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Health Risk Behaviors and Prostate-Specific Antigen Awareness Among California Men

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Abstract

Purpose—Differences in prostate-specific antigen (PSA) awareness may contribute to differences in frequency of PSA testing. We investigated the association of health risk behaviors, including smoking, physical inactivity, obesity, and excessive alcohol consumption with awareness of the PSA test among California men at risk for prostate cancer.

Materials and Methods—Using California Health Interview Survey (CHIS) 2003 data, a population-based random-digit-dial telephone survey, records of 7,297 men aged 50 years and older without a prior history of prostate cancer were identified. The outcome was self-reported awareness of the PSA test. The main independent variables were smoking status, level of physical activity, body mass index (BMI), and alcohol consumption. Prevalence, odds ratios (OR) and 95% confidence intervals (CI) for PSA awareness were calculated using SUDAAN to account for the complex sampling design.

Results—The overall prevalence of PSA awareness was 73.0%. After controlling for potential confounders, the odds of being aware of the PSA test was lower among current smokers (OR= 0.53; 95% CI =0.41-0.68 vs. never smoked), physically inactive (OR=0.77; 95% CI=0.63-0.93 vs. physically active) and obese men (OR=0.77; 95% CI= 0.62-0.95 vs. normal weight).

Conclusions—Health risk behaviors are associated with lower PSA awareness. Our findings suggest opportunities for focused health education interventions and quality improvement programs tailored to men who engage in unhealthy behaviors to improve their PSA test awareness.

Keywords

Prostate-Specific Antigen; Awareness; Smoking; Obesity; Exercise

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INTRODUCTION

Health risk behaviors such as smoking and obesity have been found to be associated with higher prostate cancer morbidity and mortality. Evidence suggests that prostate cancer patients who smoke present with more advanced stages of prostate cancer, greater risk of metastases, and worse prognosis compared to patients who do not smoke.¹ A growing body of research suggests that obesity is associated with more advanced stages and higher grades of prostate cancer.² ³ Regular physical activity may **lower the risk of prostate cancer**,⁴ slow **its** progression, and ultimately lower **prostate cancer** mortality.⁵

A recent study demonstrated that persons who seek out cancer information are more likely to acquire knowledge, display healthy behaviors, and undergo cancer screening.⁶ Awareness of PSA testing is regarded as an “important cognitive precursor” of prostate cancer screening and was found to contribute to differences in prostate cancer screening rates.⁷ **Nevertheless**, one in four men above the age of 50 remains unaware of the PSA test.⁸ Previous studies have explored **predictors of PSA test awareness**,^{9, 10} but none has focused on health risk behaviors. With **greater appreciation of the impact of health** behaviors on cancer prevention,¹¹ we sought to investigate the association between selected health risk behaviors and awareness of the PSA test. We hypothesized that men reporting health risk behaviors have less awareness of the PSA test.

MATERIALS AND METHODS

The 2003 California Health Interview Survey (CHIS), a population-based random digit dialing telephone survey conducted between August, 2003 and February, 2004, is the largest state health-related survey conducted in the U.S. It used a two-stage sampling approach to randomly select phone numbers from 41 geographic sampling strata representative of California’s population. Phone numbers were screened to confirm that they were related to residential households. Interviews were conducted in English, Spanish, Chinese, Vietnamese, and Korean. The adult interview response rate was 60%,¹² a rate comparable to the California Behavioral Risk Factor Surveillance System.

The target population for the survey was adults aged 18 years and older living in California in 2003 (n=42,044). For this analysis the sample was limited to men aged 50 years and older to reflect the joint American Cancer Society/American Urological Association recommendation to offer prostate cancer screening after informed consent.¹³ Men with a prior history of prostate cancer were excluded from the study to avoid selection bias. These exclusion criteria yielded a final sample size of 7,297 men. Due to missing data, an additional 178 records were excluded from the final multivariable logistic regression.

Exposure and Outcome Variables

PSA awareness, the study outcome, was determined from the question “Have you ever heard of the PSA test?” The independent variables included in the analysis were: smoking status, walking (a measure of physical activity), BMI (a measure of obesity), and binge alcohol drinking. Smoking status was specified as current, former or never smoked. Because assessing physical activity through self-reported measures may lead to misclassification, we used a conservative definition of physical activity that allows identification of men with sedentary life-styles. Self-reported physical activity was defined as walking for transport or fun/exercise **for at least 10 minutes within the past week** and it was coded as a binary variable (yes/no). BMI was categorized according to the International Classification of Adult Body Mass Index as underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (> 30.0 kg/m²). Since drinking in moderation has a cardiac protective effect,¹⁴ we were interested in excessive alcohol consumption as a health risk behavior. Thus, we

used binge drinking, a binary variable that required having at least 5 drinks per occasion within the past 30 days, **to identify men with unhealthy alcohol intake.**

