Prostate-specific antigen test use reported in the 2000 National Health Interview Survey

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Abstract

Background. In 2000, the National Health Interview Survey (NHIS) collected information about prostate-specific antigen (PSA) test use in a representative sample of U.S. men.

Methods. This study examined PSA test use in subgroups defined by personal and social characteristics.

Results. Among men aged 50 and older with no history of prostate cancer, 56.8% reported ever having had a PSA test, 34.1% reported having had a screening PSA test during the previous year, and 30.0% reported having had three or more tests during the previous 5 years. Screening was greater among men aged 60–79 years, those with greater access to care, and those practicing other preventive behaviors. Among men in their 40s, use tended to be higher among African-American men.

Conclusions. The prevalence and patterns of PSA screening suggest that PSA is used like other cancer screening tests among about a third of U.S. men. Because of the lack of scientific consensus on whether prostate cancer screening is beneficial, more information is needed on how knowledgeable both patients and practitioners are about the potential benefits and harms of screening and how prostate cancer screening decisions are made.

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Introduction

Although there is no scientific consensus that screening with the prostate-specific antigen (PSA) test reduces deaths from prostate cancer, and the debate is ongoing as to whether the potential benefits of screening outweigh the possible harms [1–6], the PSA test is commonly used [7–12]. Medicare claims data [9,13], and surveys of clinicians [14–16], and men [7,9–11,13,17–19] in certain U.S. geographic areas or health care systems indicate that PSA testing increased during the 1980s and 1990s.

Although use has increased, there is limited published information about the prevalence of PSA test use in subpopulations of men defined by demographic or social characteristics that may influence use of PSA tests; additionally, studies do not routinely distinguish between PSA tests done

for screening and other purposes. Many studies are specific to a particular region or clinic, have small samples, or are not population-based [9–14,17–25]. Factors related to use of PSA testing and/or use of digital rectal examination (DRE) include age [11,20,21,26], race/ethnicity [13,14,17–19,22,26], income/poverty status [17,19,21,23,26], immigrant status [26], education [12,20,26], health insurance status [12,26,27], having a regular source of healthcare [12,21,26], marital status [23], prior prostate screening history [23], family history of prostate cancer [24], history of urinary tract symptoms [23,25], other illnesses [7,21], and health behaviors such as exercise and diet [11].

The 2000 National Health Interview Survey (NHIS) provides information about PSA test use among a nationally representative sample of U.S. men [26]. Our study uses these data to provide the first detailed examination of PSA use in a nationally representative sample of U.S. men. Its main purposes were to (1) examine the prevalence of annual PSA screening and routine test use; (2) describe use among

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subgroups defined by three sets of characteristics: factors found to be related to PSA test use in earlier research, factors reported to influence use of cancer screening tests in women, and some specific health-related factors that might influence decisions about PSA test use; and (3) examine use adjusted for other factors that may affect use.

Study methods

The NHIS is an annual health survey conducted by the National Center for Health Statistics [28]. The survey includes core questions about the respondent's health, demographic and socioeconomic circumstances, and access to and use of health services. It also contains one or more annual supplements addressing particular health issues. In 2000, the survey collected information related to cancer prevention and control [26]. One sample adult was randomly selected from each family participating in the NHIS. In-person interviews were conducted by trained U.S. Bureau of the Census interviewers. African-Americans and Hispanic households were over-sampled to obtain for more precise estimates [28].

Study population

Interviews were conducted with 32,374 adults in 39,264 families. In 7,784 families, there were no adult males in residence. The adult sample response rate was 72.1%. Our analysis focused on men aged 50 and older because most organizations that support prostate cancer screening recommend that annual testing begin at age 50 [29]. Because African-American men and men with a family history of prostate cancer are at higher risk at younger ages, some organizations recommend offering PSA testing at an earlier age for those men [5]. Therefore, we conducted additional analyses for men in their 40s. From the sample of 5,220 men aged 50 and older, we excluded 222 men because they had prostate cancer and were likely to have PSA testing as part of their routine care and 368 men because they did not answer the PSA test use questions. For multivariate analysis, we excluded additional 287 men for whom we lacked information on other relevant variables.

Data collection

Male respondents aged 40 and older were asked if they had heard of the PSA test, and if so, whether they had one, and if they had, when their most recent test was and the reason for it. They were also asked how many tests they had received in the last 5 years. From those questions, we created four PSA test use measures indicating (1) if a man had ever had a PSA test, (2) if he had had a test in the previous year, (3) if he had had a recent PSA test for screening purposes (as a "routine test" or "screening test" or because of a family

history), and (4) if he was a routine user, defined as having had three or more tests in the previous 5 years. PSA tests for any purpose were included in this variable because the NHIS did not ask respondents the reasons for having a PSA test other than the most recent one.

A set of factors that may influence test use was selected from the literature [7–30] and categorized as indicated in Table 1. We included several other factors associated with cancer screening in women [26,30,31] that have not been examined for their relation to PSA use in men. These include occupation [32], personal history of other cancers [30], use of other health services [31], and other health-related behaviors [31], such as alcohol consumption and smoking. More detailed information on these variables is published elsewhere [26,28].

From 16 possible race categories used in the interview, we recorded race into five commonly used categories: white, black/African-American, American Indian/Alaska Native, Asian, and other/multiple race. Poverty levels were based on definitions of federal poverty levels developed by the Social Security Administration [33]. For 2000, the published Census Bureau poverty level for a family of four was set at \$17,603.

