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Non-medical Information Seeking Amid Conflicting Health Information: Negative and Positive Effects on Prostate Cancer Screening

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Abstract

This study investigates the impact of seeking information about the prostate-specific antigen (PSA) test on men's PSA test use during a period of conflicting recommendations. Analyses used longitudinal survey data collected in 2005 and 2006 from a nationally representative sample of U.S. males aged 40 to 70 (n=777). Cross-sectionally, non-medical seeking was significantly associated with increased odds of having a PSA test in the past year (Time 1 OR=9.74, $p < .01$, 95% CI=4.37, 21.70; Time 2 OR=5.78, $p < .01$, 95% CI=3.17, 10.55). However, lagged analyses showed that, among men who had a PSA at Time 1, active seeking is associated with *reduced* odds of later having a PSA test (OR=0.33, $p < .05$, 95% CI=0.13, 0.85). Participants who had not had a PSA test in the past year very rarely sought information about PSA tests. Information acquisition in an environment of conflicting recommendations may influence adoption of cancer screening behaviors.

Introduction

Consumers today are increasingly exposed to health information from their social and media environments (Fox, 2011; Viswanath, 2005). Health information exposure could occur as a result of consumers actively searching for specific health topics that they are interested in from a variety of sources including the internet, printed materials, healthcare professionals, or family and friends (Finney Rutten, Squiers, & Hesse, 2006). Unfortunately, it is well-

documented that the health information environment often contains contradictory and conflicting health information across various health domains including cancer prevention and screening. For instance, news, popular media, internet sources, and even healthcare professionals disseminate a cacophony of competing and potentially confusing recommendations surrounding the benefits and risks of cancer screening for prostate and breast cancers (K. C. Smith, Kromm, & Klassen, 2010).

How does the public respond to conflicting recommendations from their social and media environment when making decisions about their health? Ideally, a diverse marketplace of health information would provide consumers with a range of arguments and counterarguments from a variety of sources. To the extent that individuals are savvy consumers of health information (for example, understanding which sources and types of information are trustworthy), this access to information should empower individuals to make optimal and rational health decisions. This notion is consistent with the growing emphasis on informed decision making among consumers, in contrast with the traditional paternalistic model of healthcare delivery (Institute of Medicine, 2001).

The Current Study

We investigate the impact of exposure to conflicting recommendations in the social and media environment in the specific context of active seeking of information about prostate cancer screening with the prostate-specific antigen (PSA) test, and its impact on subsequent screening behavior among a cohort of U.S. males aged 40 years and older. We further focus our research on non-medical sources of information (rather than on medical sources) because earlier studies indicated that men were much more likely to obtain information about potential risks of prostate cancer screening from media, friends or family members (Ferrante, Shaw, & Scott, 2011) rather than medical sources. Notably, this study was conducted between 2005 and 2006, during which time there were conflicting recommendations from major medical organizations and mixed messages about PSA testing in the public information environment (Smith et al, 2010).

Although this study focuses on one specific cancer screening test, our objective is to generate much needed information that would also apply to similar cases involving other preventive and screening behaviors (e.g., mammography, genetic testing, imaging studies for cancer, childhood vaccinations). This will advance the understanding of how information seeking in the presence of conflicting information in the social and media environment could influence health behaviors in the population across different health domains. The findings will also have important implications for practitioners in deciding the best strategy for communicating complex health recommendations to the public. In the following sections, we provide an overview of prostate cancer incidence in the U.S., the controversy over PSA testing, a description of the presence of conflicting information about PSA testing in the media environment based on content analyses, information seeking effects on PSA testing, and the research hypothesis in the current study.

Prostate Cancer Incidence

Prostate cancer is the most commonly diagnosed cancer in men in the United States and the second leading cause of cancer death in American men, behind only lung cancer (American Cancer Society, 2014). The American Cancer Society estimates that during 2014 about 233,000 new cases of prostate cancer will be diagnosed in the United States and that 29,480 men in the United States will die of prostate cancer (American Cancer Society, 2014). About 1 in 7 men will be diagnosed with prostate cancer during his lifetime, but only 1 in 36 will die of it (American Cancer Society, 2014). In the mid-1980s through mid-1990s, the incidence rate for prostate cancer increased steadily in part due to the introduction of screening with the PSA test (Hsing & Devesa, 2001). Since 2005, the incidence rate for prostate cancer has been declining by 1.9% annually. Still, given the high prevalence of prostate cancer among men, it is justifiable to investigate the impact of exposure to prostate cancer screening information on the likelihood of prostate screening in the population.

