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Trends in Prostate Cancer Incidence Rates and Prevalence of Prostate Specific Antigen Screening by Socioeconomic Status and Regions in the United States, 2004 to 2013

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Abstract

Purpose: To our knowledge it is unknown whether decreases in the prevalence of prostate specific antigen screening and prostate cancer incidence rates following the USPSTF (United States Preventive Services Task Force) recommendations against routine prostate specific antigen screening are similar across socioeconomic groups and United States census regions.

Materials and Methods: We analyzed incidence rates and prostate specific antigen screening prevalence by age, race/ethnicity, disease stage, United States region and area level socioeconomic status. Annual percent changes were examined for changes in rates with time. The predicted marginal probability and 95% CIs were calculated to estimate changes in prostate specific antigen screening.

Results: Incidence rates in men 50 years old or older decreased in all race/ethnic, regional and socioeconomic status groups. From 2007 to 2013 the overall incidence rates for localized cancer significantly decreased 7.5% per year (95% CI −10.5–−4.4) at ages 50 to 74 years and 11.1% per year (95% CI −14.1–−8.1) at ages 75 years or greater. In contrast, the incidence of distant stage cancer significantly increased 1.4% per year (95% CI 0.3–2.5) from 2008 to 2013 at ages 50 to 74 years but stabilized from 2011 to 2013 at ages 75 years or greater at 5.1% per year (95% CI −3.4−14.4). Distant stage disease rates increased with increasing poverty level at ages 50 to 74 years but not at 75 years or greater.

Conclusions: The prostate cancer incidence of early stage disease decreased in men 50 years old or older while the rate of distant stage disease slightly increased in men 50 to 74 years old following USPSTF recommendations against routine prostate specific antigen screening. Further

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studies with additional years of data are needed to substantiate our findings and monitor the effects of the late stage disease increase on prostate cancer mortality rates.

Keywords

prostatic neoplasms; prostate-specific antigen; mass screening; socioeconomic factors; mortality

The USPSTF recommended against routine PSA screening of men 75 years old or older in 2008 and men of all ages in 2012.[1,2] The ACS® (American Cancer Society®) and AUA (American Urological Association) recommend informed decision making for screening, and patient consultation about the risks and benefits of PSA screening in men with at least 10 years of life expectancy.[3] Several studies associate the USPSTF recommendations against routine PSA screening with reductions in the prevalence of PSA screening and early stage incidence rates in men 50 years old or older in the United States.[4–8] Recent data suggest that rates of advanced stage disease remained unchanged in men 50 years old or older between 2012 and 2013.[6] Other studies show a significant increase in distant metastases at diagnosis in men 75 years old or older.[9] Despite reported decreases in incidence and PSA testing to our knowledge it is unknown whether changes in PSA screening and stage specific incidence rates following the USPSTF recommendation are similar across races/ethnicities, socioeconomic groups and United States Census regions.

This report describes recent trends in stage specific prostate cancer incidence rates and PSA screening prevalence by age, race/ethnicity, United States Census region and area level SES. In this study we examined recent trends in prostate cancer incidence rates and the prevalence of routine PSA screening by area level socioeconomic status and region. In addition, we examined the incidence of late stage disease by United States region and area level SES.

METHODS

Prostate cancer incidence data on 2004 to 2013 were obtained from the official USCS population based data set and defined using ICD-O-3 site code C61.9. USCS contains state based cancer incidence data reported to the CDC (Centers for Disease Control and Prevention) NPCR (National Program of Cancer Registries) or the NCI (National Cancer Institute) SEER Program. Together these 2 federal systems provide cancer incidence data for 100% of the United States population.[10] Population coverage varies annually depending on the states' ability to meet USCS publication criteria. This report covers 96.5% of the United States population with the exclusion of Nevada, Kansas and Minnesota because they did not meet publication criteria for all study years or did not include county level data. Cases were excluded if they were verified by autopsy or death certificate and not microscopically confirmed.