Access to health care was indicated by several factors including type of health insurance and usual source of care. Private insurance was defined as a private insurance plan, a single hospital service plan, a military plan, CHAMPUS, Tricare, Medicare with private supplementation, or a health maintenance organization plan. Public health insurance included Medicaid, Medicare without private supplementation, Children's Health Insurance Program, Indian Health Service, or other public assistance such as state-sponsored programs [28]. Usual source of care was determined by asking "Is there a place that you usually go when you are sick or need advice about your health?" Persons who stated that the emergency room was their usual source of care were defined as having no usual source of care.

Health status characteristics that we anticipated might influence PSA test use included family history of prostate cancer, self-assessment of general health, and an indicator of the number of chronic diseases the respondent had at the time of the interview. We computed an index of chronic diseases by summing the following self-reported conditions: hypertension, stroke, emphysema, diabetes, chronic bronchitis, failing kidneys, liver condition, and heart disease. Many organizations suggest that men with a limited life expectancy, usually less than 10 years, would not benefit from screening [29]. The presence of one or more chronic diseases and age category of 80 and older were used as indicators of possibly reduced life expectancy.

Data analysis

The NHIS used a stratified, multistage-cluster sample [28]. The statistical program SUDAAN was used in all of

Table 1
Characteristics of men^a aged 50 or older in the 2000 NHIS

	N	% ^b
<i>Demographics</i>		
Age	4998	
50–64 years		60.4
65–79 years		32.2
80+ years		7.4
Race	4998	
White		86.6
African-American		8.1
American Indian, Alaskan Native		0.7
Asian		2.8
Other		1.7
Ethnicity	4998	
Hispanic		7.0
Non-Hispanic		93.0
Region	4998	
Northeast		19.9
Midwest		24.4
South		35.9
West		19.8
Length of U.S. residence	4936	
<10 years		1.3
≥10 years		9.1
Born in US		89.6
<i>Socioeconomic status</i>		
Education	4924	
<High school graduate		23.5
High school graduate		28.0
Some college/tech school		22.7
College grad		25.8
Poverty threshold	4998	
<200%		18.1
200–299%		12.0
300–399%		8.8
400–599%		7.9
500%+		25.2
Unknown		28.1
Marital status	4981	
Married/living with partner		78.1
Widowed		7.0
Divorced or separated		10.4
Never married		4.5
Family size	4998	
1 person		18.0
2 persons		54.9
3 persons		14.5
4+ persons		12.6
Occupation	4874	
Executive/professional/managerial		17.0
Technicians/sales/admin support/student		10.4
Blue collar/service/homemaker		23.4
Retired		38.8
Unable to work/laid off/looking		10.4
<i>Access to health care</i>		
Health insurance	4978	
None		7.1
Public		15.5
Private/military		77.4
Usual source of medical care	4978	
Yes		91.2
No		8.8

Table 1 (continued)

	N	% ^b
<i>Access to health care</i>		
Language spoken, among Hispanics	552	
Spanish		48.8
English		51.2
Seen MD or health care provider in past year	4921	
Yes		84.5
No		15.5
<i>Health status</i>		
Reported health status	4986	
Excellent		20.6
Very good		30.3
Good		29.9
Fair or poor		19.2
Family history of prostate cancer	4712	
Yes		6.3
No		93.7
Number of chronic diseases	4998	
None		43.5
1 disease		31.6
2 diseases		16.1
3 diseases		5.8
4+ diseases		3.1
Cancer ^c	4998	
Yes		4.9
No		95.1
<i>Screening</i>		
Had colorectal cancer screening ^d	4627	
Yes		30.7
No		69.3
<i>Health-related behaviors</i>		
Cigarette use	4953	
Current (smoke everyday or some days)		19.5
Former		45.6
Never		34.9
Alcohol use	4897	
Lifetime abstainer		17.4
Former drinker		22.5
Moderate drinker		50.6
Excessive drinker		9.5
(2 or more drinks per day or 5 or more drinks on 12 or more occasions per year)		

^a Excluding men with prostate cancer.

^b Adjusted for the NHIS sampling methods and weighted to the U.S. census as described in Study methods.

^c Excluding non-melanoma skin cancer.

^d Fecal occult blood test in past 5 years or sigmoidoscopy, proctoscopy, or colonoscopy in last 5 years.

our analyses to account for this sampling [34]. The SUDAAN analyses used sample weights provided with the NHIS public use data file to adjust for the complex, cluster sampling, and over-sampling. Further, the analyses were weighted (“post-stratified”) to the U.S. census distributions by age and race/ethnicity for the year 2000 to provide estimates representative of U.S. men in the general population [28]. We first computed the percentages of men who reported a PSA test in groups defined by the socio-

Table 2
Percentage of men^a aged 50 or older who have had PSA test(s) by population subgroups