Controversy over PSA Testing

PSA testing for population screening of prostate cancer has generated heated debate among medical professionals and the public across various countries since the 1990s (Barry, 2009) through today. The PSA test has been widely used to screen men for prostate cancer. It measures the blood level of PSA, a protein produced by the prostate gland. The higher a man's PSA level, the more likely it is that he has prostate cancer. This is useful when tracking prostate cancer recurrence; however, population screening of prostate cancer is controversial because the test is not particularly diagnostic for that purpose. There are other reasons for having elevated PSA levels, and some men who have prostate cancer do not have elevated PSA. Also, even if it were completely accurate, as the numbers above suggest, prostate cancer typically progresses so slowly that often men die *with* prostate cancer, not *from* prostate cancer. So it's debatable whether the risks of impotence or incontinence, which are common after prostate cancer treatment, are worth the potential benefits (Mayo Clinic, 2013).

In 2005, at the time of the current study, the American Cancer Society recommended annual screening (R. A. Smith, Cokkinides, & Eyre, 2005). On the other hand, the most up-to-date recommendations from the American Urological Association, the US Preventive Services Task Force, and the American Academy of Family Physicians did not recommend screening (or recommended screening every 2 years) (American Urological Association, 2000; Harris & Lohr, 2002). Further, only 25 of 50 states required insurers to provide coverage for the PSA test in 2005 (only 16 specified coverage for annual tests; 8 did not specify frequency, and one, Oregon, specified coverage every two years; National Cancer Institute, 2005).

Sources of conflicting information about PSA Testing—Non-medical sources expose men to the screening debate. While many studies focus on how conversations with doctors impact cancer screening (Vedel, Puts, Monette, Monette, & Bergman, 2011), as described above, obtaining information from non-medical sources is also quite common. Non-medical sources are particularly interesting when studying a controversial topic as there are more opportunities to be exposed to conflicting information (for example, from friends or family who have had different experiences or organizations with different

recommendations). There are two ways people can gather information. One is during their routine use of media or interactions with others in their social network. This form of less purposive or active information exposure has been called *information scanning* (Kelly, Niederdeppe, & Hornik, 2009; Niederdeppe et al., 2007). Others have conceptualized such information acquisition as incidental or mere exposure, passive learning, routine information acquisition or browsing (for a review, see Niederdeppe et al., 2007). The second way—the focus of this paper—is through health *information seeking* which is defined as the "purposive acquisition of information from selected information carriers" (Johnson & Case, 2012, p. 31). Other related concepts described in the literature include health information seeking behaviors, consumer health information seeking, or health information acquisition. Among U.S. adults, seeking cancer-related information is a common behavior. For instance, data from the Health Information National Trends Survey (HINTS) showed that about half of U.S. adults (49%) have sought general cancer information, most frequently from the internet, printed materials, or a health care professional at some point in their lives (Finney Rutten et al., 2006). This study focuses on the effects of non-medical seeking about the PSA test on PSA test uptake because it has not been studied as frequently as medical seeking and there is the potential for more exposure to conflicting information (Nagler & Hornik, 2012).

If men sought information about the PSA test in 2005, what information would they have found? Smith and colleagues (2010) analyzed news articles on prostate cancer screening in major U.S. newspapers and magazines in 2005 and reported the occurrence of two conflicting themes among the stories. One group of articles promoted PSA unequivocally and did not discuss the benefits of testing versus harms. Another group of articles depicted the complexity of interpreting the PSA test results based on various factors, cast doubts about the reliability of PSA testing, or presented the ongoing debate in the medical community about prostate cancer screening.

We conducted a content analysis of the news coverage of PSA testing from October 2004 to October 2006 (i.e., the time span over which respondents were asked to report). Following the strategy and keywords used by Niederdeppe (2006) for his content analysis of PSA testing news coverage, we used Lexis-Nexis to identify 248 texts which mentioned PSA testing from the Associated Press State and Local Wire, major US newspapers, and TV news transcripts. One hundred seven of these were relevant based on Niederdeppe's criteria of having enough references to PSA testing, referring to routine cancer testing, and not being obituaries or listings of community events. Of these, 40% provided positive assessments similar to the unequivocally promoting group of articles described by Smith et al (2010). Thirty-six percent of the remaining texts were coded as mixed, 17% were coded as having no valence, and 7% were coded as negative. Also, about half of the relevant texts (54%) included messages of contradiction, inconsistency, or confusion in PSA testing research and/or recommendations (as defined by Nagler (2010)), similar to the other group of articles described by Smith et al (2010). So these two types of information about PSA testing were about equally available in the media environment during the time of the study. Additionally, half of the texts recommended screening starting at age 50 (50%), but a large percentage did not mention any age for initiation (43%). Finally, most did not mention how frequently to get a PSA test (66%), but all of those that did prescribed annual tests. Although this content

