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Ann Epidemiol. Author manuscript; available in PMC 2018 August 07.

Published in final edited form as:

Ann Epidemiol. 2018 May ; 28(5): 328–330. doi:10.1016/j.annepidem.2018.03.001.

Stage-specific incidence rates and trends of prostate cancer by age, race, and ethnicity, United States, 2004-2014

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Abstract

Purpose: Current literature shows different findings on the contemporary trends of distant-stage prostate cancer incidence, in part, due to low study population coverage and wide age groupings. This study aimed to examine the stage-specific incidence rates and trends of prostate cancer by age (5-year grouping), race, and ethnicity using nationwide cancer registry data.

Methods: Data on prostate cancer cases came from the 2004—2014 United States Cancer Statistics data set. We calculated stage-specific incidence and 95% confidence intervals by age (5-year age grouping), race, and ethnicity. To measure the changes in rates over time, we calculated annual percentage change (APC).

Results: We identified 2,137,054 incident prostate cancers diagnosed during 2004—2014, with an age-adjusted incidence rate of 453.8 per 100,000. Distant-stage prostate cancer incidence significantly decreased during 2004—2010 (APC = −1.2) and increased during 2010—2014 (APC = 3.3). Significant increases in distant prostate cancer incidence also occurred in men aged older than or equal to 50 years except men aged 65—74 and older than or equal to 85 years, in men with white race (APC = 3.9), and non-Hispanic ethnicity (APC = 3.5).

Conclusions: Using data representing over 99% of U.S. population, we found that incidence rates of distant-stage prostate cancer significantly increased during 2010—2014 among men in certain ages, in white, and with non-Hispanic ethnicity.

Keywords

Prostate cancer; Cancer incidence; Cancer stage

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Disclosure: 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.

No financial conflict of interest for all authors and no funding sources claimed.

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Background

With the introduction of prostate-specific antigen (PSA) testing in the mid-1980s, the incidence rate of distant-stage prostate cancer has decreased more than 60% during the last two decades [1]. Concluding that harms from PSA-based screening outweighed benefits, the United States Preventive Services Task Force recommended against routine PSA-based screening for men older than or equal to 75 years of age in 2008 and all ages in 2012 [2]. Studies have consistently shown that PSA testing prevalence and localized/regional prostate cancer incidence rates declined following these recommendations [3—6]. However, current literature shows different findings on the contemporary trends of distant-stage prostate cancer incidence. These differences might be because of low population coverage (≤28%) and wide age groupings [3,7,8].

Objective

To examine the stage-specific incidence rates and trends of prostate cancer by age (5-year grouping), race, and ethnicity using nationwide cancer registry data.

Methods and findings

Data on prostate cancer cases came from the United States Cancer Statistics (USCS) data set, which includes the National Program of Cancer Registries and Surveillance, Epidemiology, and End Results (SEER) programs. Incidence data for all registries except Nevada met USCS publication criteria (http://www.cdc.gov/cancer/npcr/standards.htm) during 2004—2014, and represented 99.1% of the U.S. population. We identified prostate cancer cases using the *International Classification of Diseases for Oncology, Third Edition* site code C619 and behavior code 3. We excluded 1160 autopsy or death certificate-only cases (0.05%) and 72,232 nonmicroscopically confirmed cases (3.27%). We calculated stage-specific (localized, regional, distant, and unstaged) incidence and 95% confidence intervals by age (5-year age grouping), race (white, black, Asian/Pacific Islander, and American Indian/Alaska Native), and ethnicity (Hispanic and non-Hispanic) using SEER*Stat. Rates for all variables except age were age standardized to the 2000 U.S. standard population. To measure the changes in rates over time, we calculated annual percentage change (APC) using Joinpoint regression software. A maximum of two join points were used to determine a change of direction in trends during our study period. APCs were considered to be statistically significant if $P < .05$.

