Factors Predicting Prostate Specific Antigen Testing among First-Degree Relatives of Prostate Cancer Patients

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Abstract

First-degree relatives (FDRs) of prostate cancer patients are known to be at increased risk for the disease, yet relatively little is known about their screening behaviors. The current lack of consensus about the value of prostate cancer screening underscores the importance of examining why some men at increased risk participate in screening and others do not. In this study, variables from Protection Motivation Theory were used to identify predictors of prostate specific antigen (PSA) testing in this at-risk population. Toward this end, scales assessing perceived vulnerability, perceived severity, response efficacy, and self-efficacy for prostate cancer screening were administered to 82 unaffected male FDRs aged 40 and older. When recontacted approximately 14 months later, 50% of FDRs were found to have undergone PSA testing in the interim. Older age, prior prostate cancer screening, and a greater sense of personal efficacy about being able to undergo prostate cancer screening were found to be significant (P < 0.05) predictors of subsequently undergoing PSA testing. These findings provide partial support for the predictive validity of Protection Motivation Theory variables and suggest the importance of considering efficacy beliefs in attempting to understand decision-making about PSA testing in at-risk individuals. (Cancer Epidemiol Biomarkers Prev 2004;13(5):753–8)

Introduction

Prostate cancer (PC) is a leading cause of cancer specific morbidity and mortality among men in the United States. In the year 2003, there are expected to be 220,900 new cases of prostate cancer and 28,900 deaths from the disease (1). Despite the large number of men affected by the disease, there is currently a lack of consensus by leading health agencies on appropriate screening measures for prostate cancer. The National Cancer Institute, the United States Preventive Services Task Force, and the American College of Preventive Medicine do not endorse screening for prostate cancer in the general population or high-risk groups (2, 3). In contrast, the American Cancer Society and the American Urological Association recommend annual screening for all men age 50 and older who have a life expectancy of at least 10 years and commencing at an earlier age (40–45) for men in high-risk groups such as African Americans and those with affected first-degree relatives (FDRs) (1, 4, 5).

Several studies have examined the relation of family history and use of PSA testing (8, 9). In studies of men with a family history of prostate cancer, having more affected relatives with prostate cancer, higher levels of education, greater knowledge about PSA testing, lower levels of cancer specific distress, and a physician recommendation were associated with higher levels of PSA testing (10–12). Although providing important information, most of these studies are characterized by a number of methodological limitations. These include a focus on intentions to obtain a PSA test rather than actual behavior as the primary outcome, cross-sectional measurement of health beliefs and PSA testing behavior, and no or partial application of a theoretical framework or model.

Our study sought to address these limitations by prospectively evaluating the potential usefulness of Protection Motivation Theory (PMT) variables, assessed at the time of a baseline interview, in predicting subsequent PSA test use over a 14-month follow up period among men with a family history of prostate cancer. PMT has not commonly been used in studies of cancer screening. However, this model has provided insight into prevention and early detection behaviors including consumption of low-fat diets, alcohol use, high-risk sexual behaviors, and smoking cessation to prevent long-term chronic conditions (13–19), and thus may be
useful in understanding PSA testing. The theory seeks to explain health behavior change in terms of threat and coping appraisal. The threat appraisal aspect of the model reflects the individual's: (a) perceived vulnerability to a particular disease or condition, in our case prostate cancer; and (b) the perceived severity of having the disease or condition. Coping appraisal reflects the individual's: (a) response efficacy or the expectation that carrying out recommendations can remove the threat; and (b) self-efficacy or believing oneself to be able to carry out the coping response such as PSA testing (20–22). We hypothesized that the PMT variables of perceived vulnerability, response efficacy, and self-efficacy would all be positively associated with use of PSA testing. Previous cancer-related studies have shown little variability in perceived severity among respondents, who overwhelmingly agree that cancer is a serious disease (23–26). Therefore, we hypothesized that the PMT construct of perceived severity would not be associated with PSA testing in our model.