analysis only included newspapers and TV news, we assume that these capture what was available in the broader non-medical environment from which people might seek information. Some seeking would have used these actual sources; other sources (e.g. Internet, or interpersonal) might be indirect conduits for the same mix of information particularly given that that was (and is) the debate in the medical community. We cannot know this for sure, but these sources are the ones available to capture what was potentially available in 2005-2006.

Effects of Information Seeking on Prostate Cancer Screening Behavior

In terms of the impact of seeking PSA information on behavior, two cross-sectional studies conducted in the time period leading up to and including the time period of this current study have documented that seeking general health information or specific information about prostate cancer screening is associated with increased uptake of PSA testing. For instance, Shim et al. (2006) analyzed the 2003 HINTS data and reported that controlling for sociodemographic factors, general health information seeking behaviors were associated with men ever having had a PSA test. Unlike the HINTS data, Kelly et al. (2010) utilized information seeking measures specifically about PSA testing in 2005 from the same data set analyzed here, and found that controlling for demographic factors, seeking was also associated with self-reported PSA testing in the preceding two years. These two studies were based on cross-sectional analyses, which are constrained by threats of reverse causality. In this current study, we aim to contribute to this research area by examining the longitudinal effects of non-medical information seeking on the uptake of PSA testing among men. Based on the positive cross-sectional associations between information seeking and PSA testing, we hypothesized that men who seek information about the PSA test would be more likely to undergo screening with the PSA test subsequently. We were surprised by the contrary evidence we found.

Methods

Study Procedure and Sample

Data were collected in two rounds from a nationally representative group of adults aged 40 to 70 years old.[1] Respondents were sampled from a national, list-assisted RDD-recruited panel run by Knowledge Networks (KN). At recruitment into the KN panel, 74% had home internet access. Those without home internet access were given hardware and internet access. Panel recruitment from the KN panel into the online survey averaged 22% across all months. As these analyses focus on getting a PSA test, the sample was restricted to men. Overall, complete baseline data were collected weekly for one year starting in October 2005 for a total of 1,214 baseline male respondents. 73% of those male respondents answered the follow-up survey the following year (n=890). Participants lost to follow-up were significantly younger (about 1.5 years), lower income (about one category lower), more likely to be non-Hispanic black or a non-Hispanic race other than white or black, less well educated (fewer with bachelor's degrees, more with less schooling), and less likely to be married (more formerly married). The analyses were therefore weighted to the benchmark

[1]This is the same dataset used by Hornik et al, 2013, Kelly et al, 2010, Kelly et al, 2009, and Ramírez et al, 2013.

U.S. adult population and adjusted for these potential confounders. Thirty-five of these men had prostate cancer at baseline or follow-up and were excluded because they would have more frequent PSA tests than the rest of the group. Also, 14 of the remaining respondents were missing on the dependent variable at either baseline or follow-up. Finally, 64 additional participants were missing on one or more of the confounders, so the final sample size for analysis was 777. [2]

Measures

Non-medical seeking—The primary independent variable was non-medical seeking. *Non-medical seeking* was defined as actively looking for information relevant to the PSA test from any non-medical source. Participants were first told about the difference between seeking and scanning ("Some people are actively looking for information about the PSA test [seeking] while other people just happen to hear or come across such information [scanning]. Some people don't come across information about the PSA at all."). Participants were then asked how much seeking about PSA tests they had done in the past year from four categories of non-medical sources: 1) newspapers, magazines, or newsletters; 2) television or radio; 3) the internet; and 4) family, friends, or coworkers. We created a binary measure for seeking, capturing whether or not they had sought PSA test information from any of the four categories of non-medical sources in the previous 12 months. This measure was collected at Time 1 and Time 2.

All refusals were coded as missing. However, if participants hadn't heard of a PSA test before or couldn't recall if they had come across any PSA information, they were coded as not seeking for PSA information. Also, although the survey included questions about information seeking from medical sources, they are not included in our primary analyses since our interest here is in information gathered from non-medical sources. However we do compare the effects of medical and non-medical seeking in separate analyses, and make the case that the observed effects are more stable for non-medical than for medical seeking.

