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Information Seeking From Media and Family/Friends Increases the Likelihood of Engaging in Healthy Lifestyle Behaviors

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Abstract

The amount of cancer-related information available to the general population continues to grow, yet its effects are unclear. This study extends previous cross-sectional research establishing that cancer information seeking across a variety of sources is extensive and positively associated with engaging in health-related behaviors. We studied how active information seeking about cancer prevention influenced three healthy lifestyle behaviors using a two-round nationally representative sample of adults ages 40–70 (n=1795), using propensity scoring to control for potential confounders including baseline behavior. The adjusted odds of dieting at follow-up were 1.51 [95% CI: 1.05 to 2.19] times higher for those who reported baseline seeking from media and interpersonal sources relative to non-seekers. Baseline seekers ate 0.59 [95% CI: 0.28, 0.91] more fruits/vegetable servings per day and exercised 0.36 [95% CI: 0.12 to 0.60] more days per week at one-year follow-up compared to non-seekers. The effects of seeking from media and friends/family on eating fruits/vegetables and exercising were independent of seeking from physicians. We offer several explanations for why information seeking predicts healthy lifestyle behaviors: information obtained motivates these behaviors; information sought teaches specific techniques;

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the act of information seeking may reinforce a psychological commitment to dieting, eating fruits/vegetables, and exercising.

Introduction

An estimated eight to thirty-five percent of cancers can be prevented through changes in lifestyle factors relating to fruit and vegetable consumption, avoiding obesity and overweight and physical activity. (Doll & Peto, 1981; Danaei et al, 2005; Colditz, Sellers, & Trapido, 2006). Research to understand the factors underlying the adoption of healthy lifestyle behaviors suggests that individual cognitions and intentions influence decision-making about healthful behaviors (Hagger, Chatzisarantis, & Biddle, 2002; Armitage, 2005, 2007; Bryan, Hutchinson, Seals & Allen, 2007; Blue, 2007; Wong, 2009; Smith-McLallen & Fishbein, 2009). There is a great deal of information available to the public concerning lifestyle behaviors, through media coverage of them, and through media and interpersonal sources of information they can seek out. Does the availability of such information influence the adoption of healthy behaviors? In line with uses and gratifications theorizing (Blumler & Katz, 1974), the public uses the media environment to meet an array of needs, which ultimately serve as the drivers of media use. Research has begun to examine the public's information-seeking experience with the growing body of publicly-available health information (Niederdeppe, Frosch & Hornik, 2008; Rains, 2008; Arora et al., 2008), and the public's interest in information related to prevention of chronic diseases including cancer (Finney Rutten, Squiers, & Hesse, 2007). Other research has identified people in the general population who vary in their likelihood of seeking information related to cancer prevention (Sullivan & Finney Rutten, 2009), their experiences with publicly-available cancer-related information (Arora, Hesse, Rimer et al., 2008), and information they encounter in news coverage (Jensen, Moriarty, Hurley & Stryker, 2010; Smith, Kromm & Klassen, 2010).

In this context, it seems reasonable that people interested in healthy living and disease prevention may use the media to acquire information to achieve healthier lifestyles. How this occurs and its effects remain the subject of current research. Other studies have focused on how different forms of information acquisition influence lifestyle behaviors: seeking by topic (Dolinsky et al., 2006; Mellon et al., 2006) or by source (Bright et al., 2005; Walji et al., 2005).

Cross-sectional evidence suggests a relationship between active information acquisition (seeking) and engaging in healthy behaviors (Kelly et al., 2010) however, research has been unavailable to show that the relationship is causal: that seeking influences behavior. Additionally unclear is the interplay of seeking from a clinician versus mass media and interpersonal sources on outcomes. The present study moves the examination of causality forward using nationally-representative longitudinal data and provides evidence that information seeking influences later adoption of healthy lifestyle behaviors. It also explores the role of information seeking from non-clinical sources versus medical professional sources in their effects on engaging in preventive health behaviors.

Information Seeking Behavior

The body of literature surrounding the effect of health information seeking on health behavior suggests that seeking may carry particular relevance for cancer (Johnson, 1997). Studies suggest that cancer information seeking is a pivotal element in health behavior decisions (Fox & Rainie, 2002; Niederdeppe et al., 2007). Other studies have indicated that information seeking may be positively associated with preventive and screening behavior (Dutta-Bergman, 2005; Shim, Kelly & Hornik, 2006). In these studies, the conceptualization of health information seeking has varied from seeking in general to more specific definitions that differentiate between active seeking and passive information acquisition.

In contrast to previous conceptualizations of seeking but consistent with Grunig (1997), we argue that seeking is not an undifferentiated behavior but involves actively looking for information about a specific topic. We are particularly interested in whether seeking from non-medical sources has the potential to be as influential as seeking from medical sources. As we have argued in Kelly et al., 2010, information seeking involves actively looking for information from specific sources. This effort is characterized by active pursuit of information beyond the information typically encountered through routine exposure to mediated and interpersonal sources (Niederdeppe et al., 2007). Defined as such, seeking may involve a host of behaviors related to the active acquisition of information about a specific topic through non-habitual media use or interpersonal conversation. This may range from search engine queries on the Internet or watching a newscast expected to carry relevant information, to asking family, friends or physicians questions about specific health topics outside the realm of typical conversation.

