

Correlates of Prostate-Specific Antigen Testing in a Large Multiethnic Cohort

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Approximately 218,890 men living in the United States were diagnosed as having prostate cancer in 2007, and 1 in 6 men nationally will receive the diagnosis in his lifetime.¹ Prostate cancer is the second leading cause of death among men in this country, and an estimated 27,350 US men died in 2006 of prostate cancer.² Rates of prostate cancer are markedly higher among African American men versus men of other racial/ethnic groups (248.5 vs 156.7 cases per 100,000 men between 2001 and 2005).¹ During the same period, the rates were 93.8 cases per 100,000 men among Asian or Pacific Islanders and 138.0 cases per 100,000 men among Latinos. Factors that predict whether a man undergoes prostate-specific antigen (PSA) testing among men of different races/ethnicities are not well known.

While national consensus exists for breast and colorectal screening guidelines, controversy continues to surround guidelines for prostate screening.^{1,3,4} The American Cancer Society (ACS)⁵ does not support routine testing among men of average risk, while the American Urologic Association (AUA)⁶ recommends annual PSA screening among men of average risk beginning at age 40 years. A 2008 study by the US Preventive Services Task Force (USPSTF)⁷ found that the current evidence was insufficient to assess the balance of benefits and harms of screening for prostate cancer among men younger than 75 years and recommended against screening among older men (≥ 75 years). Nevertheless, the USPSTF suggests that the group most likely to benefit from prostate cancer screening includes men aged 50 to 74 years and recommends testing every 1 to 4 years. Similar to most other major US medical associations, the USPSTF recommends that clinicians discuss the benefits and harms of prostate cancer screening with their patients and assist them with informed decision making regarding PSA testing.

Given the debate about prostate cancer screening guidelines, surprisingly little is known about the factors associated with screening behavior among men of diverse races/ethnicities. Data suggest that African American men are less likely to seek preventive healthcare compared with non-Hispanic white men.⁸ Because African American men are at greater risk of developing prostate cancer and dying of it, examination of variations in PSA testing rates by race/ethnicity is particularly warranted.

Results of the few recent community-based studies⁹⁻¹¹ that compared PSA testing prevalence by race/ethnicity suggest that African American men are substantially less likely to undergo

Objective: To examine factors associated with prostate-specific antigen (PSA) testing in the multiethnic California Men's Health Study.

Study Design: Cross-sectional analysis nested within a cohort of male health plan members (n = 55,278).

Methods: We extracted laboratory serum PSA values during the study period from 1998 to 2002. Using selected demographic and health-care factors, we estimated the proportion of men who underwent PSA testing at least once during the 5-year period. Odds ratios and corresponding 95% confidence intervals were estimated to assess the association between these factors and PSA screening use.

Results: African American men had substantially higher PSA screening prevalence than white men (82.6% vs 73.7%). Low PSA screening use was associated with Latino race/ethnicity, lower level of education, residency in the United States for 25 years or less, current smoking, and lack of PSA test discussion with healthcare providers. The strongest positive predictors of PSA testing were African American race/ethnicity (odds ratio, 1.66; 95% confidence interval, 1.50-1.83) and high concern about prostate cancer (odds ratio, 1.53; 95% confidence interval, 1.38-1.69). In contrast, when men did not discuss PSA testing with their physicians, they were 80% less likely to undergo screening.

Conclusions: In this insured population for whom financial barriers are minimized, PSA screening varied by race/ethnicity and by other patient and clinical factors, possibly reflecting inconsistencies in prostate cancer screening guidelines. Despite these differences, healthcare providers have a key role in patients' likelihood of undergoing PSA screening.

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Take-Away Points

Unlike previous studies of prostate cancer screening, this study adds to the literature by obtaining prostate-specific antigen (PSA) test utilization data from automated databases rather than by relying on self-reports.