We identified 2,137,054 incident prostate cancers diagnosed during 2004—2014. The age-adjusted incidence rate was 453.8 per 100,000. Of these cases, 80% were localized, 10% were regional, 4% were distant, and 5% were unstaged (data not shown). Table 1 shows cancer stage-specific incidence rates and trends by age, race, and ethnicity. For localized- and regional-stage prostate cancers, incidence rates were stable during 2004—2007 and significantly declined during 2007—2014. In contrast, distant-stage prostate cancer incidence significantly decreased during 2004—2010 (APC = −1.2) and increased during 2010—2014 (APC = 3.3). Significant increases in distant prostate cancer incidence also occurred in men aged older than or equal to 50 years except men aged 65—74 and older

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than or equal to 85 years, and in men with white race (APC = 3.9), or non-Hispanic ethnicity (APC = 3.5).

Discussion

Using data representing over 99% of U.S. population, we found that incidence rates of distant-stage prostate cancer significantly increased during 2010—2014 among men aged older than or equal to 50 years. Stratified analyses by age, race, and ethnicity suggest that this increase occurred among men of white race, non-Hispanic ethnicity, and men aged 50—64 and 75—84 years.

Two previously published SEER studies showed stable trends of distant-stage prostate cancer among men aged less than 75 years [3,5]. However, three other SEER studies reported increasing trends among men aged 45—64, 50—69, and 45—69 years, respectively [7,9,10]. Past studies reported either increasing or decreasing trends for men aged older than or equal to 75 years [5,8,9]. These studies were smaller and did not include the 2014 cancer incidence data. Using the 2004—2014 USCS data, we found a significant increase in distant-stage prostate cancer incidence among men aged 50—64 and 75—84 years. A significant increase was also observed among white men, which confirms findings reported by Dalela et al. [9] Despite the differences in prostate cancer screening recommendations among major medical organizations [2,11,12], studies have shown that prostate cancer incidence and PSA-based screening rates declined after the United States Preventive Services Task Force issued the “D” recommendations for prostate cancer screening in 2012 [3—5]. Because of the long natural history of prostate cancer and only two additional years’ cancer incidence data after 2012 available for analysis, long-term studies are needed to discern increased rates of distant cancer were a result of decreased screening. These studies will help to inform the development of future prostate cancer screening recommendations.

This study has at least five limitations. First, full case ascertainment may impede timely reporting of prostate cancer cases; however, delayed reporting likely caused underestimation of rates and increasing trends in the recent years. Second, trend analyses, a function of time, may be affected by outliers in a given year. Third, only two years of incidence data after 2012 were available for analysis. Fourth, Joinpoint models choose the best fit segmented line with the smallest number of join points through several years of data. The pattern of the trend is sensitive to the number and location of join point and may partially contribute to differences in trends from previous studies. Last, we did not examine Gleason scores because they are not currently available in the USCS data set.

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Table 1

Stage-specific incidence rates and trends of prostate cancer by age, race, and ethnicity, United States, 2004—2014