	Had a screening PSA in the past year				Had any PSA in the past year				Had 3+ PSAs in the past 5 years			
	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d
<i>Demographics</i>												
All men	4630	34.1		32.5–35.7	4630	39.0		37.3–40.7	4569	29.7		27.9–31.4
Age			0.000				0.000				0.000	
50–64 years	2676	29.9		27.7–32.1	2676	33.2		30.9–35.4	2659	23.8		21.7–26.0
65–79 years	1577	43.8	0.000	41.2–46.4	1577	51.3	0.000	48.7–53.9	1539	41.7	0.000	38.8–44.5
80+ years	377	26.3	0.189	21.5–31.1	377	33.8	0.828	28.6–39.1	371	26.5	0.334	21.5–31.6
Race			0.059				0.003				0.003	
White	3859	34.8		33.1–36.5	3859	40.2		38.5–41.9	3811	30.9		29.2–32.6
African-American	513	31.4	0.154	27.0–35.8	513	34.4	0.017	29.9–38.9	503	26.5	0.088	21.5–31.4
American Indian, Alaskan Native	32	18.7	0.002	8.7–28.8	32	27.9	0.096	13.5–42.4	32	20.3	0.095	8.0–32.7
Asian	104	21.8	0.001	14.0–29.6	104	24.9	0.000	18.1–31.8	103	18.5	0.000	12.0–24.9
Other	122	28.8	0.172	20.3–37.3	122	32.0	0.085	22.8–41.2	120	16.8	0.001	8.9–24.7
Ethnicity			0.000				0.000				0.000	
Hispanic	538	24.4	0.000	19.8–29.1	538	28.9	0.000	24.1–33.8	535	17.9	0.000	14.0–21.9
Non-Hispanic	4092	34.9		33.2–36.5	4092	40.0		38.3–41.7	4034	30.9		29.2–32.6
Region			0.072				0.025				0.040	
Northeast	869	34.4		30.9–38.0	869	41.0		37.4–44.6	850	31.7		27.5–36.0
Midwest	1074	35.2	0.721	32.7–37.8	1074	40.0	0.657	37.4–42.6	1059	28.6	0.235	25.9–31.4
South	1701	35.5	0.650	32.7–38.2	1701	40.3	0.765	37.3–43.2	1681	32.0	0.902	29.3–34.8
West	986	30.1	0.111	26.2–34.1	986	34.9	0.022	31.2–38.6	979	26.6	0.062	23.3–29.9
Length of U.S. residence			0.000				0.000				0.000	
<10 years	62	12.3	0.000	2.2–22.4	62	17.4	0.000	5.9–28.9	62	13.5	0.001	3.6–23.4
≥10 years	492	24.5	0.000	19.9–29.1	492	30.3	0.000	25.2–35.3	489	22.0	0.001	17.1–27.0
Born in US	4028	35.5		33.8–37.1	4028	40.6		38.9–42.3	3971	31.2		29.5–33.0
<i>Socioeconomic status</i>												
Education			0.000				0.000				0.000	
<High school graduate	1234	22.9		20.3–25.5	1234	27.3		24.7–30.0	1224	17.9		15.4–20.5
High school graduate	1257	32.2	0.000	29.2–35.1	1257	36.9	0.000	33.8–39.9	1240	27.2	0.000	24.4–30.0
Some college/tech school	1017	39.5	0.000	36.0–42.9	1017	44.4	0.000	41.0–47.8	998	35.7	0.000	32.2–39.1
College grad	1078	43.3	0.000	39.4–47.3	1078	50.2	0.000	46.5–53.9	1066	41.4	0.000	38.1–44.8
Poverty threshold			0.000				0.000				0.000	
<200%	1056	25.7		22.8–28.6	1056	29.7		26.6–32.8	1046	19.7		16.7–22.8
200–299%	579	27.9	0.380	24.1–31.7	579	31.8	0.404	27.9–35.8	574	24.1	0.080	20.3–28.0
300–399%	411	31.1	0.069	26.5–35.7	411	38.7	0.003	33.9–43.6	407	30.6	0.000	25.9–35.3
400–499%	357	33.5	0.022	27.4–39.6	357	40.8	0.003	34.3–47.2	353	31.4	0.000	26.4–36.5
500%+	1062	45.6	0.000	41.4–49.9	1062	52.1	0.000	48.0–56.1	1058	43.0	0.000	39.3–46.8
Unknown	1165	33.5	0.000	30.5–36.5	1165	38.0	0.000	34.8–41.1	1131	29.7	0.000	26.5–32.9
Marital status			0.000				0.000				0.000	
Married/living with partner	2999	36.0		34.0–38.0	2999	41.4		39.4–43.4	2965	31.8		29.8–33.8
Widowed	501	31.1	0.148	24.7–37.4	501	36.8	0.196	30.2–43.4	486	24.0	0.004	19.2–28.7
Divorced or separated	790	24.6	0.000	20.5–28.8	790	27.9	0.000	23.9–32.0	781	20.5	0.000	17.0–24.1
Never married	331	30.7	0.099	24.7–36.7	331	35.6	0.079	29.5–41.7	328	23.3	0.004	17.9–28.7
Family size			0.000				0.000				0.000	
1 person	1497	28.4		26.0–30.9	1497	32.8		30.2–35.3	1471	25.6		23.1–28.1
2 persons	2281	36.6	0.000	34.4–38.7	2281	42.4	0.000	40.3–44.5	2253	32.8	0.000	30.8–34.9
3 persons	481	35.0	0.010	30.6–39.5	481	38.2	0.037	33.6–42.8	475	24.2	0.568	20.0–28.3
4+ persons	371	28.8	0.915	22.5–35.1	371	32.6	0.971	26.2–39.1	370	26.4	0.819	19.9–32.9
Occupation			0.000				0.000				0.000	
Executive/professional/ managerial	694	40.8		35.1–46.6	694	43.9		38.2–49.6	688	38.8		33.1–44.5
Technicians/sales/ admin support/student	426	38.9	0.667	32.3–45.5	426	45.9	0.599	41.3–50.4	423	36.6	0.624	29.7–43.4
Blue collar/service/ homemaker	1067	27.9	0.001	23.0–32.7	1067	30.8	0.001	26.0–35.7	1058	18.7	0.000	14.9–22.4
Retired	1823	39.8	0.776	35.0–44.5	1823	44.5	0.879	39.8–49.2	1782	33.6	0.139	29.5–37.7
Unable to work/ laid off/looking	523	25.2	0.000	20.5–30.0	523	30.4	0.000	25.3–35.5	522	21.1	0.000	16.7–25.4