PSA Behavior—The outcome of interest was PSA screening in the past year. We chose one year because that was the interval between study waves, and so it made the most sense when predicting behavior at Time 2 from seeking behaviors at Time 1. Also, at least one medical organization at the time, the ACS, recommended that PSA screening should take place annually (R. A. Smith et al., 2005). Whether or not men had had a PSA test in the past year was measured by first asking respondents a screening question to determine whether they had "ever heard of a PSA (or prostate-specific antigen test)." Respondents who reported never having heard of a PSA test were coded as not having had one (0). Respondents who *had* heard of a PSA were then asked whether they had ever had a PSA test. Men who had never had a test were also coded as 0. Those who reported that they had obtained a PSA test were then asked when their most recent PSA test occurred (a year ago or less; more than 1 but not more than 2 years ago; more than 2 but not more than 5 years ago; and over 5 years ago). Respondents who reported having had a PSA one year ago or less

[2]Note that the analytic sample, reflecting the assignment and rounding of weights, appears slightly smaller (n = 769).

were coded as 1; all others were coded as 0. This outcome was measured both at Time 1 and Time 2.

Confounders—*Non-medical scanning* was a primary confounder and measured in a similar way to non-medical seeking. Participants were asked how much scanning about PSA tests they had done in the past year from the same four categories of non-medical sources. Respondents had the option to report three levels of exposure: if they had never come across information about PSA they were coded as 0, those who reported scanning 1 or 2 times were coded as 1, and those reporting 3 times or more were coded as 2. We created a scale ranging from 0 to 8 for scanning, capturing how frequently they had scanned PSA information (ranging from 0-2) from how many different categories of non-medical sources (ranging from 0-4) in the previous 12 months.

Other predictors of getting a PSA test which have been reported in the literature (and also might affect non-medical seeking behaviors) include older age, race/ethnicity (African-American) marital status (married), higher education and income levels, region of the US (south relative to west), good and better self-reported physical health, obese categorization on the body mass index (BMI), number of chronic diseases, family history of prostate cancer, and having seen a doctor in the past year (Finney Rutten, Meissner, Breen, Vernon, & Rimer, 2005). Those confounders, as well as other measures of general and health-specific media use, health knowledge, health-related behaviors (exercise and fruit and vegetable consumption in the past week, dieting in the past month, and smoking status), health orientation, cancer fatalism, personal colon cancer history, and prostate cancer history in friends were included in analysis models. Health knowledge was measured with an additive index of seven True/False questions about general health (e.g., “Doctors say that both types of cholesterol (called LDL and HDL) should be kept as low as possible” (correct answer “false”).) Health orientation was measured with a three-item scale (e.g., *“My health is important to me”*) derived from items developed by Dutta-Bergman (2003, 2005). Finally cancer fatalism was assessed with a three-item index (e.g., *“It seems like almost everything causes cancer”*). All confounders were measured at Time 1.

Statistical Analysis

The primary analyses use logistic regression to predict PSA use in the past year from non-medical seeking of PSA information. The first set of analyses considers the cross-sectional relationships between non-medical seeking and PSA use at Time 1 or Time 2. Models adjusting for non-medical scanning and other confounders are reported. The next set of analyses considers the lagged relationships which predict PSA use at Time 2 from non-medical seeking at Time 1, adjusting for PSA use at Time 1, non-medical scanning, and the other confounders. In order to better understand these lagged relationships, we also consider how they are affected by differences in PSA use at Time 1.

All analyses were performed with the Stata 12 survey (SVY) module and used the SUBPOPULATION option because the analysis sample was restricted as described above. The post-stratification weights (benchmarked against the Current Population Survey (CPS)) were applied to all analyses. Missing data were less than 10% and were listwise deleted. The

University of Pennsylvania Institutional Review Board reviewed and approved all study procedures and materials.

Sensitivity Analysis

In follow-up sensitivity analyses, respondents who had never heard of a PSA test were coded as missing rather than as not having had a PSA test (0). Treating those who had not heard of the PSA test as not having one may inflate the relationship between information seeking and PSA use because those who had not heard of the test were also coded as not having done any seeking about the PSA test. There is no way to know whether or not this inflation is real or artificial. The sensitivity analysis simply indicates whether or not the pattern of results would be the same making the assumption that the data added by those who had not heard of the PSA test is not meaningful.