Characteristics	Count	Rate*	95% CI	Years	APC1†	95% CI	Years	APC2†	95% CI
Total	2,137,054	453.8	453.2—454.4	2004—2007	3.7	−3.7 to 11.7	2007—2014	−7.5‡	−9.3 to −5.6
Stage									
Localized	1,708,064	362.5	361.9—363.0	2004—2007	4.3	−3.8 to 13.1	2007—2014	−8.6‡	− 10.6 to −6.6
Regional	233,245	46.3	46.1—46.5	2004—2007	2.9	−4.1 to 10.5	2007—2014	−3.2‡	−5.0 to ∑1.3
Distant	84,954	19.5	19.4—19.7	2004—2010	− 1.2‡	−2.0 to −0.3	2010—2014	3.3‡	1.6 to 5.0
Unstaged	110,791	25.5	25.3—25.6	2004—2014	−4.4‡	−6.1 to −2.6			
Localized									
Age									
50—54 years	126,885	109.9	109.3—110.5	2004—2009	3.4	−0.2 to 7.2	2009—2014	−8.9‡	−12.1 to −5.6
55—59 years	240,578	235.4	234.5—236.3	2004—2008	3.5	−0.9 to 8.0	2008—2014	−8.1‡	−10.2 to −5.9
60—64 years	327,540	394.7	393.4—396.1	2004—2007	6.3	− 1.9 to 15.2	2007—2014	−7.8‡	−9.7 to −5.8
65—69 years	373,529	594.2	592.3—596.1	2004—2007	5.3	−3.9 to 15.3	2007—2014	−7.8‡	−10.0 to −5.5
70—74 years	300,278	643.9	641.6—646.2	2004—2007	4.1	−4.3 to 13.3	2007—2014	−8.9‡	−11.0 to −6.9
75—79 years	202,941	575.0	572.5—577.5	2004—2007	2.6	−5.7 to 11.6	2007—2014	−10.1‡	−12.1 to −8.1
80—84 years	95,107	384.3	381.8—386.7	2004—2007	−0.6	−9.0 to 8.7	2007—2014	−11.6‡	−13.7 to −9.5
85 + years	41,206	216.7	214.7—218.8	2004—2007	−2.8	− 10.6 to 5.6	2007—2014	−13.2‡	−15.2 to −11.3
Race									
White	1,380,775	341.5	340.9—342.0	2004—2007	4.3	−4.0 to 13.4	2007—2014	−9.1‡	−11.1 to −7.1
Black	244,065	544.0	541.8—546.3	2004—2008	1.5	−2.2 to 5.2	2008—2014	−7.8‡	−9.6 to −6.0
API	6296	181.5	176.6—186.4	2004—2009	−2.2	−5.6 to 1.3	2009—2014	−11.7‡	−14.7 to −8.5
AIAN	32,356	182.6	180.5—184.6	2004—2011	−5.1‡	−7.5 to —2.6	2011—2014	−15.0‡	−22.8 to −6.4
Ethnicity									
Non-Hispanic	1,605,664	368.7	368.1—369.2	2004—2007	4.5	−3.8 to 13.5	2007—2014	−8.6‡	−10.6 to −6.5
Hispanic	102,161	293.6	291.7—295.5	2004—2008	0.0	−3.2 to 3.3	2008—2014	−9.4‡	−10.9 to −7.8
Regional									
Age									
50—54 years	24,586	21.3	21.0—21.6	2004—2009	0.9	−2.9 to 4.8	2009—2014	−6.0‡	−9.5 to −2.3
55—59 years	44,333	43.4	43.0—43.8	2004—2010	−0.6	−3.5 to 2.3	2010—2014	−5.7‡	−10.7 to −0.4
60—64 years	57,258	69.0	68.4—69.6	2004—2007	3.3	−4.2 to 11.3	2007—2014	−4.1‡	−6.0 to −2.1
65—69 years	56,593	90.0	89.3—90.8	2004—2010	1.0	− 1.6 to 3.7	2010—2014	−5.7‡	−10.3 to −1.0
70—74 years	30,332	65.0	64.3—65.8	2004—2007	4.4	−2.2 to 11.5	2007—2014	−1.5	−3.2 to 0.2