Information seeking about specific cancer-related prevention and screening behaviors have been cross-sectionally associated with engaging in those behaviors (Niederdeppe et al., 2007; Kelly et al., 2010), and positively related to improved lifestyle choices (Shim, Kelly, Hornik, 2006). In a nationally-representative study of American adults, Kelly et al. (2010) found that seeking was positively associated with dieting to maintain a healthy weight, exercise, and fruit/vegetable consumption. Building upon these findings and others suggesting that information seeking may represent an important factor in cancer-related prevention behaviors (Johnson, 1997; Dutta-Bergman, 2005; Niederdeppe et al., 2007), we propose that information seeking from non-clinical sources will predict increased likelihood of engaging in healthy behaviors.

The present study is part of a research program that seeks to understand how information obtained from non-clinical information sources influences decision-making across the cancer continuum, prevention, screening and post-diagnosis treatment and survivorship behaviors. In this article, we report results of a general population survey asking about information seeking related to prevention behaviors, focusing on three healthy lifestyle behaviors: dieting among overweight/obese adults, fruit/vegetable consumption, and exercise. We test the following hypotheses:

> H1A: Seeking about dieting from non-clinical sources at baseline increases the likelihood of dieting at follow-up among overweight/obese individuals, adjusting for baseline behavior and other potential confounders.

H1B: Seeking about fruits/vegetables from non-clinical sources at baseline increases the likelihood of consuming fruits/vegetables at follow-up, adjusting for baseline behavior and other potential confounders.

H1C: Seeking about exercise from non-clinical sources at baseline increases the likelihood of exercising at follow-up, adjusting for baseline behavior and other potential confounders.

Additionally, the over-time effects of seeking from non-clinical sources versus medical professional sources have remained relatively unexplored. Cross-sectionally, it appears that the general population uses a range of non-clinical sources (mass media, interpersonal conversations, internet) in addition to consulting physicians (Kelly et al., 2010). We therefore expected seeking from non-clinical sources to predict healthy behaviors beyond the effect of seeking from medical professional sources.

H2A: Seeking about dieting from non-clinical sources at baseline increases the likelihood of dieting at follow-up among overweight/obese individuals beyond the effect of seeking from medical professional sources.

H2B: Seeking about fruits/vegetables from non-clinical sources at baseline increases the likelihood of consuming fruits/vegetables at follow-up beyond the effect of seeking from medical professional sources.

H2C: Seeking about exercise from non-clinical sources at baseline increases the likelihood of exercising at follow-up beyond the effect of seeking from medical professional sources.

Data Collection

The study sample is a nationally-representative cohort of 40–70-year-olds, for whom cancer screening behaviors are most relevant (although this study reports only on lifestyle behaviors, the basis for the sample was screening test relevance). Data was collected by Knowledge Networks (KN) through an online survey. KN selects and maintains a list-assisted, national random digit dial-recruited panel of the U.S. population. Households are recruited into the panel through RDD techniques; once a household is selected, one adult is recruited to complete periodic surveys. Households without home internet access are given hardware and internet access. For this survey, a sample was selected from the KN panel.

Data was collected weekly over two years, with a pre-test before baseline launch (N=211), baseline data collected October2005-October2006 (N=2489), and follow-up data collected October2006-November2007 (N=1812). Follow-up questionnaires were submitted to individual respondents the same week, one year following baseline. The baseline survey completion rate among those asked to participate was 73%, and the follow-up survey completion rate was 73% of those in baseline. The final sample includes only respondents for whom we have follow-up data (N=1812).

The institutional review board of the University of Pennsylvania approved this study.

Measures

.All measures were based on self-reports assessed at baseline and follow-up. *Dieting:* "During the past 30 days, have you controlled your diet to lose weight?" [Yes/No]. *Fruit/vegetable consumption:* "In the past week, on average, how many servings of fruit did you eat or drink per day? Please include 100% fruit juice, and fresh, frozen or canned fruits." "In the past week, on average, how many servings of vegetables did you eat or drink per day, not counting potatoes? Please include green salad, 100% vegetable juice, and fresh, frozen or canned vegetables." Six response options were provided for each question, from "Less than one serving per day" to "5 or more servings per day." The response options were treated as interval-level variables, with the first treated as zero and 5 or more servings per day treated as 5. Responses for the two questions were summed for a final variable with a range 0–10. *Exercise*: "During an average week are you able to exercise at least once per week?" [Yes/No]. If yes, respondents were asked "During an average week, how many days do you exercise?" and entered a number between 0–7. Responses to the two questions were merged: "No's" on the first question were coded as 0; "Yes's" were coded as the value they responded on the second question.