Another sensitivity analysis tested the effects just for men 50-70 years old, as the PSA test has never been recommended for the general population of men under 50. We chose to include younger men in our main analysis because our content analysis showed that only about half of the articles reported what age to begin testing, and in addition, men may think about the issue of testing before they reach the testing age. This sensitivity analysis indicates whether or not the pattern of results would be the same limiting the sample to men who might find PSA testing information to be more relevant to them because they are 50 years old or older.

Results

Descriptive Analyses

The analyzed sample was weighted to be nationally representative of 40-70 year old males. Table 1 describes the unweighted sociodemographic characteristics (as measured at Time 1; n = 777). The mean age of men included in the analysis sample was 53 years (SD=8.4). The majority was non-Hispanic White (80%) and married (70%). Forty percent were college graduates and the mean annual income was about $66,000 ($SD$=$42,000).

The weighted distributions of non-medical seeking for PSA information, and PSA testing in the past 12 months (as measured at Time 1 and Time 2) are described in Table 2. Fewer men sought PSA information from non-medical sources (only about 10%) relative to those who scanned for PSA information from non-medical sources (33% as reported in Kelly et al, 2010). Of those men who did non-medical seeking, most sought information from their family, friends, or co-workers (about 70% of those who sought). Finally about a quarter of men had had a PSA in the past year at Times 1 and 2, while about half of them had never had a PSA test (including those who had not heard of PSA testing as not having had one, at Times 1 and 2).

Cross-sectional Analyses

The first set of analyses tested whether or not cross-sectional non-medical seeking of PSA information was associated with a greater likelihood of having had a PSA test in the *past year* at both Time 1 and Time 2. Non-medical seeking was significantly positively

associated with having a PSA test in the past year at both Times 1 and 2, even after adjusting for non-medical scanning and the other confounders (Time 1 OR=9.74**, 95% CI=4.37, 21.70; Time 2 OR=5.78**, 95% CI=3.17, 10.55; see Table 3). These results parallel those reported by Kelly and colleagues (2010), although now with a sample which was limited to those who had completed both waves of the survey. Sensitivity analyses limited to those who had heard of PSA testing or to those 50 years old or older showed parallel effects (not shown).

Lagged Analyses

Lagged analyses provide more evidence about the temporal order of the relationship between information seeking and PSA testing. In lagged analyses predicting having a PSA test in the past year at Time 2 from non-medical seeking at Time 1 and adjusting for prior behavior, non-medical scanning, and the other confounders, the relationship is in the *opposite* direction to the cross-sectional findings (OR=0.41*, 95% CI=0.19, 0.87). Those who sought at Time 1 were less likely to have had a PSA test in the past year at Time 2. These results were again parallel to alternative analyses limited to those who had heard of PSAs or to those 50 or older.

Lagged Analyses for Time 1 PSA Test Behavior Sub-Groups

The reversal in direction of effect for non-medical seeking on PSA testing was unexpected given the cross-sectional findings. In order to better understand this relationship, we considered how differences in PSA use at Time 1 might affect the observed lagged association. PSA use at Time 1 was divided into three groups: 1) never had a PSA (n = 443), 2) last PSA was more than a year ago (n = 121), and 3) last PSA was a year ago or less (n = 205). Seeking for information about the PSA test from non-medical sources was rare among men in the first group, who reported that they had never had a PSA at Time 1 (n=13 of 443), and among men in the second group, with PSAs more than a year ago (11 of 121). With so few men doing non-medical seeking in these two groups, effects on PSA testing at Time 2 could not be reliably estimated and men from these two groups could not have contributed substantially to the observed negative effect. Instead, it was clear that the negative lagged relationship reported above was driven by men who had a PSA test in the past year at Time 1 (OR=0.33*, 95% CI=0.13, 0.85, n=205; see Table 4). Also, the original positive cross-sectional relationship between seeking and testing still held at Time 2, even when restricted to this sample of men, all of whom had been tested at Time 1, although the effect is not significant (OR=2.62, 95% CI=0.88, 7.83, n=203, adjusting for confounders).