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Characteristics	Count	Rate*	95% CI	Years	APC1†	95% CI	Years	APC2†	95% CI
75—79 years	11,651	33.0	32.4—33.6	2004—2014	−0.8	− 1.8 to 0.3			
80—84 years	5146	20.8	20.2—21.4	2004—2014	−2.7‡	−4.3 to −1.1			
85 + years	3346	17.6	17.0—18.2	2004—2014	−3.7‡	−5.2 to −2.2			
Race									
White	196,138	45.7	45.5—45.9	2004—2007	3.0	−4.2 to 10.9	2007—2014	−3.3‡	−5.1 to −1.4
Black	28,288	56.3	55.6—57.0	2004—2014	−1.6‡	−2.6 to −0.5			
API	947	23.2	21.6—24.8	2004—2014	−3.2‡	−5.9 to −0.4			
AIAN	5280	26.7	25.9—27.4	2004—2011	1.0	−2.0 to 4.1	2011—2014	−9.5	−19.1 to 1.2
Ethnicity									
Non-Hispanic	218,892	47.2	47.0—47.5	2004—2007	3.1	−4.1 to 10.9	2007—2014	−3.1‡	−5.0 to −1.2
Hispanic	14,336	36.5	35.8—37.1	2004—2014	−2.1‡	−3.0 to −1.2			
Distant									
Age									
50—54 years	4480	3.9	3.8—4.0	2004—2014	2.0*	0.9 to 3.0			
55—59 years	8484	8.3	I	2004—2014	2.8*	1.5 to 4.1			
60—64 years	11,898	14.3	14.1—14.6	2004—2008	−2.1	−5.9 to 1.9	2008—2014	3.5‡	1.3 to 5.7
65—69 years	13,310	21.2	20.8—21.5	2004—2014	−0.4	− 1.5 to 0.7			
70—74 years	12,847	27.5	27.1—28.0	2004—2008	−2.1	−5.6 to 1.5	2008—2014	1.9	0.0 to 3.9
75—79 years	12,405	35.1	34.5—35.8	2004—2011	−1.4*	−2.4 to —0.4	2011—2014	5.1‡	1.2 to 9.1
80—84 years	11,372	45.9	45.1—46.8	2004—2010	−2.4*	−4.4 to —0.2	2010—2014	4.2‡	0.1 to 8.5
85 + years	10,158	53.4	52.4—54.5	2004—2014	−0.5	− 1.7 to 0.8			
Race									
White	65,709	17.5	17.4—17.7	2004—2010	−0.8	− 1.8 to 0.1	2010—2014	3.9‡	2.1 to 5.7
Black	16,062	41.1	40.4—41.8	2004—2010	−3.3*	−4.9 to −1.8	2010—2014	0.3	−2.6 to 3.4
API	476	15.8	14.2—17.4	2004—2014	−0.4	−3.3 to 2.6			
AIAN	2005	12.6	12.0—13.2	2004—2014	−1.2	−3.2 to 0.8			
Ethnicity									
Non-Hispanic	78,399	19.4	19.3—19.6	2004—2010	−1.1*	− 1.9 to −0.3	2010—2014	3.5‡	1.9 to 5.1
Hispanic	6553	20.9	20.4—21.5	2004—2011	−2.9*	−3.9 to −1.9	2011—2014	2.9	−1.0 to 7.0
Unstaged									
Age									
50—54 years	4555	3.9	3.8—4.1	2004—2014	0.7	− 1.5 to 3.0			
55–59 years	9477	9.3	9.1 —9.5	2004—2014	1.0	−0.8 to 2.9			
60–64 years	15,082	18.2	17.9—18.5	2004—2009	3.3	− 1.5 to 8.2	2009—2014	−3.9	−8.3 to 0.8
65–69 years	19,879	31.6	31.2—32.1	2004—2014	−1.1	−3.4 to 1.1			
70–74 years	20,362	43.7	43.1—44.3	2004—2010	0.4	−4.6 to 5.6	2010—2014	−9.4‡	−17.6 to −0.5
75–79 years	18,539	52.5	51.8—53.3	2004—2007	1.9	−9.5 to 14.8	2007—2014	−7.9‡	−10.8 to −4.9

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Characteristics	Count	Rate*	95% CI	Years	APC1†	95% CI	Years	APC2†	95% CI
80—84 years	13,162	53.2	52.3—54.1	2004—2007	−2.0	− 11.8 to 9.0	2007—2014	−10.9‡	−13.4 to −8.3
85 + years	9735	51.2	50.2—52.2	2004—2007	−3.6	−13.1 to 7.0	2007—2014	−12.9‡	−15.3 to −10.4
Race									
White	76,699	20.5	20.3—20.6	2004—2014	−7.0*	−8.9 to −5.2			
Black	14,995	39.2	38.5—39.9	2004—2014	−5.0*	−6.6 to −3.3			
API	587	20.9	19.1—22.9	2004—2014	−4.6*	−7.4 to −1.6			
AIAN	2341	15.0	14.4—15.7	2004—2010	6.3	−0.2 to 13.4	2010—2014	−9.3	−19.5 to 2.2
Ethnicity									
Non-Hispanic	100,599	24.9	24.7– 25.0	2004–2014	−4.4‡	−6.1 to −2.7			
Hispanic	9975	33.5	32.8– 34.2	2004–2009	5.0	−3.7 to 14.5	2009–2014	− 12.3‡	−19.6 to −4.3

APC = Annual Percentage Change; API = Asian or Pacific Islander; AIAN = American Indian/Alaska Native; Cl = confidence interval.

*Rates are per 100,000 and rates for all variables except age are age-adjusted to the 2000 U.S. Standard Population (19 age groups—Census P25–1130).

†Trends were measured with annual percentage change in rates and were considered to increase or decrease if P < .05; otherwise trends were considered stable.

‡$P < .05$.

CDC's National Program of Cancer Registries and the National Cancer Institute's Surveillance, Epidemiology, and End Results Program.