- Prostate-specific antigen screening varied by patient and clinical factors, perhaps reflecting the inconsistencies in prostate cancer screening guidelines.
- African American men had significantly higher PSA test utilization than white men, while Latino men and Asian or Pacific Islander men had lower PSA test utilization.
- Concern about prostate cancer was a strong predictor of PSA test use.
- Men who discussed PSA screening with their clinician were more likely to get tested.

letter and a short questionnaire. In the second step, 134,060 men who completed the short questionnaire were then mailed a long questionnaire. The long questionnaire assessed information about demographics, personal and family history of cancer, healthcare utilization, health conditions, medication use, lifestyle, diet, and physical activity and was completed by 84,170 men.

screening than white men. The objective of this cross-sectional study was to examine factors associated with utilization of at least 1 screening PSA test during a 5-year period among men who were at average risk for prostate cancer and who were participants in the California Men's Health Study (CMHS),¹² a large multiethnic cohort established within the Kaiser Permanente Northern California and Kaiser Permanente Southern California health plans. Recommendations for PSA testing within these health plans generally follow those of the ACS; that is, asymptomatic men should be given information about the potential risks and benefits of the test, and the test should be provided if requested. For men with prostate gland symptoms, PSA screening or other screening modalities (eg, digital rectal examination) may be considered for men older than 50 years. Prostate-specific antigen screening is not recommended for men with life expectancy shorter than 10 years. Unlike several previous studies¹³ of prostate cancer screening, this population-based study adds to the research by obtaining PSA test utilization data from automated databases rather than by relying on self-reports, which tend to be an inaccurate measure of screening compliance. Furthermore, because out-of-pocket cost is an important known barrier to cancer screening, we were able to examine patient and healthcare factors in a population with equal access to care.

Participants, of whom approximately 40% self-reported being in a racial/ethnic minority group, closely reflected the sociodemographic diversity of the men residing in the state of California.¹² After exclusions for length of membership, history of prostate cancer, and diagnostic PSA tests, the eligible study group included 55,278 men. The study was approved by the institutional review boards of Kaiser Permanente Northern California and Kaiser Permanente Southern California.

Study Participants

The analysis presented herein includes men without a personal history of prostate cancer (as identified by the tumor registry) who were continuously enrolled members of the health plans from 1998 to 2002. In addition, we excluded men who underwent PSA tests as ordered by a urologist and men who reported that they completed the PSA test because of symptoms or follow-up of previous abnormal test results. Such tests potentially would have been completed for diagnostic and not screening purposes.

Data Sources

Using unique medical record identifiers, we extracted data on PSA test utilization between 1998 and 2002 from the automated laboratory databases. For men who had multiple serum PSA tests during the 5-year window, only the first test was included in the analysis. We obtained information about overall healthcare utilization and about the department of each participant's primary healthcare provider from other automated health plan databases. Self-reported information obtained from the questionnaire included the following: demographics (age, race/ethnicity, level of education, income, and residency in the United States), knowledge about PSA testing, family history of prostate cancer, occurrence of benign prostatic hyperplasia, prostatitis, lower urinary tract symptom severity using the AUA symptom index (AUASI) score, and smoking habits. The AUASI score provides an overall evaluation of lower urinary tract symptoms based on a questionnaire published by the AUA.

METHODS

Design and Setting

The Kaiser Permanente Medical Care Program is an integrated group practice prepaid health plan in 6 regions across the United States. The program cares for more than 6 million members in California. The analysis was nested within a prospective cohort study, the CMHS, described in detail previously.¹² Briefly, the CMHS consists of male Kaiser Permanente Medical Care Program members aged 45 to 69 years at the time they completed self-administered questionnaires from January 2002 to December 2003. Participants were recruited in a 2-step process. In the first step, eligible health plan members were mailed a recruitment

Statistical Analysis

We estimated the proportion of men who underwent PSA testing by dividing the number of men with any serum PSA test in the 5-year period by the number of men at risk for being screened. The proportion was estimated for the cohort overall and was stratified by selected demographic and healthcare factors. Odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were estimated to assess the association between these factors and PSA screening use. We used unconditional logistic regression analysis to estimate the association of each factor, with adjustment for other factors. All demographic factors and healthcare factors were included in the multivariate model.