(continued on next page)

Table 2 (continued)

	Had a screening PSA in the past year				Had any PSA in the past year				Had 3+ PSAs in the past 5 years			
	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d
<i>Access to health care</i>												
Health insurance			0.000				0.000				0.000	
None	378	8.0	0.000	4.2–11.7	378	9.7	0.000	5.7–13.6	378	6.0	0.000	2.6–9.5
Public	861	26.8	0.000	22.9–30.8	861	31.6	0.000	27.5–35.7	850	20.7	0.000	16.9–24.5
Private/military	3374	37.4		35.4–39.3	3374	42.7		40.7–44.6	3325	34.0		32.1–36.0
Usual source of medical care			0.000				0.000				0.000	
Yes	4148	36.3		34.6–38.0	4148	41.6		40.0–43.3	4086	31.9		30.2–33.6
No	479	9.5	0.000	6.1–12.9	479	11.4	0.000	7.6–15.2	480	8.2	0.000	4.9–11.6
Language spoken, among Hispanics			0.043				0.004				0.000	
Spanish	274	20.0	0.070	14.3–25.8	274	22.9	0.014	17.0–28.9	273	9.8	0.000	6.7–13.0
English	262	28.5		21.5–35.4	262	34.7		27.5–41.8	260	25.4		18.9–31.9
Seen an MD or HCP in past 12 months			0.000				0.000				0.000	
Yes	3809	38.6		36.8–40.3	3809	44.2		42.4–46.0	3750	33.7		31.8–35.6
No	792	9.1	0.000	6.5–11.8	792	10.8	0.000	7.8–13.7	791	9.8	0.000	6.9–12.6
<i>Health status</i>												
Reported health status			0.012				0.180				0.001	
Excellent	915	37.0		33.4–40.6	915	41.4		37.7–45.1	903	33.8		30.3–37.4
Very good	1345	36.8	0.914	33.6–39.9	1345	41.3	0.950	38.2–44.4	1331	33.7	0.964	30.7–36.7
Good	1396	32.7	0.060	29.9–35.5	1396	37.9	0.133	35.1–40.7	1373	27.0	0.003	24.2–29.8
Fair or poor	964	29.6	0.003	26.4–32.9	964	36.6	0.070	33.2–40.0	952	26.4	0.003	23.1–29.7
Family history of prostate cancer			0.001				0.000				0.001	
Yes	263	44.4	0.002	37.5–51.2	263	53.7	0.000	46.7–60.7	258	40.3	0.002	33.7–47.0
No	4,294	33.4		31.8–35.1	4294	38.3		36.6–40.0	4245	29.5		27.8–31.2
Number of chronic diseases			0.000				0.000				0.000	
None	1966	29.1		26.7–31.5	1966	34.2		31.7–36.7	1946	26.6		24.2–29.0
1 disease	1470	37.3	0.000	34.5–40.1	1470	41.3	0.000	38.6–44.1	1450	30.6	0.019	28.0–33.1
2 diseases	774	40.1	0.000	36.3–44.0	774	45.9	0.000	41.7–50.0	761	37.5	0.000	33.4–41.6
3 diseases	271	34.2	0.182	27.2–41.2	271	42.3	0.046	34.7–49.9	270	29.4	0.444	22.6–36.2
4+ diseases	149	40.8	0.032	30.4–51.3	149	48.5	0.011	37.8–59.1	142	28.3	0.701	19.9–36.7
Cancer ^e			0.389				0.344				0.135	
Yes	227	31.6	0.513	23.9–39.4	227	45.1	0.180	36.7–53.5	222	33.2	0.347	26.4–40.0
No	4403	34.3		32.7–35.9	4403	39.1		37.5–40.8	4347	29.8		28.2–31.5
<i>Screening</i>												
Had colorectal screening ^f			0.000				0.000				0.000	
Yes	1308	57.3	0.000	54.2–60.4	1308	61.9	0.000	58.8–64.9	1289	47.4	0.000	44.2–50.7
No	3209	24.3		22.6–26.0	3209	29.7		27.9–31.5	3178	22.4		20.7–24.0
<i>Health-related behaviors</i>												
Cigarette use			0.000				0.000				0.000	
Current (smoke everyday or some days)	962	27.1	0.001	23.4–30.8	962	30.2	0.000	26.3–34.1	954	19.3	0.000	15.9–22.8
Former	2088	36.3	0.551	34.1–38.6	2088	41.6	.547	39.3–44.0	2062	32.1	0.970	29.9–34.3
Never	1569	35.3		32.5–38.0	1569	40.5		37.7–43.2	1543	32.2		29.5–34.9
Alcohol Use			0.001				0.000				0.000	
Lifetime abstainer	791	29.5		26.0–32.9	791	33.0		29.5–36.6	775	23.5		20.3–26.8
Former drinker	1083	31.2	0.914	27.9–34.5	1083	35.7	0.950	32.3–39.1	1064	26.7	0.964	23.6–29.8
Moderate drinker	2251	37.7	0.060	35.3–40.2	2251	44.3	0.133	41.9–46.7	2229	35.3	0.003	33.0–37.5
Excessive drinker ^g	468	33.4	0.003	28.4–38.4	468	35.1	0.070	30.1–40.1	466	26.3	0.003	21.2–31.4

^a Excluding men with prostate cancer.^b Adjusted for the NHIS sampling methods and weighted to the U.S. census as described in Study methods.^c *P* values for a Wald Chi-square when the *P* value is located on a row of a main effect. *P* values for a general linear contrast comparing a row percent to its reference level. The reference levels are blank.^d 95% Confidence limits.^e Excluding non-melanoma skin cancer.^f Fecal occult blood test in past 5 years or sigmoidoscopy, proctoscopy, or colonoscopy in last 5 years.^g Two or more drinks per day or five or more drinks on 12 or more occasions per year.