The independent variables were measured in three steps, to allow for a distinction between active seeking and non-purposive information attainment. Seeking was defined as actively looking for information relevant to healthy lifestyle decisions (Shim, Kelly & Hornik, 2006; Niederdeppe et al., 2007). "Some people are actively looking for information about [controlling their diet to lose weight/fruits and &vegetables/exercise] for health while other people just happen to hear or come across such information. Some people don't come across information about [controlling their diet to lose weight/fruits and vegetables/exercise] for health at all." "Thinking about the past 12 months, did you actively look for information about [controlling your diet to lose weight/fruits and vegetables/exercise] for health?" Response options included "Yes," "No," and "I don't recall." If yes, respondents were asked, "How many times were you actively looking for information about [controlling your diet to lose weight/fruits and vegetables/exercise] for health in the past 12 months, from each of the following sources: [doctor (or other medical professional)/family, friends or co-workers/television or radio/newspapers, magazines or newsletters/the internet/other source]." Response options, by source: Not at all/1 or 2 times/3 times or more/I don't recall. Seeking about each topic by source was coded as a 3-level ordinal variable, where "Not at all," "I don't recall," and respondents claiming they had never actively looked for information about the topic were coded as 0, those who reported seeking 1 or 2 times were coded 1, and 3 times or more coded as 2. The three-level variables for family/friends/co-workers, television/radio, newspapers/magazines, and the internet were then averaged to create a single measure of seeking from media and interpersonal sources. This variable was dichotomized; 0 represents no seeking and 1 indicates seeking about [diet/fruits&vegetables/exercise] at least one time from at least one media or non-clinical interpersonal source. This was our primary independent variable. A separate measure captured seeking from doctors/other medical professionals; this was treated as a three-level ordinal variable, and was used for comparative effects analyses described below.

In addition to the seeking variables, demographic and psychometric measures were entered into the propensity model as potential confounders, including: general and health-specific media use, health knowledge, health-related behavior, health orientation, cancer fatalism, cancer history, and family cancer history. The full questionnaire and details about the propensity models are available upon request from the first author.

Analytic Approach

This study examined the effects of information seeking from media and non-clinical interpersonal sources about a specific behavior on performing that behavior. To conclude that information seeking affected a given outcome, two conditions were required. First, we must establish that there is a statistically significant association between information seeking at baseline and the behavior at follow-up, controlling for baseline behavior. Regression models were used to determine whether this condition was met. Second, we must demonstrate that the association is not a function of any potential confounding variable(s). To control for confounders, we used propensity scoring. The propensity score is also called a balancing score; it allows for comparison of follow-up healthy lifestyle behavior of individuals who are equally likely to seek at baseline, contingent on the measured confounders. Propensity scoring approximates experimental designs by comparing respondents who are matched on the probability of reporting seeking conditional on observed covariates (Rosenbaum & Rubin, 1983). Seeking effects on behavior are examined conditional on the propensity score. Propensity scoring has advantages over traditional regression-based methods by allowing the determination of whether covariates are balanced between conditions before proceeding with the estimation of treatment effects (Rosenbaum, 2002; Yanovitzky, Hornik & Zanutto, 2008). We could claim that the evidence was consistent with a seeking effect on behavior if the propensity-controlled regression models produced statistically-significant seeking coefficients.

Fifty-six covariates, including baseline health behavior, were entered as dummy variables into logistic regression models predicting likelihood of seeking about each of the three behaviors (dieting, fruit/vegetable consumption, and exercise) to generate the propensity score. Dummy variable regression was selected to address potential issues in the functional form of the relationship of each variable to seeking. Individuals equal in propensity to seek at baseline, controlling for potential confounders, are then compared on outcome behaviors. Because it is important to compare only individuals with similar propensities, and following standard propensity modeling approaches, we eliminated seeking cases which had propensity scores higher than the highest non-seeking cases, and non-seeking cases which had propensity scores lower than the lowest seeking cases. Next the propensity scores are divided into quintiles, with individuals in each quintile having approximately equal probabilities of having sought information. We can be satisfied that the propensity scores adequately adjust for observed covariates if there is no association between propensity to seek and each covariate – that is, seekers and non-seekers in each propensity quintile are equally likely to be in any level of each observed covariate. In addition to the 56 variables on which the propensity model was generated, we checked for balance on psychosocial variables derived from the Reasoned Action Approach (Fishbein and Ajzen, 2010). Final treatment effects were estimated by regressing the outcome behavior (logistic for dieting;

OLS for fruit/vegetable and exercise) on seeking and propensity (using dummy indicators for the propensity quintiles). We also tested the interaction of propensity quintile dummy indicators and seeking; we eliminated interactions that were not significant as a set.

A particular concern in our analysis of the effects of seeking from non-clinical sources was whether the information seeking from non-clinical sources was merely a surrogate for seeking from clinical sources, which are actually influential. To test this, we performed supplementary analyses to see whether adding the variable for seeking information about the topic from doctors or other medical professionals to the propensity-controlled regression models eliminated the effects of the non-clinical seeking measure. The non-clinical seeking hypothesis would be supported if the coefficient for seeking from media and non-clinical interpersonal sources remained significant after this addition.