Analyses were performed using SEER*Stat, version 8.3.2 (https://seer.cancer.gov/seerstat/). We report the incidence rates and 95% CIs by age group (all ages, and less than 50, 50 to 74 and 75 years or greater), race/ethnicity (NH Caucasian, NH African American, Hispanic, NH American Indian/Alaska Native or NH Asian/Pacific Islander), geographic region (Northeast, Midwest, South and West), county level poverty status or percent living below the federal poverty level (less than 5%, 5% to 9%, 10% to 19% and

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20% or greater) and SEER Summary stage (localized, regional, distant and unstaged).[11] With the exception of age specific rates the rates were age adjusted to the 2000 United States standard population with 19 age groups (Census P25–1130). Household incomes below the federal poverty threshold were classified as poverty. We combined SEER Summary Stage 2000 and collaborative staging systems to create stage categories. Incidence rate data on the most recent 5 years (2009 to 2013) were stratified by demographic and clinical characteristics. Joinpoint Trend Analysis Software, version 4.3.1.0 (https://surveillance.cancer.gov/joinpoint/) was used to examine rate changes with time (2004 to 2013). The annual percent change and the average annual percent change were considered statistically significant at $p < 0.05$. Using the Tiwari method the incidence RR and the corresponding 95% CIs were calculated to compare relative changes in late stage incidence by geographic location with South as the referent and county level poverty status with less than 5% poverty as the referent. We also calculated the incidence rate, 95% CI and rate trend in men younger than 50 years.

NHIS data on 2005, 2008, 2010 and 2013 were used to estimate the rate of self-reported PSA screening in the last year for men 50 to 74 and 75 years old or older. NHIS is a national cross-sectional household survey of noninstitutionalized adults in the United States.[12] Male sample adults 40 years old or older were asked whether they underwent PSA screening as part of a routine examination, due to a problem or for other reasons. For our analysis we estimated the proportion of men who reported undergoing a PSA test in the last year as part of a routine examination. PSA screening was stratified by race/ethnicity (NH white, NH black, Hispanic and NH other); United States Census region (Northeast, Midwest, South and West); the percent of the federal poverty threshold (less than 139%, 139% to 250%, 251% to 400% and greater than 400% of poverty). The federal poverty category is based on Medicaid expansion to adults with an annual income below 138% of the federal poverty level pursuant to the Patient Protection and Affordable Care Act.[13,14] PSA screening data collected in 2005 were used as the baseline since the survey was administered before USPSTF screening guideline changes (in 2008). Using SAS-callable SUDAAN®, version 9.3.2 we calculated PM RRs and 95% CIs[15] to estimate changes in PSA screening rates between survey years (eg 2008 vs 2005).

RESULTS

A total of 1,963,206 prostate cancer cases were diagnosed in the United States between 2004 and 2013 (supplementary table 1, http://jurology.com/). From 2009 to 2013 a higher incidence was observed in African American men (184.3/100,000), in residents in the Northeast region (131.4), in counties with low poverty (128.9) and in men 75 years old or older (459.0). From 2007/2008 through 2013 incidence rates decreased by at least 6% per year in all categories of age, region and county level poverty ($p < 0.05$). Compared to other racial/ethnic groups the incidence rates decreased earlier in Caucasian men. Between 2009 and 2013 the incidence rate of localized cancer was 93.0/100,000 and for distant stage disease it was 5.4/100,000. Rate trends showed significantly decreasing rates of localized disease while rates of regional and distant stage disease remained unchanged (supplementary table 1, http://jurology.com/).