Potential Confounders

Based on prior studies demonstrating relationships with PSA testing^{7-9, 15} which is likely highly correlated with PSA awareness, we included several potential confounding variables, including demographics, socioeconomic status, access to healthcare, health status and colon cancer screening. Age was classified into five-year intervals and **greater than 70** years old. Race and ethnicity were categorized as: White, African American, Latino, Asian, American Indian/Alaska Native, Pacific Islander and Other Races. Acculturation was represented by English proficiency (speaks only English, speaks English well/very well, speaks English not well/not at all) and the percentage of an individual's lifetime spent in the U.S. (**categorized in quintiles:** $\leq 20\%$, 21-40%, 41-60%, 61-80%, and $\geq 80\%$ of life time). Socioeconomic indicators were annual household income as a percentage of the Federal Poverty Level (%FPL), educational attainment, and marital status. The %FPL (calculated from the total annual household income, family size, and the 2002 federal poverty guidelines) was **categorized** into four categories: below 100%, 100-199%, 200-299%, and $\geq 300\%$ FPL. Education was specified as four levels: less than high school, high school graduate, some college, and college or higher education. Marital status was categorized into three levels: married, never married, and others.

Access to healthcare measures included health insurance status during the past year (uninsured for the whole year, uninsured for part of the year, insured), number of physician visits within the past year (zero, one to two times, three to four times, five times and above), and having a usual source of care other than an emergency room (ER) (yes/no). Self-reported health status was categorized into five levels (excellent, very good, good, fair, and poor). Finally, colorectal cancer screening behavior (defined as having a colonoscopy, sigmoidoscopy or fecal occult blood test) was categorized **as** screened within past 5 years, not screened within past five years, and never screened.

Statistical Analysis

Descriptive statistics were used to examine the characteristics of the sample and the prevalence of PSA awareness. To test for significant differences in PSA awareness across levels of each characteristic (covariate), we used the chi-square **statistic**. Logistic regression models were implemented to estimate the association of each risk behavior (smoking, physical inactivity, obesity, and binge drinking) with the participants' awareness of PSA before and after adjusting for selected covariates. To test whether the strength of the association between each health risk behavior and awareness of PSA test differs by age, race/ethnicity and income, interaction terms were tested. A sensitivity analysis was conducted including BMI as a continuous variable and a quadratic term to evaluate for possible curvilinearity or a threshold effect of BMI on awareness of the PSA test.

Since health risk behaviors tend to coexist,¹⁶ we tested whether the presence of more than one risk behavior would **incrementally** affect awareness of the PSA test. We created a variable representing the number of health risk behaviors for each individual, ranging from zero (for men with no health risk behavior) to **three** (for men having **three or more** risk behaviors). We measured the prevalence of PSA awareness across levels of this variable and tested the association between this variable and PSA awareness while adjusting for other covariates.

Data management was conducted using SAS (version 9.1; SAS Institute Inc., Cary, NC) while all analyses were performed using SUDAAN (Research Triangle Institute, Research Triangle Park, NC), which takes into account the complex sampling design and yields unbiased standard

error estimates. Estimates for **percentages**, prevalence and odds ratios (ORs) with their 95% confidence intervals (CI) are weighted.

RESULTS

Characteristics of the study population are shown in Table 1. Nearly one-half of the subjects were between the ages of 50 and 60. The majority were white, married, spoke only English, and up-to-date for colorectal cancer screening; lived most of their lives in the US; reported their health status as good or better; had income of at least 300% of FPL, had at least some college education, health insurance, and a usual source of medical care.

Overall, the prevalence of PSA awareness for the study population is 73% while the prevalence of PSA testing is 39% (data not shown). The prevalence of PSA awareness increases with age up to 70 years old and then declines. PSA awareness was highest among whites, Pacific Islanders and American Indians and lowest among Asians; Latinos and African Americans exhibited an intermediate PSA awareness. The prevalence of PSA awareness was positively associated with education, income, health status, and number of physician visits in the past year. Those with health insurance, a usual source of healthcare other than the ER, and recent colorectal cancer screening had higher prevalence of PSA awareness than those lacking such resources.

Table 2 shows the ORs (crude and adjusted) with their 95% CI for the association between health risk behaviors and PSA awareness. After adjusting for all covariates, smoking, physical inactivity and obesity were significantly associated with **lower odds** of PSA awareness. Specifically, current smokers (**OR=0.53; 95%CI: 0.41-0.68**), physically inactive men (**OR=0.77; 95%CI: 0.63-0.93**), and obese men (OR=0.77; 95%CI: 0.62-0.95) had a lower odds of being aware of the PSA test than those who never smoked, were physically active and had normal weight, respectively.

There were neither interactions observed between age, race/ethnicity or level of income and any of the risk behaviors, nor significant confounding by any of the covariates, except for partial negative confounding of the association between BMI and PSA awareness by race.