Stata 10 survey (SVY) module (Statacorp, 2007) was used for analysis. Missing data on covariates was multiply imputed (Allison, 2001; Little & Rubin, 2002). The median item response rate for the full set of covariates (56) was 100%; 14.2% of respondents skipped one item, 5.3% skipped 2 or more items. We used the ICE module (Royston, 2005) to conduct multiple imputations; consistent with Rubin and others' recommendations, five imputed data sets were generated. This procedure was conducted independently for each of the three outcome behaviors. We used the MIM module (Galati, Royston, & Carlin, 2007) to combine results from models run on each imputation. Post-stratification techniques were used to weight the sample at follow-up to the Current Population Study estimates of the U.S. population.

Results: Descriptive Statistics[1]

Approximately forty percent of overweight/obese respondents reported dieting to control their weight at both survey time points (baseline: 42.8%, follow-up: 39.4%), and there is some consistency in dieting behavior (kappa=.37 [95% CI: 0.35, 0.40]). Fruit/vegetable consumption was stable across time periods: the mean number of fruits/vegetable portions consumed daily at baseline was 3.63[95% CI: 3.57, 3.69]; at follow-up the mean was 3.61 [95% CI: 3.55, 3.67] (r=.64 [95% CI: 0.62, 0.66]). On average, individuals exercised 2.64 days per week at baseline [95% CI: 2.51, 2.77], and 2.60 days at follow-up [95% CI: 2.55, 2.65] (r=0.63[95% CI: 0.62, 0.66]). Additional descriptive statistics, including sample demographic characteristics, are found in Table 1.

Seeking from non-clinical sources and media about healthy behaviors is widespread. Thirty-five percent (35.1%) of respondents report having sought about fruit/vegetables from at least one non-clinical source, with just one in eight (12.5%) reporting seeking from the internet and nearly one in three from friends and family (28.7%) and newspapers or magazines (29.9%); 19% reported seeking from a physician. Forty-four percent sought about exercise from non-clinical sources at baseline, with about one-third having sought from newspapers/magazines (30.3%), television/radio (34.1%), and family/friends (35.5%), compared with

[1]The statistics reported in this section were run on the full samples that correspond to those that were used in the treatment analyses for each behavior. That is, data were multiply imputed and then filtered as appropriate for the behavior. Diet: N=1282, imputed 5 times = 6410; F&V: N=1780, imputed 5 times = 8900 EX: N=1795, imputed 5 times = 8975.

less than one-third who sought from the internet (28.0%) or from physicians (27.4%). Forty-four percent reported seeking about dieting from non-medical sources, while 28% sought from clinicians (Figure 1).

Results: Diet

The sample was reduced to include only respondents who were overweight/obese, determined by BMI≥25 as calculated by self-reported height and weight, and who had valid responses to the outcome measure at baseline and follow-up (N=1282).

Baseline seekers were nearly three times more likely than non-seekers to diet at follow-up (OR=2.70 [95% CI: 2.14 to 3.42]) (Table 2). After adjusting for baseline dieting, baseline seekers were almost twice as likely as non-seekers to report dieting at follow-up (OR=1.85 [95% CI: 1.43 to 2.39]) (Table 2). These findings satisfied our first criterion for establishing seeking effects.

Next we computed propensity scores from 56 potential confounders, including baseline fruit/vegetable consumption and exercise. There was some non-overlap between seekers and non-seekers, so we removed the 39 cases above the lowest maximum and below the highest minimum[2]. We ran a logistic regression model predicting dieting behavior at follow-up from baseline seeking and four dummy indicators for the seeking propensity quintiles[3],[4]. Controlling for potential confounders, those who reported seeking from media and non-clinical sources at baseline were 51% more likely to report having dieted at follow-up compared to non-seekers (OR=1.51 [95% CI: 1.04–2.20]) (Table 2). When seeking from healthcare professionals was added to a model with seeking from media and interpersonal sources, the latter (media/interpersonal seeking OR=1.49 [95% CI: 0.96,2.31]) was only marginally significant while the former was not significant (OR=1.02 [95% CI: 0.76,1.39]). In this case we could not separate the effects of seeking from doctors/medical professionals and seeking from non-clinical sources because the two behaviors were highly associated (r=.86, p<.001).

Results: Fruit and vegetable consumption

Baseline seekers ate more fruits/vegetables at follow-up (b=1.14 [95% CI: 0.91,1.37]) (Table 2). Seeking remained a unique contributor to fruit/vegetable consumption at follow-up after controlling for baseline behavior (seeking b=.39 [95% CI: 0.21,0.58]).

[2]The minimum and maximum values from the last imputed dataset were selected for removal; those respondents were removed from all imputed datasets to maintain consistency across datasets. This procedure was repeated for all three analyses (diet, exercise, fruit/vegetable).

[3]We found that several variables were not fully balanced with the propensity score. That is, the distribution of respondents for each potential confounder was not equal across propensity quintiles. We added these variables, along with the propensity, to the treatment effects model to make sure that our claims were not sensitive to mis-specification of the propensity model. Results were consistent with those described, indicating the odds of dieting at follow-up were 1.52 [95% CI: 1.04 to 2.20] higher for seekers from media and non-clinical interpersonal sources compared with non-seekers.