Table 3
Percentage^a of men^b aged 50 or older who had PSA test(s), adjusting for all population subgroups, by population subgroups

	Had a screening PSA in the past year, <i>n</i> = 4343			Had 3+ PSAs in the past 5 years, <i>n</i> = 4296		
	%	CI ^c	PV ^d	%	CI ^c	PV ^d
<i>Demographics</i>						
Age			0.000			0.000
50–64 years	31.6	29.0–34.1		26.3	23.7–28.9	
65–79 years	41.0	37.8–44.2	0.000	38.1	34.7–41.5	0.000
80+ years	27.0	21.4–32.5	0.182	25.0	19.6–30.5	0.705
Race			0.277			0.550
White	34.0	32.2–35.8		30.0	28.2–31.8	
African-American	38.4	32.3–44.4	0.161	33.8	26.9–40.6	0.275
Other	37.2	28.9–45.6	0.448	29.5	21.1–37.9	0.915
Ethnicity			0.323			0.469
Hispanic	37.4	31.4–43.4	0.324	32.5	26.3–38.6	0.469
Non-Hispanic	34.3	32.5–36.0		30.1	28.3–32.0	
Region			0.034			0.001
Northeast	33.8	30.1–37.5		31.3	27.2–35.4	
Midwest	35.1	32.3–37.9	0.597	28.3	25.4–31.2	0.227
South	36.9	33.9–39.9	0.207	33.7	30.8–36.6	0.357
West	29.6	25.8–33.4	0.111	25.2	21.8–28.6	0.018
Length of U.S. residence			0.016			0.059
<10 years	18.6	2.2–35.0	0.113	18.0	5.0–31.0	0.108
≥10 years	27.8	22.0–33.5	0.022	24.5	18.4–30.6	0.070
Born in US	35.2	33.4–37.0		30.8	28.9–32.7	
<i>Socioeconomic status</i>						
Education			0.002			0.000
<High school graduate	28.1	24.5–31.7		23.1	19.7–26.5	
High school graduate	33.8	30.6–36.9	0.022	29.7	26.6–32.7	0.004
Some college/tech school	37.3	34.0–40.7	0.001	32.1	28.9–35.4	0.000
College grad	37.5	33.7–41.2	0.001	34.5	30.8–38.2	0.000
Poverty threshold			0.026			0.013
<200%	31.6	27.7–35.6		25.0	21.0–29.0	
200–299%	30.9	26.8–35.0	0.792	26.8	22.7–31.0	0.507
300–399%	32.3	27.4–37.2	0.845	31.4	26.5–36.4	0.044
400–599%	32.6	26.8–38.5	0.779	28.9	23.8–34.0	0.234
500%+	39.6	36.0–43.2	0.007	34.3	31.0–37.6	0.001
Unknown	33.7	30.7–36.7	0.392	30.9	27.6–34.1	0.019
Marital status			0.069			0.057
Married/living with partner	35.3	33.2–37.3		31.0	29.0–33.0	
Widowed	30.1	25.7–34.5	0.042	26.4	22.4–30.3	0.039
Divorced or separated	30.5	26.5–34.5	0.044	27.7	23.4–31.9	0.151
Never married	34.0	27.9–40.1	0.700	26.2	21.1–31.3	0.089
Occupation			0.001			0.000
Executive/professional/managerial	35.7	31.3–40.0		28.9	25.0–32.9	
Technicians/sales/admin support/student	33.2	28.3–38.0	0.451	29.3	24.5–34.2	0.896
Blue collar/service/homemaker	27.3	24.0–30.7	0.003	20.2	16.8–23.6	0.001
Retired	38.4	35.2–41.6	0.352	36.1	33.0–39.2	0.006
Unable to work/laid off/looking	32.6	26.4–38.7	0.421	30.9	25.0–36.7	0.591
<i>Access to health care</i>						
Health insurance			0.006			0.002
None	21.6	13.8–29.3	0.003	20.5	12.9–28.2	0.013
Public	31.7	27.4–36.1	0.137	25.1	21.2–29.1	0.006
Private/military	35.5	33.6–37.4		31.6	29.6–33.5	
Usual source of care?			0.000			0.000
Yes	35.8	34.0–37.6		31.3	29.5–33.2	
No	13.6	9.0–18.2	0.000	12.3	7.7–16.9	0.000
<i>Health status</i>						
Reported health status			0.274			0.040
Excellent	35.2	31.6–38.7		32.0	28.6–35.4	
Very good	36.8	33.6–39.9	0.467	33.1	30.0–36.2	0.600
Good	32.9	29.9–35.9	0.341	27.3	24.4–30.2	0.031
Fair or poor	32.1	28.1–36.2	0.305	28.1	24.2–32.0	0.158

(continued on next page)

Table 3 (continued)