Finally, to measure the effect of clustering of risk behaviors in an individual, we examined the prevalence of PSA awareness among men with **one to four** risk behaviors as compared to men without any risk behaviors. The prevalence of PSA awareness decreased from 78% among men with no risk behaviors to 71%, 68% and 55% among men with one, two, and three or more risk behaviors, respectively. After adjusting for the covariates, the odds of PSA awareness among men with one (OR=0.76; 95%CI: 0.61 - 0.93), two (OR=0.69; 95%CI: 0.54 - 0.89), and three or more risk behaviors (OR=0.38; 95%CI: 0.26 - 0.56) was significantly lower than men with no risk behaviors in a dose-dependent manner (Figure 1).

DISCUSSION

Our primary findings **suggest** that smoking, physical inactivity, and obesity are inversely associated with awareness of the PSA test. No such association with excessive alcohol drinking was identified. Furthermore, clustering of more than one risk behavior in the same individual decreased the **odds** of PSA awareness in a dose-dependent manner. These results concur with our initial hypothesis that men who adopt unhealthy lifestyles may be less concerned with their health and less aware of preventive measures **like** the PSA test.

Intuitively, a person who is unaware of the presence of a screening test would be less likely to undergo screening. McFall demonstrated that a lack of PSA awareness contributes to lower rates of PSA test use among racial minorities.⁷ We have extended the analysis of PSA

awareness to certain health risk behaviors, each of which has been previously shown to be associated with PSA testing.^{9, 15}

An Australian study found that men who smoke were less likely to undergo PSA screening than non-smokers.¹⁷ This difference in PSA screening rates may be explained by the differences in awareness of the PSA test. Although we did not use PSA testing as an outcome measure, our results agree with the Australian study's finding in showing that current smokers are the least aware of PSA, followed by former smokers and men who never smoked. It is possible that this finding may be due to a general lack of concern about health **maintenance** or less interactions with healthcare providers among smokers. Lower awareness of the PSA test and ultimately less PSA screening among smokers warrants a focused approach by healthcare providers to offer information on the PSA test and the opportunity for prostate cancer screening.

Close showed that regular physical exercise in men was positively associated with the probability of being screened for prostate cancer.¹⁸ Our results **parallel** this finding in showing **that the odds of PSA test awareness among physically active men was higher** than those with sedentary lifestyles, though the magnitude of the association diminished after adjusting for covariates. It is plausible that men with healthy behaviors (regular exercise) may be more concerned about their health and more eager to learn about screening tests. Since there is evidence that physical inactivity is associated with increased risk of prostate cancer,⁴ physically inactive men may constitute a particularly high-risk group in that they are both less aware of screening for and more prone to developing prostate cancer.

A recent study by Scales **demonstrated** that overweight and obese men are preferentially tested for PSA.¹⁵ Although we found a similar pattern in our unadjusted analyses which is contrary to our hypothesized lower awareness among obese individuals, this pattern was reversed after controlling for the potential confounders. It is possible that the discrepancy may be due to difference in the outcomes: Scales focused on self-reported PSA testing while we focused on awareness of the PSA test. Reliance on participants' memories to recall PSA testing may result in measurement error **which could be alleviated by** reviewing medical records. Several studies have demonstrated that self-reported PSA testing is not a sensitive measure of actual PSA testing¹⁹ and that **as many as** two-thirds of men referred to a urologist because of high PSA levels were unaware that their PSA level had been measured.²⁰ To verify our BMI results, a sensitivity analysis (with BMI as a continuous variable in the prediction model) was conducted and consistently demonstrated an inverse association between BMI and PSA test awareness.

Several studies have demonstrated that health risk behaviors cluster in adults.¹⁶ Our analysis showed that clustering of more than one health risk behavior is associated with an incremental decline in the **odds** of PSA awareness. This finding agrees with our initial hypothesis that accumulating risk behaviors would be inversely associated with awareness of cancer preventive approach. Given the associations between smoking, physical activity and obesity with both prostate cancer and cardiovascular disease, men with multiple risk behaviors would seem to be ideal targets for interventions to improve their awareness of the PSA test.

There are several limitations to our study. Due to its cross-sectional design, our study cannot determine temporality between the risk factors and outcome and therefore invoke causality between them. In addition, the study is subject to measurement errors or recall bias since it is based on a self-reported phone survey. Risk behaviors like smoking, obesity, and excessive alcohol drinking are particularly prone to under-reporting and therefore our results may underestimate the true effects. Finally, using an odds ratio as a measure of association for a common outcome may overestimate the effect size. On the other hand, our study does have several **methodological** advantages including its adjustment for possible confounders, robust

statistical methods, large sample size, and weighting of the data to extrapolate to the state of California.