[4]We conducted an additional nested model that added the interaction of seeking and propensity quintiles. A likelihood ratio test indicated that the interaction terms did not significantly contribute to a change in likelihood (F (4, 936.7) = .80, *n.s.*), and these terms were thus removed.

The propensity-controlled model[5,6] (Table 2) indicated that seekers ate on average nearly half a serving of fruits/vegetables more per day (b=0.46 [95% CI: 0.19,0.72]) compared to non-seekers (Table 2). The effect of seeking from media and non-clinical interpersonal sources held up even when seeking from healthcare providers was added to the model (media/interpersonal b=.60, [95% CI: 0.54,0.66]). Seeking from healthcare providers in the combined model was negatively associated with fruit/vegetable consumption but this effect was not significant (b=−0.22 [95% CI: −0.48,0.04]).

Results: Exercise

Baseline seekers exercised on average one day per week more than non-seekers (b=.97 [95% CI: 0.74,1.21]). After controlling for baseline exercise, seekers exercised on average nearly one half-day more per week than non-seekers (b=.40 [95% CI: 0.19,0.60]; Table 2). An OLS regression model predicting frequency of exercise at follow-up from baseline exercise and seeking and four dummy indicators for the seeking propensity quintiles found that compared with non-seekers, controlling for 56 potential confounders, seekers exercised on average more than one-third day more per week (b=.37 [95% CI: 0.16,0.57). The effect of seeking from media and non-clinical interpersonal sources held up even when seeking from healthcare providers was added to the model (media/interpersonal b=.36 [95% CI: 0.12,0.60). Seeking from healthcare providers was not significant (b=.01 95% CI: −0.18,0.20).

Discussion and Limitations

Our results add to the evidence that information seeking about specific topics influences healthy behaviors, by complementing available cross-sectional results. We can offer several explanations for why seeking information predicts healthy behaviors one year later. First, it is possible that the information obtained through seeking teaches specific strategies to engage in the healthy behaviors: for example, choosing low-fat or fat-free milk and other low-fat diet tips for would-be dieters. It is also possible that people may be gaining information that motivates the adoption of healthy behaviors. Information that may be motivating is likely to vary by individual, but examples may include risk statistics, linking healthy lifestyle behaviors with diseases such as cancer, and positive role models engaging in the behaviors. Related to motivation is the idea that the act of seeking information may reinforce a psychological commitment to engaging in these behaviors. Finally, information seeking from interpersonal and social media may result in a perception of social support that contributes to the effects of seeking on behavior.

This study provides evidence that seeking from non-clinical sources predicts exercise and fruit/vegetable consumption above and beyond the influence of information seeking from

[5]We conducted an additional nested model that added the interaction of seeking and propensity quintiles. A likelihood ratio test indicated that the interaction terms did not significantly contribute to a change in likelihood (F (4, 1000) = .17, *n.s.*), and these terms were removed.

[6]We found that two variables were not fully balanced with the propensity score. We added these variables, along with the propensity quintiles, to the treatment effects model. Results were consistent with those described, indicating that seekers from media and non-clinical interpersonal sources ate on average 0.46 more servings of fruits and vegetables than non-seekers (b=.46, p<.001).

physicians and other medical professionals. This is an important finding that reinforces the role of the public information environment as an influence on health behaviors.

The longitudinal design and analysis techniques used allow us to claim with relative confidence both the direction and the size of the effect of information seeking on the three outcome behaviors. Nevertheless, the study is subject to some limitations, which we address now. One possible rival hypothesis is that rather than reflecting a true media effect, seeking may reflect motivation to engage in the behavior which affects seeking earlier and adoption of the behavior later, thus accounting for the observed lagged associations. We sought to test this rival hypothesis; we did not measure motivation, but did measure intention to engage in our three target behaviors. At baseline, we measured intention to diet to lose weight, to eat five or more servings of fruits/vegetables most days, and to exercise at least three times per week in the next year. The correlation of baseline intention and seeking was moderate for all three outcomes (fruit/vegetable=0.29; exercise=0.32; dieting=0.41). Using intention as a proxy for motivation, we re-ran the models to include the following predictors: baseline behavior, baseline seeking from media and non-clinical interpersonal sources, dummy indicators for propensity quintiles, and intention and related variables.[7] The effect of seeking was reduced but remained significant for fruit/vegetable consumption and exercise after controlling for these variables (f&v: b=.42, p<.01; exercise: b=.28, p<.01). but continued to be not significant for dieting (OR=1.3, *n.s.*).[8] It remains possible that other, unmeasured, confounders, account for the observed longitudinal relationship.