RESULTS

Of 84,067 men comprising the CMHS cohort, 66,400 had been enrolled in the health plans for 5 years before the baseline questionnaire. We excluded 11,122 men from the analysis who had prior prostate cancer ($n = 3266$) or a potentially diagnostic PSA test (as determined by self-report or if the test was ordered by a urologist) ($n = 7856$). Therefore, the eligible study population for this study included 55,278 men.

Overall, we identified 40,062 men (72.5%) who underwent any PSA screening as determined from automated laboratory data (Table 1). The prevalence of any PSA screening was highest among African Americans (82.6%) and was lowest among Latinos (64.8%). As expected, PSA testing increased with age, with the sharpest rise occurring at age 50 years. In contrast, 36.1% of the men in the youngest group (45-49 years) had undergone PSA testing. In general, the highest prevalences of PSA testing were among the following: men with the highest level of education, men who were married or living with their partners, men who lived in the United States their whole lives or for longer than 25 years, and men who were past smokers. In multivariate analyses, African American men were more likely to have undergone a PSA test compared with white men (adjusted OR, 1.66; 95% CI, 1.50-1.83). In contrast, Latino men were less likely to have undergone a PSA test (adjusted OR, 0.89; 95% CI, 0.84-0.96). No significant difference was found between Asian or Pacific Islander men and white men. Compared with men 60 years or older, men aged 50 to 59 years were 40% less likely to have had PSA testing (adjusted OR, 0.59; 95% CI, 0.56-0.62). Prostate-specific antigen testing did not vary substantially by household income level. Yet, men who had lived in the United States for 25 years or less were dramatically less likely to have undergone any PSA testing compared with those who had lived in the United States longer (adjusted OR, 0.78; 95% CI, 0.70-0.86). Compared with nonsmokers,

current smokers were 20% less likely to have undergone any PSA testing (adjusted OR, 0.80; 95% CI, 0.74-0.86).

Of all the factors examined, clinicians' discussion of PSA testing was the strongest predictor of utilization (Table 2). The prevalence of any PSA screening was 88.6% among men who reported having had a discussion with their clinician regarding this test. Clinicians more frequently discussed the test with African American men, men with higher AUASI scores, older men, and men with a college education (data not shown). A higher proportion of younger men among African Americans discussed the test with their clinician than among any other racial/ethnic group. In contrast to men who recalled a discussion, men who did not were 80% less likely to undergo screening (adjusted OR, 0.21; 95% CI, 0.20-0.22). Other factors strongly associated with PSA testing include having a high level of concern ("extremely concerned") about prostate cancer (adjusted OR, 1.53; 95% CI, 1.38-1.69) and having a family history of prostate cancer (adjusted OR, 1.34; 95% CI, 1.24-1.44).

Men who reported having benign prostatic hyperplasia and men having an AUASI score in the severe range were more likely to undergo PSA testing. However, self-reported prostatitis was not associated with increased likelihood of having a PSA test (adjusted OR, 0.99; 95% CI, 0.88-1.11) (Table 2). Men who received their healthcare from providers in internal medicine and other primary care departments were substantially more likely to have a PSA test than participants who did not have an assigned primary care provider (73.8% vs 43.6%). Prostate-specific antigen testing prevalence increased with more outpatient visits (examined in quartiles). The associations in Table 1 and Table 2 did not change appreciably after adjusting for multiple covariates.

DISCUSSION

This analysis identified the prevalence of PSA screening among insured men and the patient and healthcare factors associated with testing. Despite the controversy surrounding PSA testing, almost three-fourths of this multiethnic cohort had at least 1 PSA test in the prior 5 years. Consistent with recommendations of major US medical associations and the Kaiser Permanente Medical Care Program health plans, most men (88.6%) reported that their physician had discussed the PSA test with them (Table 2). Most important, African American men (who are at higher risk for prostate cancer) had significantly higher PSA test utilization than white men (82.6% vs 73.7%). This finding is in contrast to results from a 2001 population-based California survey of 8713 men, which found a lower prevalence of PSA testing among African American men (42%) than among white men (48%).¹¹ The greater use of screening by African Americans in the managed

■ **Table 1.** Demographic Characteristics Associated With Prostate-Specific Antigen (PSA) Testing, California Men's Health Study, 1998-2002