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Supplementary table 2 (http://jurology.com/) shows age stratified incidence rates in 2009 to 2013 and trends in 2004 to 2013 in men 50 to 74 years old and 75 years old or older. Between 2009 and 2013 the rate of localized cancer was 318.5/100,000 men 50 to 74 years old and 349.2/100,000 in men 75 years old or older as well as 12.8/100,000 for distant cancer in men 50 to 74 years old and 40.8/100,000 in men 75 years old or older. Between 2007 and 2013 the rates of localized cancer significantly decreased 7.5% annually (95% CI −10.5–−4.4) in men 50 to 74 years old and by 11.1% (95% CI −14.1–−8.1) in men 75 years old or older. Similarly, rates of regional stage disease significantly decreased 5.3% per year (95% CI −9.6–−0.8) from 2009 to 2013 in men 50 to 74 years old and by 2.1% (95% CI −3.1–−1.0) in men 75 years old or older from 2004 to 2013. In contrast, the incidence of distant stage cancer significantly increased 1.4% per year (95% CI 0.3–2.5) from 2008 to 2013 in men 50 to 74 years old but stabilized from 2011 to 2013 in men 75 years old or older at 5.1% per year (95% CI −3.4–14.4).

Figures 1 and 2 present regional and SES disparities in late stage disease by age. The incidence of distant stage disease was significantly higher in nearly all regions in men 50 to 74 years old and 75 years old or older compared to the South (12.4 and 36.6/100,000, respectively). Among men younger than 50 years old rates in the Northeast (0.18/100,000) and West (0.17/100,000) were significantly lower than in the South (0.22/100,000). Among 50 to 74-year-old men the rate in those living in the South was almost identical to the rate in men living in the West (12.4 and 12.3/100,000, respectively). The rates of distant stage disease increased with increasing poverty in 50 to 74-year-old men but not in men 75 years old or older. At each level of poverty the rate of late stage disease at ages 75 years or greater was 2 to 4 times higher than in men 50 to 74 years old.

Supplementary table 3 (http://jurology.com/) shows the change in self-reported PSA screening rates between successive survey years by race/ethnicity, region and poverty status. Among men 50 to 74 years old we observed a significant relative decrease in the PSA screening rate from 2010 to 2013 for all races/ethnicities combined, in NH Caucasian men (PM RR 0.81, 95% CI 0.75–0.88), in all regions and for all poverty levels except in the Northeast and among men with a household income of 251% to 400% of the poverty level. In men 75 years old or older PSA screening between 2010 and 2013 significantly decreased only in counties with a poverty percent of 251% to 400% (PM RR 0.71, 95% CI 0.53–0.93, supplementary table 3, http://jurology.com/).

DISCUSSION

Using nationwide data we observed decreasing incidence rates of prostate cancer among men 50 years old or older following the USPSTF recommendations against routine PSA screening. In contrast, incidence rates of distant stage disease significantly increased among men 50 to 74 years old. We did not observe an increasing incidence of distant stage disease in men 75 years old or older but this association may have been confounded by comorbidities. Longevity in an aging population increases the importance of age and comorbidity in treatment decisions and survival outcomes. Studies show that advancing age is associated with higher Gleason scores.[16] Thus, men who are 75 years old or older who are healthier may be at greatest risk for death from prostate cancer. Incidence rates of distant

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stage disease increased with increasing poverty level in men 50 to 74 years old. However, rates among men 75 years old or older were 2 to 3 times as high as among 50 to 74-year-old men.

In our analysis age specific rates coincided with 2008 USPSTF recommendations against PSA screenings in men 75 years old or older. Prior to the release of recommendations against PSA screening in 2008 overall prostate cancer rates were stable between 2001 and 2007 but rates significantly increased among 40 to 49-year-old men and decreased among older men (age 70 years or greater).[17] Following the USPSTF recommendation against routine PSA screening early stage prostate cancer decreased in men 50 years old or older.[7] Our study shows that PSA screening significantly decreased in men 75 years old or older who resided in counties with a percent federal poverty between 251% and 400%. Among men 50 to 74 years old PSA screening decreased significantly from 2010 to 2013 in the Midwest, South and West regions.