Methods

Subject Recruitment and Data Collection. Patients (index cases) with a confirmed diagnosis of prostate cancer being followed at the H. Lee Moffitt Cancer Center (Tampa, FL) or the James A. Haley Veterans Hospital (Tampa, FL) were approached either in person or by telephone by trained research assistants and asked to nominate FDRs (i.e., brothers or sons) for study participation. Eligibility criteria for FDRs were that they must: (a) be males between the ages of 40 and 75; (b) not have been diagnosed with any form of cancer, excluding non-melanoma skin cancer; (c) be able to read questionnaires in English; and (d) be able to provide informed consent.

Using the information provided by the index cases, FDRs were initially contacted by telephone and screened for eligibility. If more than one FDR per index case was nominated, a randomization process was used to determine the order of contact. If the first FDR was ineligible or unwilling to participate, additional FDRs were contacted in the predetermined order until one FDR from the list was successfully recruited. This procedure insured that the participants were unrelated to each other. Individuals who met eligibility criteria 1–3 and verbally agreed to participate were mailed an informed consent form and a study questionnaire. Approximately 2 weeks later, participants were contacted by telephone to confirm that they had received the study materials, answer any questions, and encourage return of the completed questionnaire and signed consent form. If the participants did not return the questionnaire within 2 weeks of the follow-up call, a reminder notice was mailed requesting that the questionnaire be returned by a specified deadline. Those individuals who completed the questionnaire were recontacted by telephone approximately 14 months later, at which time a brief interview was conducted.

Measures

Sociodemographic and Medical Characteristics. The following sociodemographic and medical characteristics were assessed via a self-report questionnaire at the time of recruitment: age (<50 or ≥50); marital status (Currently married/Living with someone as married or Single/ Never Married/Divorced/Widowed); education (≥College education or < College education); income (≤US$39,999 or >US$40,000); employment status (Full time or Part-time/Retired/Disabled/Unemployed); health insurance status (Currently have health insurance: yes or no); prior PSA test (PSA test at any time before baseline interview: yes or no); number of FDRs with prostate cancer (1 FDR or ≥1 FDR); relationship to the index case (Father with prostate cancer or Brother with prostate cancer); time since prostate cancer diagnosis in FDR (<1 year or ≥1 year); diagnosis of benign prostatic hypertrophy (Ever been told by a doctor that you have benign prostatic hypertrophy: yes or no).

Health Belief Variables. The PMT constructs of vulnerability, severity, response efficacy, and self-efficacy were assessed at the time of recruitment via scales that were developed specifically for this study. Items on each scale were rated using a four-point response format (4 = Strongly agree, 3 = Agree, 2 = Disagree, 1 = Strongly Disagree). Vulnerability was measured with four items (e.g., “Prostate cancer is more common among men like me”), with possible scores ranging from 4 to 16 (Cronbach’s α = 0.70). Severity was measured with eight items (e.g., “Developing prostate cancer would be one of the worst things that could happen to me”), with possible scores ranging from 8 to 32 (Cronbach’s α = 0.70). Self-efficacy was measured using four items (e.g., “I follow a doctor’s advice to go for prostate cancer screening”), with possible scores ranging from 4 to 16 (Cronbach’s α = 0.67). Response efficacy was measured with eight items (e.g., “I believe that prostate cancer screening is the best way of finding prostate cancer early”), with possible scores ranging from 8 to 32 (Cronbach’s α = 0.81). The items assessing vulnerability and severity were derived primarily from scales used previously to study women’s perceptions of breast cancer (26, 27). The items assessing self-efficacy and response efficacy were derived primarily from scales used previously to measure attitudes regarding prostate cancer screening (28), breast cancer screening (29–31), and testicular self-examination (32).

Interval PSA Testing. Occurrence of PSA testing in the 14 months following recruitment was assessed by yes/no response to the following question: “Have you had a PSA test since (interviewer reads date of last contact)?” We selected an interval of 14 months to ensure that at least a year had elapsed since any participant could have undergone prior PSA testing and thus be able to examine how health beliefs predicted subsequent PSA testing.