Characteristic	PSA Testing, No. (%) ^a		Odds Ratio (95% Confidence Interval) for PSA Testing		P ^c
	Yes	No	Crude	Multivariate Adjusted ^b	
Overall PSA testing prevalence	40,062 (72.5)	15,216	—	—	
Health plan region					.17
Southern	21,335 (72.7)	8004	0.97 (0.94-1.01)	0.98 (0.94-1.03)	
Northern	18,727 (72.2)	7212	1.00 [Reference]	1.00 [Reference]	
Race/ethnicity					<.001
African American	3405 (82.6)	715	1.70 (1.56-1.85)	1.66 (1.50-1.83)	
Asian or Pacific Islander	4326 (69.7)	1880	0.82 (0.78-0.87)	1.04 (0.96-1.12)	
Latino	4636 (64.8)	2516	0.66 (0.62-0.70)	0.89 (0.84-0.96)	
Other or mixed	2030 (68.5)	933	0.78 (0.72-0.84)	0.93 (0.84-1.02)	
White	25,665 (73.7)	9172	1.00 [Reference]	1.00 [Reference]	
Age, y					<.001
45-49	2916 (36.1)	5165	0.10 (0.09-0.10)	0.17 (0.16-0.18)	
50-59	17,438 (72.2)	6719	0.44 (0.42-0.46)	0.59 (0.56-0.62)	
≥60	19,708 (85.5)	3332	1.00 [Reference]	1.00 [Reference]	
Education					<.001
≥College or more	19,765 (74.8)	6671	1.00 [Reference]	1.00 [Reference]	
Vocational or some college	13,531 (70.4)	5695	0.80 (0.77-0.84)	0.82 (0.78-0.87)	
≤High school or less	6601 (70.2)	2799	0.80 (0.76-0.84)	0.85 (0.79-0.91)	
Marital status at time of questionnaire					<.001
Married or live with partner	33,287 (73.2)	12,213	1.00 [Reference]	1.00 [Reference]	
Other	6604 (69.2)	2942	0.82 (0.78-0.86)	0.91 (0.86-0.97)	
Current household income, \$.006
≥100,000	11,396 (71.9)	4463	1.00 [Reference]	1.00 [Reference]	
80,000-99,999	5701 (71.9)	2229	1.00 (0.94-1.06)	1.04 (0.97-1.12)	
60,000-79,999	7386 (71.4)	2952	0.98 (0.93-1.04)	1.02 (0.96-1.09)	
40,000-59,999	7297 (72.9)	2707	1.06 (1.00-1.12)	1.05 (0.98-1.13)	
<40,000	6621 (73.6)	2373	1.09 (1.03-1.16)	0.97 (0.90-1.05)	
US residence, y					<.001
Whole life or >25	37,629 (73.0)	13,896	1.00 [Reference]	1.00 [Reference]	
≤25	2089 (63.5)	1203	0.64 (0.60-0.69)	0.78 (0.70-0.86)	
Smoking status					<.001
Never	16,689 (70.0)	7163	1.00 [Reference]	1.00 [Reference]	
Past	18,629 (76.3)	5779	1.38 (1.33-1.44)	1.04 (0.99-1.09)	
Current	3567 (65.2)	1903	0.80 (0.76-0.86)	0.80 (0.74-0.86)	

^aSample total varies because of missing responses.

^bAll demographic characteristics and prostate health variables in Table 1 and Table 2 were included in the multivariate model.

^cP values (2-sided) are based on χ^2 test for heterogeneity.

care plans is noteworthy and may be the result of greater physician awareness about the higher risk among African Americans, as well as equivalent access to care, as reported among men in the Veterans Affairs system.^{14,15}

On the other hand, we found lower rates of PSA testing among Latino men compared with white men (possibly because Latino men have lower prostate cancer incidence in general). Similarly, men with less than a college education and

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Table 2. Healthcare and Prostate Health Variables Associated With Prostate-Specific Antigen (PSA) Testing, California Men's Health Study, 1998-2002