	Had a screening PSA in the past year, <i>n</i> = 4343			Had 3+ PSAs in the past 5 years, <i>n</i> = 4296		
	%	CI ^c	PV ^d	%	CI ^c	PV ^d
<i>Health status</i>						
Family history of prostate cancer			0.006			0.008
Yes	43.7	36.5–50.8	0.006	37.8	31.5–44.2	0.009
No	33.8	32.0–35.5		29.7	27.9–31.5	
Number of chronic diseases			0.000			0.000
None	29.3	26.6–32.0		26.0	23.5–28.5	
1 disease	36.4	33.6–39.2	0.000	30.4	27.8–33.0	0.012
2 diseases	41.2	37.2–45.1	0.000	38.5	34.4–42.6	0.000
3 diseases	38.3	32.7–43.9	0.005	33.8	27.7–39.9	0.016
Cancer ^e			0.149			0.478
Yes	29.7	23.4–36.0	0.150	32.3	26.3–38.2	0.478
No	34.7	32.9–36.5		30.1	28.3–31.9	
<i>Health-related behaviors</i>						
Smoking status			0.041			0.000
Current (smoke everyday or some days)	30.3	26.7–34.0	0.065	22.4	18.9–25.9	0.000
Former	35.6	33.2–37.9	0.695	31.7	29.4–34.0	0.928
Never	34.8	31.9–37.8		31.9	29.1–34.7	
Alcohol consumption			0.298			0.053
Lifetime abstainer	31.5	27.6–35.3		25.6	21.9–29.3	
Former drinker	33.2	29.7–36.7	0.502	29.5	26.1–32.9	0.121
Moderate drinker	35.6	33.2–38.0	0.083	32.0	29.7–34.3	0.007
Excessive drinker ^f	36.1	30.3–41.9	0.188	30.1	24.2–35.9	0.201

^a Adjusted for the NHIS sampling methods, weighted to the U.S. census, and adjusted to the distributions of each of the factors in this table, categorized as described in this table. See Study methods for additional detail.

^b Excluding men with prostate cancer.

^c 95% Confidence limits.

^d *P* values for a Wald Chi-square when the *P* value is located on a row of a main effect. *P* values for a Wald *t* test when the *P* value is located on a level within a main effect. The reference levels are blank.

^e Excluding non-melanoma skin cancer.

^f Two or more drinks per day or five or more drinks on 12 or more occasions per year.

demographic, health, and health care characteristics anticipated to influence use. We used 95% confidence intervals to assess variability in the estimates of these percentages and to make general comparisons across groups. The Wald chi-square test was used first to assess the overall statistical significance of each factor, such as education or health insurance in predicting PSA test use after adjusting for age. Then, general linear contrasts were used to assess the statistical significance of differences among men within the categories of the factors, for example, comparing use in men with less than a high school level of education with use in college graduates.

We used logistic regression [35] in SUDAAN [34] to estimate the percentages of men receiving PSA testing take into account the complex sampling methods, to weight the results to the Census population characteristics by age and race/ethnicity in 2000, and to further adjust for other characteristics found to be related to PSA test use. The adjusted percentages (i.e., predicted marginals) were directly standardized to the distribution of the different categories of the other variables in the logistic models [36]. These adjusted percentages do not reflect actual use in the population, but they allow comparisons of use across categories of the variables included in the model. All models were

assessed for multicollinearity. Although the final model contained a large number of factors predictive of PSA test use, we did not adjust for multiple comparisons because the factors were selected in advance based on the cancer screening literature and because use of these adjustments in observational studies increases the likelihood of excluding true associations [37].

For the multivariate logistic regression model, we excluded some variables and collapsed some categories. Asian, American Indian/Alaska Native, and other were combined into a single category because of the small numbers in each of these groups. Language spoken was dropped because it was asked only of Hispanics. Having seen a medical doctor or healthcare professional in the past 12 months was not included because of its strong association with the other health care access variables. Family size was excluded because it is a component of the poverty level and because no relation was found between family size and PSA test use in the multivariate model.

Since effects of race and ethnicity may be difficult to separate from socioeconomic circumstances, we tested for interactions among those factors, including combinations of age, race, ethnicity, level of education, poverty ratio, number of chronic illnesses, and family history.

Results

The distribution of characteristics of the NHIS sample of men aged 50 and older (Table 1) reflected patterns in the U.S. population in 2000 [28], after adjustment for sampling methods and weighting to U.S. census distributions by age and race/ethnicity.

Use of the PSA test for screening purposes was more common among men who were aged 65–79, non-Hispanic and U.S. born (Table 2). Screening PSA test use tended to be higher among men with higher levels of socioeconomic status, that is, those with higher levels of education and income, while it was lower among men who were blue collar/service workers or unable to work, laid off, or looking for work. Screening PSA use was more common among men with greater access to healthcare, as indicated by having health insurance, a usual source of healthcare, a recent doctor visit, and use of the English language. Use was also higher in married men and those living in two or three-person families. Use was lower among those who reported worse health, no family history, and no chronic health conditions. Men who had not been recently screened for colorectal cancer and who were current smokers had lower levels of PSA screening use, and men who reported moderate drinking were more likely to report PSA screening. Rates of PSA screening were higher than we expected among men who might not benefit from it, including men aged 80 and older (26%), men who reported being in fair or poor health (30%), and men with four or more chronic illnesses (41%).

Patterns of screening PSA test use adjusted for other characteristics in the multivariable model (Table 3) were generally similar to patterns of screening use observed in the data adjusted only for sampling methods and weighted to the U.S. population (Table 2). No statistically significant interaction effects were found. However, some differences among groups were reduced and some characteristics related to use were no longer statistically significant. These included Hispanic ethnicity, reported health status, and alcohol consumption.

Relationships between routine PSA test use and the characteristics we examined were generally quite similar to relationships between screening PSA test use and those characteristics.