Data Analysis. All analyses were performed using a standard statistical software package; SAS, version 6.12 (33), and all P values are two-sided with a statistical significance level set at P = 0.05. Analyses comparing men who did and did not receive a PSA test in the 14-month follow-up period were carried out using χ² tests of heterogeneity for categorical variables and independent samples t tests for continuous variables. Calculations indicated that power was adequate (0.80) to detect medium effect sizes for both t tests (continuous variables) and χ² tests (dichotomous variables) that compared men who did and did not undergo PSA testing during the follow-up interval. Effect sizes of this
magnitudes correspond to 0.6 SD unit differences between group means (t tests) or a 30% difference in the proportion of individuals in each group displaying a characteristic ($\chi^2$ test). A multiple logistic regression model was then built by using variables that demonstrated significant ($P \leq 0.05$) relationships with receipt of PSA testing in univariate analyses.

**Results**

Of the 693 index cases contacted to obtain information about their FDRs, 370 (53%) responded with 455 nominations. There were no differences based on age or marital status for those who gave contact information versus those who did not. However, those who gave nominations were more likely to be White ($P < 0.05$). Of those nominated, 236 were randomly selected from lists of more than one FDR per index case. Those who met initial study entry criteria, and were mailed a letter introducing them to the study. Of those individuals, 146 (62%) verbally agreed to participate in the study and 107 (45%) completed and returned the initial baseline questionnaire. At the time the current analyses were planned, 85 of the 107 men were eligible to complete the 14-month follow-up assessment. Of these men, 2 were lost to follow-up and 1 was deceased at the time of follow-up. Thus, a total of 82 (96%) men completed the 14-month follow-up interview. All men were included in the descriptive analyses; however, only 79 men were included in the multivariate analysis due to missing data on the income variable.

The characteristics of the men who completed the 14-month follow-up assessment are reported in Table 1. The majority were Caucasian (92%), currently married (77%), and employed (73%), with annual incomes of least US$40,000 per year (77%). Mean age was 50.5 years (SD = ±8.8), (range = 39.0–77.0), with more than half the sample (57%) under age 50. Less than one third (28%) had a college education. Most (94%) had health insurance and 50% reported having PSA testing before entry into the study. Most (95%) had only one FDR with prostate cancer, usually a father (76%). During the 14-month follow-up period, 41 men (50%) received a PSA test and 41 (50%) did not.

Results of unadjusted analyses comparing men who did and did not receive a PSA test in the 14-month follow-up period are also shown in Table 1. With regard to demographic and clinical variables, results indicated that men who had PSA test during the follow-up interval were more likely to be age 50 or above ($P = 0.001$), have annual incomes greater than or equal to US$40,000 ($P = 0.03$), and have had a PSA test before recruitment ($P = 0.02$). With regard to PMT variables, findings supported predictions. As predicted, men who had a PSA test during the follow-up interval had higher levels of both self-efficacy ($P = 0.01$) and response efficacy ($P = 0.03$) for undergoing prostate cancer screening. Also as expected, perceived severity was unrelated to undergoing PSA testing in the follow-up interval. However, contrary to the prediction, men who had a PSA test during the follow-up interval did not have evidence of a higher level of perceived vulnerability ($P = 0.22$). These results remained stable in the multivariate analysis with the exception of having a PSA test before recruitment and response efficacy, which were no longer significant after adjusting for other covariates.