Variable	PSA Testing, No. (%) ^a		Odds Ratio (95% Confidence Interval) for PSA Testing		P ^c
	Yes	No	Crude	Multivariate Adjusted ^b	
Physician discussed PSA test with respondent					
					<.001
Yes	24,222 (88.6)	3107	1.00 [Reference]	1.00 [Reference]	
No	12,840 (53.4)	11,198	0.15 (0.14-0.15)	0.21 (0.20-0.22)	
Do not know	2885 (76.5)	887	0.42 (0.38-0.45)	0.45 (0.41-0.49)	
Concerned about prostate cancer					
					<.001
Not at all	3388 (65.8)	1760	1.00 [Reference]	1.00 [Reference]	
Little	12,343 (69.9)	5322	1.20 (1.13-1.29)	1.10 (1.01-1.19)	
Moderately	13,837 (73.8)	4925	1.46 (1.37-1.56)	1.18 (1.09-1.28)	
Quite	6484 (76.1)	2032	1.66 (1.54-1.79)	1.31 (1.20-1.44)	
Extremely	3859 (77.6)	1112	1.80 (1.65-1.97)	1.53 (1.38-1.69)	
Family history of prostate cancer					
					<.001
Yes	5367 (79.4)	1391	1.55 (1.46-1.65)	1.34 (1.24-1.44)	
No	32,922 (71.3)	13,238	1.00 [Reference]	1.00 [Reference]	
Benign prostatic hyperplasia					
					<.001
Yes	9162 (87.8)	1276	3.24 (3.04-3.45)	1.68 (1.56-1.80)	
No	30,898 (68.9)	13,939	1.00 [Reference]	1.00 [Reference]	
Ever had prostatitis					
					<.001
Yes	2186 (81.7)	490	1.74 (1.58-1.92)	0.99 (0.88-1.11)	
No	37,407 (71.9)	14,598	1.00 [Reference]	1.00 [Reference]	
American Urologic Association symptom index score					
					<.001
Mild	18,487 (68.3)	8600	1.00 [Reference]	1.00 [Reference]	
Moderate	18,931 (75.8)	6054	1.45 (1.40-1.51)	1.11 (1.06-1.16)	
Severe	2411 (83.6)	472	2.38 (2.15-2.63)	1.21 (1.08-1.37)	
Primary care department					
					<.001
Internal medicine	28,248 (73.8)	10,044	1.00 [Reference]	1.00 [Reference]	
Other	10,736 (74.0)	3776	1.01 (0.97-1.06)	1.07 (1.02-1.13)	
Not designated	1078 (43.6)	1396	0.40 (0.36-0.44)	0.41 (0.37-0.45)	
No. of visits from 1998 to 2002, quartile					
					<.001
1	7777 (53.7)	6700	0.23 (0.22-0.25)	0.34 (0.32-0.37)	
2	9935 (73.6)	3557	0.56 (0.53-0.60)	0.70 (0.65-0.75)	
3	11152 (80.5)	2694	0.84 (0.79-0.89)	0.90 (0.84-0.97)	
4	11,198 (83.2)	2265	1.00 [Reference]	1.00 [Reference]	

^aSample total varies because of missing responses.

^bAll demographic characteristics and prostate health variables in Table 1 and Table 2 were included in the multivariate model.

^cP values (2-sided) are based on χ^2 test for heterogeneity.

those with 25 years or less of residence in the United States were significantly less likely to be tested. Smokers (who are at higher risk for many cancers) may also be at higher risk for prostate cancer–related morbidity and mortality as a result of their lower participation in PSA screening. These find-

ings suggest that enhanced provider education and increased health plan efforts may be needed to help reduce a health disparities gap among certain groups of men. However, it may be that urgent problems or management of comorbidities was the focus of the outpatient visits utilized by these men.

As would be expected, when men experienced urologic symptoms (eg, higher AUASI scores or a history of benign prostatic hyperplasia), they were more likely to undergo PSA testing. In our study, awareness of the potential threat of prostate cancer through having a family history of prostate cancer or expression of concern about prostate cancer was also associated with PSA testing.