Among men in their 40s, screening PSA test use was somewhat higher among African-American men than among white men (Table 4). Because the numbers of men in their 40s in the other racial groups were small, confidence intervals were wide or could not be calculated. Among men in their 50s, screening PSA test use was lower among Asian and American Indian/Alaska Native men than among white men. Differences in ever having had a PSA test for any purpose were similar to those observed in screening PSA use except for men in their 50s; in this group, use was lower among African-American men than among white men.

Discussion

Approximately one-third (34%) of men aged 50 and older interviewed in the 2000 NHIS had had a screening PSA test during the last year, despite the uncertainty about the benefits of screening. By comparison, 31% of men aged 50 and older in the 2000 NHIS had received a screening endoscopy within the previous 5 years or a fecal occult blood test (FOBT) within the previous year, the recommended intervals for colorectal cancer screening tests. Thus, PSA test use for screening is as common as screening for colorectal cancer, a procedure for which there is much stronger evidence of effectiveness and better agreement on screening [38–40]. This lack of consistency between strength of evidence and use of screening tests for prostate and colorectal cancers was borne out in another recent survey that also found prostate cancer screening to be more common among men than colorectal screening [7].

Levels of PSA test use reported in the literature in a variety of samples of men [7,9–12,17] are generally consistent with what was self-reported in the NHIS population. A study of 1998 Medicare claims data on U.S. men aged 65 and older with no prior diagnosis of prostate cancer found that approximately 38% of white men and 31% of African-American men received annual PSA tests [9]. Telephone surveys conducted in New York [10] and Texas [12,17] in the mid-1990s found that 60% of men aged 50 and older and 37% of men aged 40 and older reported ever having had a PSA test. A similar survey in Washington State found that of men aged 40 and older, approximately 30% reported having received a PSA test during the previous 2 years [11]. A survey of men aged 50 and older in all 50 states found that 75% had had at least one PSA test [7]. None of these studies appears to have distinguished screening PSA tests from diagnostic tests.

In this national sample, patterns of PSA test use were similar to those reported in other studies [10,11,13,14,17,18,20–23,27]. These relationships include those we observed for income/poverty status [17,19,21,23], education [20], health insurance [12,26,27], a regular source of health-care [12,21,26], and marital status [23]. These relations may be explained by greater access to health care due in part to greater resources and knowledge.

Although levels of PSA test use in men are lower than mammography and Pap test use in women [26], patterns of PSA test use are similar to patterns of use of the other cancer screening tests among women [26,30,31,41]. Women who report greater use of screening tests are in higher status occupations, are more likely to have access to or use other health services, and are more likely to practice healthy behaviors such as avoiding cigarette use and excessive alcohol consumption than are women who use screening tests less frequently.

We had anticipated that use of PSA as a screening test might decline among men with a greater number of chronic diseases and in fair or poor health, because screening and

Table 4
Percentage of men^a who have had PSA test(s) by age, race, and family history of prostate cancer

	40–44 years old				45–49 years old				50+ years old				Total			
	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d	N	% ^b	PV ^c	CI ^d
<i>Had any screening PSA test in the past year</i>																
All	1,417	7.3		5.8–8.8	1274	11.3		9.3–13.3	4630	34.1		32.5–35.7	7321	25.2		24.0–26.3
Race																
White	1132	6.7		5.1–8.3	1019	10.4		8.2–12.7	3859	34.8		33.1–36.5	6010	25.4		24.2–26.6
African-American	158	14.9	0.029	7.9–22.0	164	16.8	0.055	10.8–22.8	513	31.4	0.154	27.0–35.8	835	25.8	0.803	22.2–29.5
American Indian, Alaskan Native	10	0.0	^e	^e	11	35.8	0.155	1.0–70.6	32	18.7	0.002	8.7–28.8	53	18.0	0.132	8.4–27.6
Asian	40	2.9	0.202	0.0–8.5	32	11.2	0.875	1.3–21.2	104	21.8	0.001	14.0–29.6	176	16.2	0.001	10.9–21.6
Other	77	6.2	0.880	0.4–12.0	48	7.4	0.446	0.0–14.8	122	28.8	0.172	20.3–37.3	247	20.6	0.110	15.0–26.3
Family history of prostate cancer																
Yes	80	14.7		6.4–22.9	80	18.3		9.1–27.4	263	44.4		37.5–51.2	423	34.4		29.7–39.0
No	1316	6.9	0.069	5.5–8.4	1175	10.8	0.117	8.7–12.8	4294	33.4	0.002	31.8–35.1	6785	24.6	0.000	23.4–25.8
<i>Ever had a PSA test</i>																
All	1418	16.1		13.8–18.3	1277	24.7		21.9–27.5	4661	56.8		55.2–58.3	7356	43.7		42.4–44.9
Race																
White	1133	15.6		13.2–18.1	1020	24.2		21.0–27.3	3886	58.1		56.5–59.8	6039	44.4		43.1–45.6
African-American	158	25.7	0.038	16.7–34.6	165	29.8	0.154	22.6–37.0	515	52.6	0.035	47.9–57.4	838	43.7	0.765	39.4–48.0
American Indian, Alaskan Native	10	0.0	^e	^e	11	46.4	0.243	9.4–83.4	33	45.7	0.100	31.1–60.4	54	36.8	0.178	25.8–47.7
Asian	40	9.5	0.201	0.3–18.6	33	18.7	0.415	6.0–31.5	104	32.1	0.000	24.7–39.6	177	25.3	0.000	19.9–30.7
Other	77	10.2	0.173	2.8–17.6	48	20.9	0.636	7.9–33.9	123	42.6	0.002	33.1–52.1	248	32.4	0.001	25.6–39.2
Family history of prostate cancer																
Yes	80	32.3		21.3–43.4	81	42.9		30.1–55.7	266	72.2		66.3–78.1	427	59.7		55.2–64.2
No	1317	15.3	0.003	13.0–17.5	1177	23.3	0.003	20.4–26.1	4321	55.8	0.000	54.2–57.4	6815	42.6	0.000	41.4–43.9
<i>Had any PSA test in the past year</i>																
All	1417	9.1		7.5–10.7	1,274	13.3		11.1–15.4	4630	39.2		37.6–40.8	7,321	29.1		28.0–30.3
Race																
White	1132	8.7		6.9–10.5	1,019	12.6		0.2–15.0	3859	40.2		28.5–41.9	6,010	29.6		28.4–30.8
African-American	158	14.9	0.101	7.9–22.0	164	18.6	0.083	2.3–24.9	513	34.4	0.017	29.9–38.9	835	28.1	0.414	24.4–31.7
American Indian, Alaskan Native	10	0.0	^e	^e	11	35.8	0.195	1.0–70.6	32	27.9	0.096	13.5–42.4	53	23.8	0.322	12.2–35.3
Asian	40	5.6	0.439	0.0–13.1	32	11.2	0.794	1.3–21.2	104	24.9	0.000	18.1–31.8	176	18.7	0.000	13.9–23.6
Other	77	8.2	0.899	1.7–14.7	48	7.4	0.189	0.0–14.8	122	32.0	0.085	22.8–41.2	247	23.0	0.042	16.9–29.2
Family history of prostate cancer																
Yes	80	17.3		8.4–26.2	80	21.6		1.7–31.5	263	53.7		46.7–60.7	423	41.4		36.5–46.3
No	1316	8.7	0.065	7.1–10.3	1,175	12.7	0.084	0.5–14.9	4,294	38.3	0.000	36.6–40.0	6,785	28.4	0.000	27.1–29.6