A multivariate analysis incorporating those variables that demonstrated significant ($P < 0.05$) univariate relationships revealed that age (odds ratio = 6.67, 95% confidence interval 1.95–22.90), income (odds ratio = 5.32, 95% confidence interval 1.32–21.36), and self-efficacy (odds ratio = 1.53, 95% confidence interval 1.01–2.31) were all significant independent predictors of

### Table 1. Demographic characteristics, medical characteristics, and health beliefs of first-degree relatives of prostate cancer patients* ($n = 82$)

<table>
<thead>
<tr>
<th></th>
<th>Total n = 82 (%)</th>
<th>PSA test in follow-up period n = 41 (%)</th>
<th>No PSA test in follow-up period n = 41 (%)</th>
<th>$P$ value$^{*1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥50</td>
<td>35 (43)</td>
<td>25 (61)</td>
<td>10 (24)</td>
<td>0.001$^1$</td>
</tr>
<tr>
<td>Married</td>
<td>63 (77)</td>
<td>35 (85)</td>
<td>28 (68)</td>
<td>0.07</td>
</tr>
<tr>
<td>≥College education</td>
<td>23 (28)</td>
<td>11 (26)</td>
<td>12 (29)</td>
<td>0.81</td>
</tr>
<tr>
<td>Income ≥US$40,000</td>
<td>62 (77)</td>
<td>35 (85)</td>
<td>27 (66)</td>
<td>0.03$^1$</td>
</tr>
<tr>
<td>Caucasian</td>
<td>75 (92)</td>
<td>36 (88)</td>
<td>39 (95)</td>
<td>0.43</td>
</tr>
<tr>
<td>Employed</td>
<td>60 (73)</td>
<td>33 (80)</td>
<td>27 (66)</td>
<td>0.14</td>
</tr>
<tr>
<td>No current health insurance</td>
<td>4 (6)</td>
<td>1 (3)</td>
<td>3 (8)</td>
<td>0.30</td>
</tr>
<tr>
<td>Prior PSA test</td>
<td>41 (50)</td>
<td>26 (63)</td>
<td>15 (37)</td>
<td>0.02</td>
</tr>
<tr>
<td>One FDR with prostate cancer</td>
<td>78 (95)</td>
<td>39 (95)</td>
<td>39 (95)</td>
<td>1.00</td>
</tr>
<tr>
<td>Father with prostate cancer</td>
<td>62 (76)</td>
<td>29 (71)</td>
<td>33 (80)</td>
<td>0.30</td>
</tr>
<tr>
<td>Brother with prostate cancer</td>
<td>17 (21)</td>
<td>10 (24)</td>
<td>7 (17)</td>
<td>0.41</td>
</tr>
<tr>
<td>≥1 year since relative diagnosed with prostate cancer</td>
<td>23 (28)</td>
<td>31 (76)</td>
<td>10 (24)</td>
<td>0.06</td>
</tr>
<tr>
<td>Personal history of benign prostatic hypertrophy</td>
<td>11 (13)</td>
<td>8 (20)</td>
<td>3 (7)</td>
<td>0.19</td>
</tr>
<tr>
<td>Perceived vulnerability ($\bar{X} \pm SD$)</td>
<td>10.89 (1.95)</td>
<td>11.15 (1.98)</td>
<td>10.60 (1.91)</td>
<td>0.22</td>
</tr>
<tr>
<td>Perceived severity ($\bar{X} \pm SD$)</td>
<td>20.84 (3.33)</td>
<td>21.02 (2.92)</td>
<td>20.66 (3.73)</td>
<td>0.62</td>
</tr>
<tr>
<td>Self-efficacy ($\bar{X} \pm SD$)</td>
<td>13.28 (1.88)</td>
<td>13.85 (1.78)</td>
<td>12.71 (1.82)</td>
<td>0.01$^1$</td>
</tr>
<tr>
<td>Response efficacy ($\bar{X} \pm SD$)</td>
<td>26.59 (3.24)</td>
<td>27.24 (3.20)</td>
<td>25.83 (3.13)</td>
<td>0.03$^1$</td>
</tr>
</tbody>
</table>

*For dichotomous variables, $\chi^2$ test of heterogeneity was used to compare groups; for continuous variables, independent samples $t$ test was used to compare groups.

$^1$Fisher’s Exact Test used in variables with <5 in each cell.

$^2$Significant at $P < 0.05$.

