need for etiologic studies designed to elucidate regional variation in prostate cancer incidence and other cancers that can assist in prioritizing future cancer control efforts.

Although routine screening with PSA is not recommended by the US Preventive Services Task Force nor by most other major health organizations, it is still widely used by clinicians. Therefore, the differences in PSA testing between AI/AN and NHW men may reflect similar disparities in health access as noted for other cancers, such as breast and colorectal, for which screening recommendations are widely accepted.[44,49] Cultural issues may play a role in the limited use of PSA screening tests in AI/AN populations. Several studies, involving only AI/AN females, have examined relations between cultural beliefs and practices, or "traditionality," and receipt of breast and/or cervical cancer screening.[50–55] Although the results of these and other studies were generally mixed, future research regarding the influences of traditionality on receipt of cancer screening tests (eg, for colorectal cancer) or seeking care when symptoms develop should include AI/AN men.

The current study has several important strengths. We used the most current, complete, and accurate data available regarding prostate cancer incidence and stage at diagnosis for AI/AN males. Specifically, few previous studies have reached the broad coverage achieved in this analysis. In addition, our ability to conduct data linkages and to restrict our analyses to CHSDA counties has likely improved the classification of AI/AN race in participating cancer registries. Finally, our study includes BRFSS prostate cancer test receipt data on AI/AN men analyzed by 6 geographic regions.

The current study has several important limitations. First, the analyses presented here for AI/AN populations are based on residents of CHSDA counties and excluded many AI/AN residents in urban areas not part of CHSDA counties; therefore, the findings do not represent all AI/AN populations in the US or in individual IHS regions, particularly the East.[6] There may be significant differences in cancer risk–related and screening behaviors between the AI/AN and NHW men who live in these selected counties and those not living in those counties. Second, although linkage with IHS patient registration databases improves the race classification for AI/AN cases, AI/AN persons who are not eligible for IHS services are not represented in the IHS database. Third, BRFSS data are limited by being self-reported, by selection bias related to the sampling strategy and the relatively low response rate,[56] by the small numbers of AI/AN participants, and perhaps most importantly in this case, by the fact that these data were not limited to CHSDA counties. Finally, we did not provide comparable prostate cancer mortality data among AI/AN and NHW men in the CHSDA counties. Other reports have noted that prostate cancer mortality in AI/AN men in the Plains regions for time periods similar to our incidence analyses exceeds that of NHW men.[45,57] Future analyses could determine whether there is an association between lack of PSA testing, presenting at advanced stage, and mortality. In addition, linking mortality data with cancer registry data linked to the IHS patient registration database could reveal stage-specific mortality rates for AI/AN and NHW men, and be able to evaluate whether survival differences were related to access to/receipt of treatment.

In conclusion, AI/AN men have a generally lower prostate cancer incidence than NHW men and lower rates of PSA testing. The current study data also demonstrate marked regional variation in cancer incidence rates among AI/AN persons. Future research should include data regarding prostate cancer mortality for AI/AN men to better correlate factors with disease stage, treatment decisions, and outcomes. In addition, future research among AI/AN men should also examine the role of diabetes status and duration as well as other patient factors on prostate cancer screening, incidence, and outcomes.

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