for some groups, especially American Indian/Alaska Native and Asian populations.

The findings of this study and other PSA test use studies have important implications for medical and public health professionals. First, the methods by which PSA testing has been promoted among men, especially African-American men, may be useful for promoting the use of preventive services that are more clearly beneficial. Historically, access to or use of health services has been lower among men than among women and lower among African-Americans than among white men and women [26,46,47]. The level of PSA test use among men, combined with the findings that men are no more likely than women to underuse colorectal cancer screening, suggests that men may be reachable with other preventive services [26]. Similarly, recent research on PSA test use suggests that its use among African-Americans may not be very different from use among white men [10,17,23,26,47–49]. The greater use of the PSA test among younger African-American men may signify the success of campaigns to make them aware of their higher risk of prostate cancer at younger ages and to encourage PSA screening [29]. More research is needed to understand strategies that contribute to these successes; the results of such research could be used to improve efforts to promote the use of effective preventive services.

Our findings and those from the literature also raise the question of how decisions are made about the use of PSA as a screening test. The level of PSA screening test use and patterns of use, which are similar to other cancer screening tests, suggests that for some men and their clinicians, PSA may be a routine cancer screening test. This possibility is supported by research showing that many physicians consider PSA screening to be the standard of care [16]. In addition, since about one-fourth of men in their 80s and a similar proportion of men apparently in poor health are being screened, some clinicians may be using the test more broadly than is generally recommended.

Although the major medical associations differ in their support of PSA screening recommendations, they all suggest that clinicians should use a process of shared decision-making that includes discussing with patients the risks of prostate cancer, the potential benefits and harms of screening, and involving the patients in the decision [29,50]. Shared decision-making is recommended because there is no firm evidence or general agreement that the benefits of PSA screening outweigh the harms [1–6,29]. By 2005–2008, two large-scale randomized screening trials, the NCI-sponsored Prostate, Lung, Colorectal and Ovary (PLCO) cancer trial in the United States [51] and the European Randomized Screening for Prostate Cancer (ERSPC) trial in Europe [52], will provide more definitive information on the effects of screening on prostate cancer. These trials are aimed at assessing whether screening reduces deaths from prostate cancer.

The higher level of use of the PSA test for prostate cancer screening may be explained by several factors,

including more supportive recommendations by some organizations including the American Cancer Society (ACS) [5]. ACS also recommends a form of shared decision-making for prostate cancer screening. Many clinicians follow ACS recommendations [53–55].

Survey research suggests that most medical practitioners are aware of the screening controversy but think that PSA screening is efficacious [16,56]. The extent to which medical providers are aware of the harms and the inconsistencies in the evidence of effectiveness is uncertain [6,57], and recent studies indicate that men too have many misconceptions about prostate cancer screening [58]. Other factors that may contribute to PSA screening include the ease of ordering the blood test, patient interest, reports in medical journals about effectiveness, publicity in the mass media, and celebrity endorsements of screening [16,53,56].

Because of the disagreements about prostate cancer screening, the Centers for Disease Control and Prevention (CDC) organized a conference to recommend public health approaches to prostate cancer [59]. The main recommendation was that agencies provide information needed for informed decision-making to the public and to clinicians [59]. CDC has several related projects underway, and informed decision-making aids are available at CDC's web site www.cdc.gov/cancer/prostate. In addition, major medical associations have this type of information available on their web sites [29], and the U.S. Preventive Services Task Force just released a detailed review and recommendations [1,2].

In conclusion, the levels and patterns of PSA test use suggest that some men and their clinicians may be adopting PSA testing as general practice as they have other screening tests. Like the results of some other recent studies of PSA test use [6,57,58], our findings raise questions about how screening decisions are made. More information is needed on how knowledgeable medical professionals and patients are of the uncertainties about prostate cancer screening and how decisions are being made.

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