A recent study examining changes in PSA screening following USPSTF prostate screening recommendations showed significant decline in PSA screening from 2008 to 2013 among men 40 years old or older, especially those 75 years old or older.[18] Despite the decrease approximately a third of the men who were 50 years old or older continued to be screened after the 2012 USPSTF recommendation discouraging routine PSA screening in all men.[19] There is concern that PSA testing leads to the detection of incidental disease and over diagnosis of low grade prostate cancer.[20,21] However, the implementation of targeted screening programs could reduce the risk of over diagnosing and exposing men to harmful risks associated with excess screening.[3] In the May 2017 draft recommendations USPSTF recommended that “clinicians inform men ages 55 to 69 years about the potential benefits and harms of PSA based screening for prostate cancer,” revoking its 2012 recommendation against screening in men who are 50 years old or older.[22]

Racial/ethnic differences in rate trends may be related to differences in PSA screening patterns. Compared to other race/ethnic groups the incidence rate in men 50 to 74 years old decreased earlier for NH Caucasian men. A recent study examining PSA screening among men 40 years old or older after the USPSTF screening recommendations against screening revealed a significant decrease in PSA screening from 2010 to 2013 among Caucasian men and men who were 50 to 74 years old.[19] Similarly we observed a significant decrease in PSA screening between 2010 and 2013 in Caucasian men 50 to 74 years old but not in men 75 years old or older.

The 2012 USPSTF recommendations against PSA testing at all ages have raised concern about its effects on late stage disease.[23,24] Contrary to previous findings illustrating stable rates of metastatic disease in men who are 50 years old or older,[5] recent reports documented increasing rates of metastatic prostate cancer in men 75 years old or older.[8,9] However, the findings of Weiner et al were based on case counts rather than population based incidence rates, which could be affected by growth in the aging population.[9] In our nationwide analysis the increase in distant stage disease during the most recent period was not statistically significant, which is consistent with the findings by Jemal et al.[5] We observed significant increasing rates of distant stage disease from 2008 to 2013 among men

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50 to 74 years old but additional years are needed to determine whether the trend is real or an artifact of modeling. Even if this trend is real, we may not observe an increase in prostate cancer death rates in the near term, given the long natural history of the disease and recent advances in treatment that extend survival.

The association between regional variability and access to health care may also influence screening and incidence rates. For example, 1 study found lower odds of PSA screening among men living in urban areas and states with a lower prevalence of physicians.[24] Our study demonstrated significantly increasing rates of distant stage disease with increasing county level poverty status among men 50 to 74 years old. Studies have shown a significant association between higher SES and early stage disease.[25] Evidence also indicates that there are higher rates of late stage disease and a lower prevalence of PSA screening in nonmetropolitan counties compared to metropolitan areas.[26]

Our findings of a lower rate of late stage disease in the South in men who are 50 years old or older may reflect targeted efforts to improve screening rates in African American men.[27] In men 75 years old or older we did not observe disparities by poverty status, in part maybe because of relatively uniform health coverage to all through Medicare. Another possible explanation is consensus by medical organizations against routine PSA screening in older men.[2] Higher rates of late stage disease in counties with higher poverty among men 50 to 74 years old highlights the need to reduce health disparities in this population.

A strength of our study is the use of nationwide data to provide contemporary trends in prostate cancer incidence rates and the prevalence of PSA screening across racial/ethnic groups, regions and socioeconomic status.

Our study also has a few limitations. 1) Joinpoint models choose the best fit segmented line with the smallest number of joinpoints through several years of data. Thus, steeply rising rates for a short segment may not be statistically significant. 2) Full case ascertainment may hamper timely and accurate reporting of cases in catchment areas. However, delayed reporting likely caused underestimation of rates and increasing trends in recent years. Further, late reporting of incidence cases to cancer registries has become less significant during the years because of efforts to improve the collection of nonhospital cases in a timely manner.[28] 3) Trend analyses are a function of time and may be affected by outliers in a given year. 4) We were unable to control for Gleason scores and comorbidities because these data items are not currently available in the USCS data set. 5) NHIS collects self-reported data and, thus, our PSA screening findings are subject to social desirability bias.