CONCLUSION

This study demonstrates that health risk behaviors are **associated with lower awareness** of the PSA test which may lead to a lower likelihood of undergoing **actual** prostate cancer screening. Coupling greater cardiovascular co-morbidities with higher risk disease places these men in a particularly high-risk group. These men would likely benefit from focused health education and counseling regarding PSA testing. Healthcare providers should be aware of such knowledge deficits and the concomitant effects they may have on cancer screening.

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Glossary

PSA, Prostate-Specific Antigen; BMI, Body Mass Index; CHIS, California Health and Interview Survey; ACS, American Cancer Society; ER, Emergency Room; OR, Odds Ratio; CI, Confidence Interval; UCLA, University of California, Los Angeles; FPL, Federal Poverty Level.

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Figure 1. Effect of Clustering of Health Risk Behaviors on Odds Ratios of PSA Awareness

OR adjusted for age, race, percentage of life spent in the US, English language speaking ability, income, education, marital status, health insurance, usual source of care other than ER, number of physician visits in the past year, self reported health status, and colorectal cancer screening.

Table 1

Characteristics of the Study Population and Prevalence of PSA Awareness: CHIS 2003

Characteristics	Population n=7,297 (%) ^a	Prevalence of PSA Awareness (%) ^a	p-value ^b
Age			
50-54	26.5	65.9	0.0001
55-59	20.6	75.3	
60-64	15.8	77.0	
65-69	11.0	77.1	
70+	26.0	74.3	
Race/Ethnicity			
White	66.0	80.7	<0.0001
Latino	13.6	58.9	
Pacific Islander	0.3	85.8	
American Indian /Alaska Native	1.0	76.8	
Asian	10.5	48.0	
African American	6.0	68.6	
Other, Single/Multiple Race	2.6	62.1	
Income			
0-99% FPL	9.1	47.2	<0.0001
100-199% FPL	14.7	55.8	
200-299% FPL	14.0	64.0	
≥300% FPL	62.3	82.9	
Education			
< High school	17.9	51.6	<0.0001
High school	17.8	69.8	
Some college	23.8	75.1	
≥College degree	40.4	82.8	
Marital Status			
Married	73.1	74.9	0.02
Divorced/separated/ widow/partner	21.2	67.5	
Never married	5.7	69.6	
Insurance Status			
Currently Uninsured	7.8	54.0	0.12
Uninsured Any Period Past Year	2.0	51.2	
Insured Past 12 Months	90.1	75.2	
Physician Visits in Past Year			
0	12.6	58.8	0.0001
1-2	32.2	73.2	
3-4	23.5	74.9	
5 or more	31.8	77.1	
Self-Reported Health Status			
Excellent	18.3	79.6	0.03

Characteristics	Population n=7,297 (%) ^a	Prevalence of PSA Awareness (%) ^a	p-value ^b
Very Good	28.2	80.5	
Good	27.1	73.1	
Fair	18.0	60.2	
Poor	8.5	61.0	
Colonic Cancer Screening			
Within Past 5 Years	52.9	81.1	<0.0001
Not Within Past 5 Years	16.6	78.2	
Never	30.5	56.3	

^aWeighted percentages

^bp-value of Chi-Square statistic.

Table 2

Distribution of Health Risk Behaviors, Prevalence, and Odds Ratios (Crude and Adjusted) with 95% Confidence Intervals of PSA Awareness: CHIS 2003

Health Risk Behaviors	Population n=7,297 (%) ^a	Prevalence of PSA Awareness (%) ^a	p-value ^b	Crude OR ^c	95% CI	Adjusted OR ^d	95% CI
Smoking							
Current	15.2	57.5	<0.0001	0.40	0.31-0.51	0.53	0.41-0.68
Former	48.0	74.8		0.88	0.73-1.06	0.80	0.66-0.97
Never	36.8	77.2		1.00		1.00	
Walking							
Yes	71.1	75.0	0.007	1.00		1.00	
No	28.9	68.8		0.74	0.62-0.87	0.77	0.63-0.93
BMI descriptive							
Underweight	0.9	51.0	0.047	0.41	0.21-0.82	0.84	0.34-2.05
Normal	30.3	71.8		1.00		1.00	
Overweight	46.4	74.7		1.16	1.02-1.33	0.87	0.75-1.01
Obese	22.5	72.0		1.01	0.83-1.23	0.77	0.62-0.95
Binge Drinking							
Yes	13.4	69.8	0.74	0.83	0.67-1.03	0.96	0.75-1.23
No	86.6	73.6		1.00		1.00	

^aWeighted percentages

^bChi-square test.

^cUnivariate logistic regression.

^dOR adjusted for age, race, percentage of life spent in the US, English language speaking ability, income, education, marital status, health insurance, usual source of care other than ER, number of physician visits in the past year, self reported health status, and colorectal cancer screening.