Another source of concern may be related to the representativeness of the sample. Although Knowledge Networks recruits the internet-maintained panel from which our sample was randomly drawn through accepted RDD techniques (Knowledge Networks, 2007), and we used post-stratification weighting to reflect the U.S. population, we also sought to establish the similarity of the sample to the general population by comparing raw (unweighted) distributions in the sample to the population (Table 1). Because data collection was internet-based, we were particularly concerned that the sample not be skewed in terms of internet access and familiarity. Two-thirds of our sample (66%) had internet access at home at recruitment, compared with just under two-thirds (62%) of the general population (Harrigan & Smith, 2007). We further compared the prevalence of the three outcome behaviors in our sample to those reported by the CDC's Behavioral Risk Factor Surveillance System (BRFSS), and find substantial overlap in the mean number of fruits/vegetables consumed daily (Table 1). Our exercise and dieting behavior questions were substantially different from those used in the BRFSS. Our sample claimed to exercise about a half day more per week than the BRFSS sample, but the BFRSS questionnaire addressed not just any exercise but moderately intense exercise, or moderate exercise, in separate questions. Our dieting question was not comparable to the BFRSS question. However we were able to compare our

[7]Related variables: perceived behavioral control, injunctive norm, descriptive norm, attitude (good/bad), attitude (pleasant/unpleasant), beliefs that eating fruits and vegetables/exercising/maintain healthy weight: reduces colon cancer, heart disease, and breast/prostate cancer risks.

[8]We did not include intention as a potential confounder originally because its causal role is ambiguous. It could be a confounder or it could be a mediator between seeking and later behavior. If it is a confounder it is appropriate to adjust for it; if it is a mediator adjusting for it will cause the seeking and behavior relationship to be underestimated. The original results can be viewed as a more liberal version of the analysis; the version controlling for intention a conservative version. Even with the conservative version, we continued to see effects on two of the three outcomes, and non-significant but consistent effects on the third.

sample and the BFRSS sample on percentage overweight/obese, and there was fairly close comparability. We are satisfied that our sample is reasonably representative of the U.S. population aged 40–70 years.

Perhaps the biggest concern this paper highlights is that although we found positive effects of information seeking on three healthy lifestyle outcomes, in absolute terms, the rates of these behaviors remain unsatisfactorily low, failing to meet CDC guidelines. Even at follow-up, daily fruit/vegetable consumption averaged just 3.8 portions, individuals exercised on average 2.7 days per week, and 41.7% of overweight/obese respondents were dieting to control their weight. Moreover, we do not know whether dieting resulted in weight loss. Our study only supports a claim that information seeking from public media and interpersonal sources positively influences these behaviors, not that they reach adequate levels.

Given these findings, future research should consider what health promoters can do to motivate seeking across the population. Our previous research has demonstrated that some demographic characteristics (female gender, white ethnicity, and education) are associated with seeking (Kelly et al., 2010); however, we do not know to what extent seeking is an enduring personality trait or style, or whether it is a situation-specific behavior. Understanding how to motivate seeking is particularly important given a move toward internet-based health promotion, which largely presumes that people using the internet will be actively seeking information. Additional research to understand more details about the specific sources and content of the information used for decision-making also would be warranted. Such research could consider the quality of the information available in the public information environment.

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References

Allison, PD. Missing data. Thousand Oaks, CA: Sage; 2001.

Armitage CJ. Can the theory of planned behavior predict the maintenance of physical activity? Health Psychology. 2005; 24(3):235–245. [PubMed: 15898858]

Armitage CJ. Effects of an implementation intention-based intervention on fruit consumption. Psychology and Health. 2007; 22(8):917–928.

Arora NK, Hesse BW, Rimer BK, Viswanath K, Clayman ML, Croyle RT. Frustrated and confused: The American public rates its cancer-related information-seeking experiences. Journal of General Internal Medicine. 2008; 23(3):223–228. [PubMed: 17922166]

Blue CL. Does the theory of planned behavior identify diabetes-related cognitions for intention to be physically active and eat a healthy diet? Public Health Nursing. 2007; 24(2):141–150. [PubMed: 17319886]

Blumler, JG.; Katz, E. The uses of mass communications: Current perspectives on gratification research. Beverly Hills: Sage; 1974.

Bright MA, Fleisher L, Thomsen C, Morra ME, Marcus A, Gehring W. Exploring e-Health usage and interest among cancer information service users: The need for personalized interactions and multiple channels remains. Journal of Health Communication. 2005; 10(S1):35–52. [PubMed: 16377599]

Bryan A, Hutchinson KE, Seals DR, Allen DL. A trandisciplinary model integrating genetic, physiological, and psychological correlates of voluntary exercise. Health Psychology. 2007; 26(1): 30–39. [PubMed: 17209695]

Centers for Disease Control. Cancer fact sheet. 2002a. Available at: http://www.atsdr.cdc.gov/COM/cancer-fs.html

Centers for Disease Control. HHS Launches New Campaign to Encourage Physical Activity and Healthy Behaviors for Kids [Press release]. 2002b. Retrieved from http://www.cdc.gov/media/pressrel/r020717.htm

Centers for Disease Control. Behavioral risk factor surveillance system: 2005 survey data. 2005. Available at: http://www.cdc.gov/brfss/technical_infodata/surveydata/2005.htm

Colditz GA, Sellers TA, Trapido E. Epidemiology — identifying the causes and preventability of cancer? Nature Reviews Cancer. 2006; 6(1):75–83.10.1038/nrc1784