Follow-up analyses with medical seeking—To further probe the negative effect among men who have had a PSA test in the past year at Time 1, we examined whether it is only non-medical seeking that leads to negative effects, or whether information that was delivered through doctors at this time was also associated with a lower likelihood of having a PSA test at Time 2. Medical seeking (men asking their doctors about PSA testing) is related in the same direction (OR=0.50, 95% CI=0.22, 1.11, n=205), although, in contrast to non-medical seeking, the effect is not significant.[3]

Discussion

In this study among a nationally representative sample of older men, we found that seeking about PSA testing information was associated with increased likelihood of PSA testing in the cross-sectional analyses, in line with what Kelly et al. (2010) reported from the same dataset focusing on PSA test adherence in the past two years. However, the lagged analysis here showed a different pattern between seeking and screening behavior; the association between seeking and repeated PSA testing was in the negative direction at one-year follow-up, after controlling for non-medical scanning and the other confounders. These findings contrast with the lagged non-medical scanning analysis reported by Hornik and colleagues (2013) that showed no relationship between non-medical scanning and PSA testing. How can we align the positive cross-sectional association with the lagged negative effects for seeking on PSA testing?

The positive cross-sectional association may reflect several forces including the influence of unmeasured confounders affecting both the tendency to seek information and the tendency to be sufficiently involved in the medical system so as to have opportunities to be tested, as well as the possibility of reverse causal effects where the experience of being tested and receiving results leads to increased medical seeking. The lagged negative effect, in contrast, is reported among men who have already been tested, and who need to decide whether to be tested again. These analyses are likely affected by different forces, particularly since most unmeasured potential confounders threatening inference in the cross-sectional analysis are de facto controlled for in the lagged analysis given that baseline testing is held constant, and the reverse causal explanation is no longer a concern.

We have shown that much of the information in the social and media environments about whether PSA testing is recommended for routine prostate cancer screening is contradictory (even in 2005). So, men who recalled seeking information about PSA testing from non-medical media and interpersonal sources are assumed to have encountered conflicting recommendations about prostate cancer screening with the PSA test. Decision and health behavior theories suggest that when men are exposed to conflicting recommendations, this could either encourage or discourage PSA testing through various pathways including perceived ambiguity, beliefs about cancer preventability, perceived threat, or cancer worry. In a study by Han and colleagues (Han, Moser, & Klein, 2007), subjective perception of ambiguity regarding lung cancer prevention recommendations was positively related to consumers' perceived risk of developing lung cancer and lung cancer-related worry. However, ambiguity was inversely related to perceived preventability of lung cancer and associated with lower adherence to preventive behavior (i.e., smoking abstinence). Han and colleagues found a similar reduction in adherence to mammography over time when women had high levels of perceived ambiguity about mammography recommendations (Han,

[3]An alternate version of the lagged analyses incorporating medical and non-medical seeking as a single predictor (3 categories: non-seekers, medical seekers, and both non-medical and medical seekers (non-medical seekers were lumped with non-seekers as there weren't many of them)) was conducted in response to a reviewer suggestion. The results indicate that ORs only reversed among those who did both non-medical and medical seeking relative to non-seekers; medical-seekers were not different from non-seekers. This is consistent with our interpretation that non-medical seeking, and not medical-seeking, is associated with lower odds of PSA testing at follow-up. Detailed results are available from the authors upon request.

Kobrin, et al., 2007). One potential explanation for the findings for our present study is that perceived ambiguity about PSA testing produced by exposure to the contradictory public communication environment might reduce motivation for repeat screening over time. While we do not have the data to test this hypothesis, we recommend that future research studies how seeking and perceived ambiguity are associated with differential effects in these mediating pathways over time.

Strengths and Limitations

A major strength of this study is that it uses a nationally representative sample. And while these results are limited because they reflect a single point in time (2005-2006) the controversy over PSA screening remains, so these effects may still be present. These analyses also draw strength from predicting behavior over time, while adjusting for prior behavior. Lagged analyses are more powerful when drawing causal claims about the direction of effects (by showing that information exposure precedes testing behavior). Still, there is the potential threat of unmeasured confounders which could also explain these surprising findings. One important confounder is the nature of men's experience with their PSA test at Time 1. Men who received a false positive result in the prior year may be more likely to engage in non-medical seeking and less likely to test again because of their testing experience. We also might expect that men who falsely tested positively would be more likely to selectively attend to information suggesting that PSA testing is not beneficial. Given that 10.4% of PSA tests result in false positive results (defined as no prostate cancer diagnosis after 3 years of follow-up in the Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial; Croswell et al., 2009), if all of them sought, it's possible that about one-third of the seekers in this study (30% were seekers among those who underwent a PSA test in the past year at Time 1) are biased towards seeking information unfavorable of PSA testing. Another potential confounder is the recency of PSA testing at baseline. Since our measures of seeking rely on participant recall, those who tested more recently may remember seeking more clearly, and (unrelatedly) may also not need to get their next test as quickly.