$^3$Significant at $P < 0.001$. 
receiving PSA testing in the 14-month follow-up interval (Table 2). The two other variables found to be significant in the univariate analyses (i.e., prior PSA testing and response efficacy) were not found to be significant independent predictors when entered into the multivariate model. Additional analyses were conducted to test for possible interactions among the constructs of PMT (perceived vulnerability, perceived severity, response efficacy, and self-efficacy) with respect to PSA testing, all of which were statistically not significant.

**Discussion**

Our study found that both demographic factors such as age and income, as well as health beliefs, are important predictors of PSA testing behavior among FDRs of men with a family history of prostate cancer. It is noteworthy that even among men with another significant risk factor for prostate cancer (i.e., family history), age continues to be a strong predictor of PSA testing. Our findings are consistent with the results of the study by Miller et al. (8) which showed that age was a significant predictor of PSA testing among men with a family history of prostate cancer. This finding may be explained by recent reports showing that 70–90% of men recognize age as a risk factor for prostate cancer compared to 10–75% of men who recognize family history as a risk factor for prostate cancer (12, 34, 35). As shown in previous research, income was associated with increased likelihood of PSA testing (6, 36, 37). It is likely that income is representative of factors related to access to the health care system. In a national study of cancer screening trends in the U.S., having a usual source of health care and health insurance were associated with higher levels of PSA testing among U.S. men (38). Similarly, having talked with a health care provider about or been recommended by a health care provider to have PSA testing (which implies having access to a health care provider) was associated with increased PSA testing (7, 12).

With regard to our theoretical model, perceived vulnerability and perceived severity were not significantly associated with PSA testing in unadjusted or multivariate analyses. In studies of women at increased risk for breast cancer due to family history, those women with higher levels of perceived vulnerability were found to be more likely to engage in mammography (39–42). We hypothesized that there would be a similar relationship between perceived vulnerability and PSA testing in men with a family history of prostate cancer. As previously stated, perceived vulnerability did not predict PSA testing. Three other studies of men with family history of prostate cancer have also found no association between perceived vulnerability or risk and PSA testing (8, 11, 12). A possible explanation may be a fatalistic attitude toward developing cancer. This characteristic has been shown to be associated with reduced levels of participation in mammography and colon cancer screening (43–46). As expected, perceived severity of prostate cancer was not a significant predictor of PSA testing. In previous cancer screening research, this factor has been of little predictive value, possibly due the almost universally held belief that cancer is a severe disease (23–26).

In unadjusted analyses, response efficacy and self-efficacy were associated with increased levels of PSA testing. However, in our multivariate model, response efficacy was no longer significant. To our knowledge, PMT has not been used to predict PSA testing behavior; however, response efficacy and self-efficacy have been found to be important components of this theory in predicting other health-related behaviors among men. For example, in a study of risk reduction behavior among gay men, response efficacy and self-efficacy were associated with the belief that an individual is personally capable of limiting one's number of sexual partners (18). Similar to our results, a study of 281 male industrial workers based on PMT found that self-efficacy was predictive of using a hearing protection device (47).

In the case of PSA testing, where the clinical utility of this test is controversial, the role of efficacy is an important issue to consider. Both response and self-efficacy are centered on the belief that coping with a threat in a specific manner will reduce the threat (22). However, with PSA testing, there is a lack of consensus in the medical and scientific community about whether using this test will result in earlier detection and, therefore, reduced morbidity or mortality. The influence of response efficacy or self-efficacy on behavior may be indicative of a lack of understanding of the current limitations of this test. A recent article discussed the potentially biased positive feedback system that can occur with PSA testing for both patients and physicians (48). A patient receives positive feedback if the test is negative because of a reduction in worry about prostate cancer, but also for a positive test result due to a feeling that the cancer was caught early. For physicians, recommending PSA testing is a no-lose strategy because performing a simple blood-based PSA test requires less time than discussing with patients the pros and cons of having such a test. Additionally, performing PSA testing may decrease the chances of medical malpractice suits if patients are later discovered to have prostate cancer. This feedback system fosters an environment that reinforces minimal discussion of the limitations of PSA testing (48). Therefore, it is worth considering that the beliefs about response efficacy among FDRs who subsequently underwent PSA testing may be based on a lack of understanding of the limited clinical utility of this test in the early detection of prostate cancer.