Danaei G, Vander Hoorn S, Lopez AD, Murray CL, Ezzati M. Causes of cancer in the world: comparative risk assessment of nine behavioural and environmental risk factors. Lancet. 2005; 366(9499):1784–1793.10.1016/S0140-6736(05)67725-2 [PubMed: 16298215]

Dolinsky CM, Wei SJ, Hampshire MK, Metz JM. Breast cancer patients' attitudes toward clinical trials in radiation oncology clinic versus those searching for trial information on the internet. Breast Journal. 2006; 12:324–330. [PubMed: 16848841]

Doll R, Peto R. The causes of cancer; quantitative estimates of avoidable risks of cancer in the United States today. Journal of the National Cancer Institute. 1981; 66:1191–1308. [PubMed: 7017215]

Dutta-Bergman M. Developing a profile of consumer intention to seek out additional information beyond a doctor: The role of communicative and motivation variables. Health Communication. 2005; 17:1–16. [PubMed: 15590339]

Finney Rutten LJ, Squiers LB, Hesse B. Cancer-related information sought by the general public: Evidence from the National Cancer Institute's Cancer Information Service, 2002–2003. Journal of Cancer Education. 2007; 22:91–98. [PubMed: 17605622]

Fishbein, M.; Ajzen, I. Predicting and Changing Behavior: The Reasoned Action Approach. New York: The Psychology Press/Taylor and Francis; 2010.

Fox, S.; Rainie, L. Vital decisions: How internet users decide what information to trust when they or their loved ones are at risk. Washington, DC: Pew Internet and American Life Project; 2002. at: http://www.pewinternet.org/pdfs/PIP_Vital_Decisions_May2002.pdf [Accessed online October 30, 2008]

Galati, JC.; Royston, P.; Carlin, JB. MIM stata module to analyze and manipulate multiply imputed datasets. 2007. Available at: http://ideas.repec.org/c/boc/bocode/s456825.html#author

Grunig, JE. A situational theory of publics: Conceptual history, recent challenges and new research. In: Moss, D.; MacManus, T.; Vercic, D., editors. Public relations research: An international perspective. London: International Thomson Business Press; 1997. p. 3-48.

Haggar MS, Chatzisarantis NLD, Biddle SJH. A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of attitudinal variables. Journal of Sport and Exercise Psychology. 2002; 24:3–32.

Horrigan, JB.; Smith, A. Broadband adoption. Washington, DC: Pew Internet and American Life Project; 2007. at: http://pewinternet.org/pdfs/PIP_Broadband%202007.pdf [Accessed online May 6, 2008]

Hornik, R.; Niederdeppe, J. Information Scanning. Donsbach, W., editor. International Encyclopedia of Communication; Oxford: Blackwell; 2008.

Jensen JD, Moriarty CM, Hurley RJ, Stryker JE. Making sense of cancer news coverage. A comparison of three comprehensive content analyses. Journal of Health Communication. 2010; 15(2):136–151. [PubMed: 20390983]

Johnson, JD. Cancer-related information seeking. Cresskill, NJ: Hampton Press; 1997.

Kelly B, Niederdeppe J, Hornik R. Validating measures of scanned information exposure in the context of cancer prevention and screening behaviors. Journal of Health Communication. 2009; 14(8):721–740. [PubMed: 20029707]

Kelly BJ, Hornik RC, Romantan A, Schwartz J, Armstrong K, DeMichele A, Fishbein M, Gray S, Hull S, Kim A, Nagler R, Niederdeppe JD, Ramirez A, Smith-McLallen A, Wong N. Cancer

information scanning and seeking in the general population. Journal of Health Communication. 2010; 15(7):734–753. [PubMed: 21104503]

Little, RJA.; Rubin, DB. Statistical Analysis with Missing Data. 2. New York: John Wiley & Sons; 2002.

Mellon S, Berry-Bobovski L, Gold R, Levin N, Tainsky MA. Communication and decision-making about seeking inherited cancer risk information: Findings from female survivor-relative focus groups. Psychooncology. 2006; 15:193–208. [PubMed: 16100704]

Niederdeppe J, Hornik RC, Kelly BJ, Frosch DL, Romantan A, Stevens RS, Barg FK, Weiner JL, Schwartz JS. Examining the dimensions of cancer-related information seeking and scanning behavior. Health Communication. 2007; 22(2):153–167. [PubMed: 17668995]

Niederdeppe J, Frosch DL, Hornik RC. Cancer news coverage and information seeking. Journal of Health Communication. 2008; 13:181–199. [PubMed: 18300068]

Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. JAMA. 2006; 295:1549–1555. [PubMed: 16595758]

Rains SA. Seeking health information in the information age: The role of internet self-efficacy. Western Journal of Communication. 2008; 72(1):1–18.

Rosenbaum PR, Rubin DB. The central role of the propensity score in observational studies for causal effects. Biometrika. 1983; 70(1):41–55.

Rosenbaum, PR. Observational studies. 2. New York: Springer Verlag; 2002.