One final limitation is that we do not have the measures to test the mechanisms which could explain these findings. Perhaps men who read surprising information (i.e., PSA testing may not be beneficial) might be more likely to both remember that they sought for information and, because of the information they found, also less likely to get tested again. If we knew whether the information men found was mainly pro- or anti-PSA testing; or seemed particularly ambiguous, we would have a better shot at explaining the effects more precisely.

Future Directions

From these study findings and limitations discussed above, there are a few key directions for further investigation. First, for topics with ambiguous recommendations that have been controversial in public forums and the media, like prostate cancer screening, effects may change over time – so the effects on outcomes need to be measured more than once within the same respondent. Next, there is a need to develop measures to assess the level of exposure to conflicting information about PSA testing among respondents. The validated measures for media exposure to conflicting nutritional information described by Nagler and

Hornik (2012) could be adapted and validated for the specific context of exposure to PSA testing information among men. Third, to better understand the pathway of effects between information acquisition and prostate cancer screening behavior using decision theory, it would be necessary to include mediating variables including perceptions about ambiguity, preventability, threat, and worry described in earlier research. Fourth, we advise further investigation into whether the results in this study are also observed for other health domains where there is currently ambiguity over recommended behaviors such as genetic testing or mammography. The results suggest that active seeking in such an environment could influence short term and repeat screening behaviors in different ways and offer a foundation for further investigation of the effects of contradictory health information in the social and media environments.

Conclusion

Prior evidence about the impact of health information acquisition on behaviors suggest that more information seeking or scanning would promote preventive and screening behaviors because the public is empowered with health information and knowledge to take active steps in adopting these health behaviors (Shim et al., 2006). Even in lagged analyses, Ramirez and colleagues (2013) showed positive relationships between non-medical seeking and three healthy lifestyle behaviors (dieting, eating fruits and vegetables, and exercising). However, our analyses find that this may not always be the case if information seeking about cancer screening happens to coincide with an information environment that comprises ambiguous and conflicting expert recommendations. In such situations, more information acquisition through non-medical seeking could initially encourage screening behaviors in the short term but discourage people from undergoing repeat screening subsequently. In hindsight, for some public policy analysts, this is probably a “good” effect since routine PSA testing can be more harmful than beneficial. Nevertheless, this study provides important cautionary evidence for health communication practitioners to carefully consider the best strategy for conveying complex or conflicting health recommendations to achieve public health goals.

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Table 1

Sociodemographic Characteristics of the Sample (N = 777)

	%	*Mean* (*SD*)
Age		53 (8.4)
Male	100	
Race/ethnicity		
White (not Hispanic)	80	
Black (not Hispanic)	7	
Hispanic	8	
Other	5	
Education		
Less than high school	6	
High school	25	
Some college	29	
College and above	40	
Income (in thousands)		66 (42)
Married	70	

Note. Data are unweighted and from Time 1.

Table 2

Weighted Independent and Dependent Variables (N = 769)

	Time 1 %	Time 2 %
Non-medical seeking	11	10
from family, friends, or co-workers	8	7
from the internet	6	5
from newspapers, magazines, or newsletters	5	5
from TV or radio	3	4
PSA testing		
In the past year	27	29
Longer ago	16	16
Never (also hadn't heard of)	57	55
Had not heard of PSA testing	30	24