Among a sample of 304 men who received PSA testing at two clinics in Texas, less than half the sample (40%) reported that their doctor discussed advantages and disadvantages of PSA testing with them (49). Interventions targeted an informed decision making for PSA testing show that men are less likely to have or be interested in

| Table 2. Logistic regression model of predictors of prostate specific antigen testing (n = 79) |
|---------------------------------|----------------------------------------------------|
| Age ≥50                        | 6.67 (1.95, 22.90)*                                 |
| Income ≥US$40,000              | 5.32 (1.32, 21.36)*                                 |
| Prior PSA test                 | 1.72 (0.58, 5.10)                                  |
| Self-efficacy                  | 1.53 (1.01, 2.31)*                                 |
| Response efficacy              | 0.92 (0.72, 1.16)                                  |

*Significant at P < 0.05.
having a PSA test if they are part of an intervention that discusses both the benefits and limitations of this test (50, 51). It is important to continue to foster men’s feelings of efficacy related to cancer screening modalities based on a true understanding of personal health benefits of PSA testing.

Although our study provides some insights into PSA testing among FDRs of men with prostate cancer, the results should be considered in light of the following study limitations. Our response rate for index patients who gave contact information was 53%. Whites were more likely to give contact information about their FDRs compared to other minority groups, as reflected by the predominantly White respondents in our survey. Therefore, our findings may not be generalizable to minority men with a family history of prostate cancer. Of the 236 FDRs approached about the study, 45% returned the baseline questionnaire. It is possible that men who are more interested in PSA testing and/or family history of prostate cancer were more likely to respond to this survey than those who were not. A goal of our study was to evaluate the utility of PMT in understanding PSA testing. Ideally, use of an analytic technique such as structural equation modeling would allow us to definitively test the utility of PMT in predicting PSA testing. However, our study was designed to be a preliminary evaluation of the utility of PMT and did not have a sample size sufficient to conduct this analysis. Another limitation related to PMT is the lack of data about beliefs toward prostate cancer among men without a family history of prostate cancer. This information would provide insight into whether these beliefs and their impact on PSA testing are specific to men with a family history of prostate cancer or are more generally held among men. Additionally, our study sample was comprised primarily of Caucasian men who tended to be of higher socioeconomic status, limiting generalizability to those in lower socioeconomic status and other racial/ethnic groups. Finally, our assessment of the primary outcome variable of PSA testing was based on self-report. A study of patient self-report of PSA found that self-report of test results was discordant with medical records 29% of the time with patients tending to overreport having a PSA test in the previous 2 years when compared with medical records (52).

Conclusions

As molecular genetic diagnosis improves, family history of prostate cancer will become an increasingly important risk factor on which to base decisions for management of prostate cancer risk. The present study showed that both demographic and health belief variables are important factors associated with PSA testing among men with a family history of prostate cancer. Similar to other studies of PSA testing, age and income were important predictors of PSA test use. The use of a theoretical model in our study allowed us to gain additional insight into other factors that can impact PSA testing in this group. Our findings provide partial support for the predictive utility of PMT variables. Perceived vulnerability and perceived severity were not associated with PSA test use. However, beliefs in the efficacy of PSA testing as a means of detecting prostate cancer early and personal confidence that one can carry out this behavior were associated with PSA test use. This finding suggests that efforts to enhance informed decision making about PSA testing or increase PSA test use among men with a family history of prostate cancer are likely to be more effective if issues related to efficacy are addressed. Future studies using analytic techniques such as structural equation modeling may allow for more definitive statements about the utility of PMT. Additionally, comparative studies using PMT to understand differences in PSA testing among men with and without a family history of prostate cancer may help guide interventions aimed at helping at-risk individuals making informed decisions about PSA testing.

References

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