CONCLUSIONS

Using nationwide, population based data we observed a decreasing incidence rate in all races/ethnicities, regions and SES groups following the USPSTF recommendations against routine screening. Notably we found that the incidence rate of distant stage disease increased significantly in men 50 to 74 years old but not in men 75 years old or older. Future studies with additional years of data are needed to substantiate our findings and monitor the effects of the late stage disease increase on prostate cancer mortality rates.

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Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Abbreviations and Acronyms

NH	nonHispanic
NHIS	National Health Interview Survey
PM	predicted marginal
PSA	prostate specific antigen
RR	rate ratio
SEER	Surveillance, Epidemiology and End Results
SES	socioeconomic status
USCS	United States Cancer Statistics
USPSTF	United States Preventive Services Task Force

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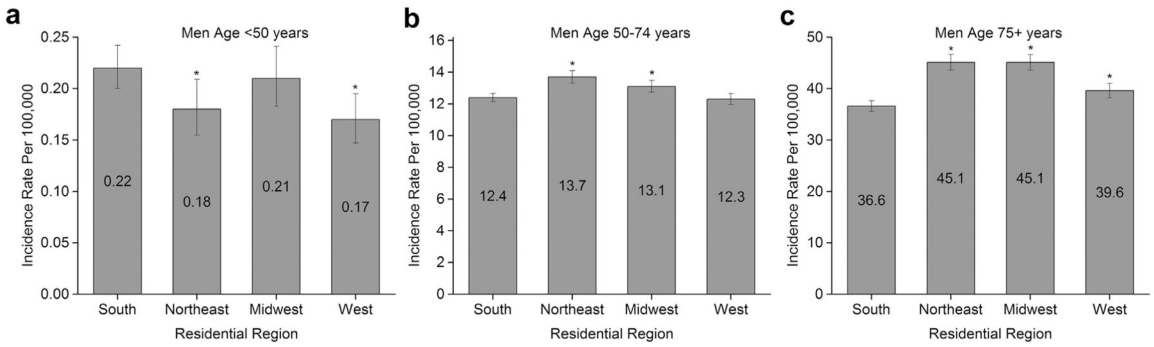

Figure 1.

Distant stage prostate cancer incidence rates per 100,000 men younger than 50 years (*a*), 50 to 74 years old (*b*) and 75 years old or older (*c*) by United States residential region as categorized by United States Census. Asterisk indicates significantly different RR than South region ($p < 0.05$).

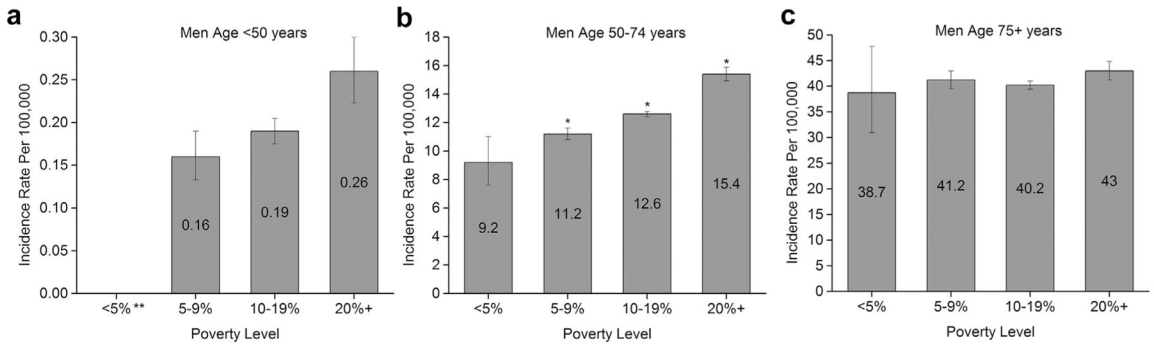

Figure 2.

Distant stage prostate cancer incidence rates per 100,000 men younger than 50 years (*a*), 50 to 74 years old (*b*) and 75 years old or older (*c*) by United States residential county poverty status. Single asterisk indicates significantly different RR than South region ($p < 0.05$). Double asterisks indicate rate not shown due to fewer than 16 cases.

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