Table 3

Cross-sectional Effects of Non-Medical Seeking on PSA Testing in the Past Year

	Time 1 *n* = 767		Time 2 *n* = 763	
	OR	**95% CI**	**OR**	**95% CI**
Non-Medical Seeking (0-1)	9.74**	[4.37, 21.70]	5.78**	[3.17, 10.55]
Non-Medical Scanning (0-8)	0.99	[0.83, 1.18]	1.07	[0.94, 1.23]
Age	1.15**	[1.11, 1.19]	1.11**	[1.08, 1.14]
Race/ethnicity				
Non-Hispanic White	1.00		1.00	
Non-Hispanic Black	0.65	[0.25, 1.68]	1.48	[0.63, 3.44]
Hispanic/Other	0.50	[0.21, 1.21]	0.89	[0.42, 1.88]
Income	1.12**	[1.04, 1.21]	1.12**	[1.05, 1.20]
Education	1.10	[1.00, 1.20]	0.96	[0.88, 1.05]
Marital status				
Married	1.00		1.00	
Single (never married)	1.26	[0.57, 2.80]	1.34	[0.63, 2.81]
Divorced/Widowed/Separated	1.31	[0.68, 2.51]	1.31	[0.73, 2.35]
Living in an urban area	0.77	[0.44, 1.38]	0.90	[0.51, 1.57]
Region of the country				
Northeast	1.00		1.00	
Midwest	0.81	[0.38, 1.72]	0.34**	[0.17, 0.69]
South	0.66	[0.34, 1.30]	0.78	[0.41, 1.50]
West	0.61	[0.29, 1.28]	0.68	[0.35, 1.32]
General media use	1.01	[0.97, 1.05]	1.01	[0.98, 1.05]
Health media use	1.05	[0.95, 1.15]	1.04	[0.95, 1.14]
Health status	0.96	[0.72, 1.28]	0.82	[0.63, 1.08]
Past year doctor visits	1.09	[1.00, 1.20]	1.04	[0.97, 1.13]
Exercise	0.91	[0.81, 1.02]	1.01	[0.90, 1.12]
Fruit and vegetable intake	1.03	[0.93, 1.15]	1.03	[0.93, 1.15]
BMI	0.96	[0.92, 1.01]	0.98	[0.93, 1.03]
Health orientation	1.27	[0.88, 1.85]	1.46*	[1.06, 2.02]
Smoking status	0.64	[0.35, 1.14]	0.38**	[0.20, 0.72]
Health knowledge	1.09	[0.93, 1.26]	1.14	[0.98, 1.33]
Dieting past month	1.10	[0.69, 1.75]	0.92	[0.57, 1.48]
Cancer fatalism	0.96	[0.74, 1.25]	0.97	[0.76, 1.24]
Personal colon cancer history	1.07	[0.56, 2.04]	0.67	[0.33, 1.35]
Family/friends prostate cancer history	1.19	[0.74, 1.91]	1.11	[0.70, 1.76]

All analyses are weighted to be nationally representative and adjust for confounders measured at Time 1. Significant differences for individual categories within a set are only noted if the set is also significant at $p < .10$.

*$p<.05$

** $p<.01$

Table 4

Lagged Effects of Non-Medical Seeking at Time 1 on PSA Testing in the Past Year at Time 2 among Men Who Had a PSA in the Past Year at Time 1

	Model 1: Binary *n*=203		Model 2: Confounders *n*=203	
	OR	**95% CI**	**OR**	**95% CI**
Non-Medical Seeking (0-1)	0.40*	[0.18, 0.89]	0.33*	[0.13, 0.85]
Non-Medical Scanning (0-8)	1.15	[0.94. 1.41]	1.14	[0.90, 1.44]
Age	--	--	1.02	[0.96, 1.08]
Race/ethnicity				
Non-Hispanic White	--		1.00	
Non-Hispanic Black	--	--	0.96	[0.25, 3.71]
Hispanic/Other	--	--	0.59	[0.16, 2.14]
Income	--	--	1.11	[0.97, 1.27]
Education	--	--	0.93	[0.79, 1.09]
Marital status				
Married	--		1.00	
Single (never married)	--	--	1.75	[0.50, 6.08]
Divorced/Widowed/Separated	--	--	1.70	[0.39, 7.37]
Living in an urban area	--	--	1.14	[0.41, 3.17]
Region of the country				
Northeast	--		1.00	
Midwest	--	--	0.22*	[0.06, 0.82]
South	--	--	0.73	[0.24, 2.22]
West	--	--	0.48	[0.12, 1.85]
General media use	--	--	0.99	[0.94, 1.06]
Health media use	--	--	1.08	[0.92, 1.27]
Health status	--	--	0.87	[0.53, 1.42]
Past year doctor visits	--	--	0.98	[0.87, 1.10]
Exercise	--	--	0.97	[0.81, 1.15]
Fruit and vegetable intake	--	--	1.01	[0.85, 1.20]
BMI	--	--	0.94	[0.86, 1.04]
Health orientation	--	--	1.97*	[1.05, 3.72]
Smoking status	--	--	0.18**	[0.05, 0.57]
Health knowledge	--	--	0.95	[0.75, 1.21]
Dieting past month	--	--	0.87	[0.40, 1.88]
Cancer fatalism	--	--	0.90	[0.59, 1.37]
Personal cancers history	--	--	0.56	[0.15, 2.08]
Family/friends prostate cancer history	--	--	0.89	[0.39, 2.00]

All analyses are weighted to be nationally representative. Model 2 adjusts for confounders measured at Time 1. Significant differences for individual categories within a set are only noted if the set is also significant at $p < .10$.

*$p<.05$

**$p<.01$