Clearly, physicians were the most powerful influence on PSA testing in this cohort of middle-aged men. When men did not discuss a PSA test with their physician, they were 80% less likely to have a test. With the available data, we were unable to examine the content of the actual discussion. Future research that includes physician-patient interactions is needed to understand how the conversation affects decision making about PSA testing. Prostate-specific antigen testing increased significantly in proportion to the number of patient contacts with primary care providers. Yet, our examination of healthcare delivery identified missed opportunities for PSA screening. Only 3.4% of men without an assigned primary care physician had a PSA test compared with 4.0% of men with a regular source of care (data not shown).

This study has potential limitations. Despite the large size and racial/ethnic diversity of the CMHS cohort, our findings may not be generalizable to other populations. It is feasible that men with higher utilization of preventive health screening or with greater concern about prostate cancer were more likely to participate in the CMHS. However, the CMHS cohort members are similar to the male participants of a California population-based survey with respect to race/ethnicity, body mass index, level of education and income, marital status, and birthplace.^{11,12,15} Additional data are needed to examine PSA screening at earlier ages. Although digital rectal examination is also a modality for prostate cancer screening, information about this procedure was not comprehensively captured in the health plan electronic databases, and it is possible that prostate cancer screening use may be underestimated in the present study.

Because annual prostate cancer screening is mainly recommended for men considered to be at high risk, we did not specifically examine PSA screening frequency among our group of largely asymptomatic men. Most important, no clear guidelines exist about the frequency of PSA testing among men at average risk. Therefore, we examined the 5-year prevalence.

This study has several strengths. Out-of-pocket cost is an important known barrier to cancer screening. We were able to examine patient and healthcare factors in a population with equal access to care. This study occurred after the rapid rise of PSA testing in the late 1980s and early 1990s, enabling us to examine predictors associated with screening behavior

after the initial diffusion of the test. Unlike previous studies, we based our analysis on PSA testing use extracted from laboratory databases, which eliminates recall bias. Previous studies^{8-11,15-21} may have inaccurately assessed screening prevalence because the rates were based on self-reports or may have included diagnostic tests. To differentiate screening from diagnostic PSA tests, we excluded men who had a history of prostate cancer and those whose tests were ordered by a urologist or in response to patient symptoms. The overall prevalence of PSA testing was 72.5% among the CMHS study population (1998-2002) (Table 1), and these results are comparable to those of other published studies. For example, 78% of individuals in a North Carolina study¹⁷ reported obtaining a PSA test in 2003 and 75% of individuals in the national 2001 Behavioral Risk Factor Surveillance System survey.²²

Although controversy exists about the balance of benefits and harms associated with PSA testing, rates of testing continue to climb nationally.^{11,12,18} In this study, overall PSA screening rates were high, and although some recommendations for prostate cancer screening call for PSA testing to begin at age 50 years, more than one-third of men 49 years or younger had a PSA test in the prior 5 years (Table 1). Given the age criterion for the initial survey, we were unable to examine PSA testing use among men younger than 45 years or men 70 years or older; however, many national guidelines (such as the ACS⁵) do not state the appropriate age at which to start and stop screening. Furthermore, the USPSTF⁷ does not recommend testing among men older than 75 years.

In summary, the present study identified factors positively and negatively associated with PSA screening utilization in a large diverse population. Prostate-specific antigen screening varied by several patient and clinical factors possibly because of inconsistencies in prostate cancer screening guidelines, which reflect existing controversies over the benefits and risks of detection of and treatment for prostate cancer. While PSA testing was higher among African American men compared with white men, we found substantially lower testing prevalence among Latino men. Although out-of-pocket expense is minimized in these health plans, greater attention should be paid to men who belong to lower socioeconomic groups and to men who smoke. Previous findings demonstrate that patient-reported barriers to the use of screening tests include absence of symptoms, worries about pain or injury, preference that any health problems remain unknown, busy lifestyle, perceived susceptibility, and lack of physician recommendation.²³ Our results support previous findings that patients are more likely to obtain screening when providers recommend PSA testing.^{8,11} In the large health plans providing comprehensive healthcare to the men in this study, most providers discussed PSA testing with their patients, and most men had the test.

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