Royston P. Multiple imputation of missing values: update. Stata Journal. 2005; 5:188–201.

Shim M, Kelly B, Hornik R. Cancer information scanning and seeking behavior is associated with knowledge, lifestyle choices, and screening. Journal of Health Communication. 2006; 11:157–172. [PubMed: 16641081]

Smith KC, Kromm EE, Klassen AE. Print news coverage of cancer. What prevention messages are conveyed when screening is newsworthy? Cancer Epidemiology. in press.

Smith-McLallen A, Fishbein M. Predicting intentions to engage in cancer prevention and detection behaviors: Examining differences between black and white adults. Psychology, Health and Medicine. 2009; 14(2):180–189.

Statacorp. Stata survey data reference manual: Release 10. College Station, TX: Stata Press; 2007.

Sullivan HW, Finney Rutten LJ. Cancer prevention information seeking: A signal detection analysis of data from the Cancer Information Service. Journal of Health Communication. 2009; 14:785–796. [PubMed: 20029711]

Walij M, Sagaram S, Meric_Bernstam F, Johnson CW, Bernstam EV. Searching for cancer-related information online: Unintended retrieval of complementary and alternative medicine information. International Journal of Medical Information. 2005; 74:685–693.

Westcott, S. A Journey Into Cancer's Causes. Anchorage: Alaska Native Health Board; 1999. p. 11

Wong N. Investigating the effects of cancer risk and efficacy perceptions on cancer prevention adherence and intentions. Health Communication. 2009; 24(2):95–105. [PubMed: 19280453]

Yanovitzky, I.; Hornik, R.; Zanutto, E. Estimating causal effect in observational studies: The propensity score approach. In: Hayes, AF.; Slater, MD.; Snyder, LB., editors. The Sage sourcebook of advanced data analysis methods for communication research. Thousand Oaks, CA: Sage; 2008.

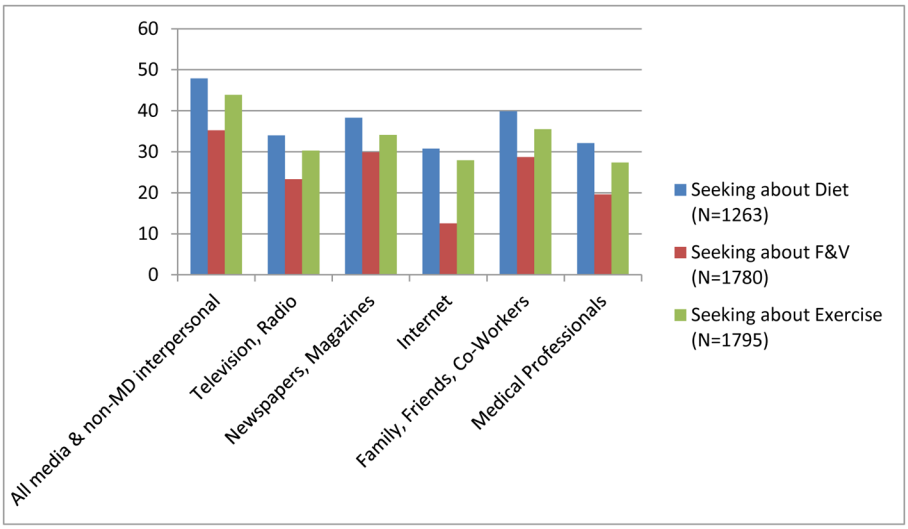

Figure 1. How much seeking is there?

Percentage of sample seeking by topic, from each source and across all media and non-clinician interpersonal sources.

Table 1

Sample Characteristics and External Comparisons

	SSB Survey N=1,812		*BRFSS Healthy Behaviors N=201,966*		*Pew Internet N=2,200*
	Weighted Estimates	**95% CI**	**Weighted Estimates**	**95% CI**	**Weighted Estimates**
Demographics					
Gender					
% Female	**51.51**	(48.67 – 54.36)	**51.40**	(50.93 – 51.8)	-
Mean Age	**52.79**	(52.32 – 53.26)	**52.64**	(52.56 – 52.71)	-
Race/Ethnicity					
% White, Non-Hispanic	**72.93**	(70.05 – 75.8)	**73.58**	(73.12 – 74.04)	-
% Black, Non-Hispanic	**10.91**	(8.96 – 12.86)	**9.15**	(8.89 – 9.42)	-
% Latino	**10.22**	(8.12 – 12.33)	**11.45**	(11.05 – 11.86)	-
Income, Middle 50% ($)	**41,000**	-	**39,088**	-	-
Education (%)					
Less than High School	**2.26**	-	**3.06**	-	-
Some High School	**6.62**	-	**5.86**	-	-
High School Diploma	**28.7**	-	**30.56**	-	-
Some College	**27.54**	-	**26.59**	-	-
College Diploma or Higher	**34.88**	-	**33.93**	-	-
HH Internet Access (%)	**63.87**	(61.07 – 66.66)		-	**62.00**
Healthy Lifestyle Behavior					
Mean daily servings of fruits & vegetables	**3.63**	(3.49 – 3.77)	**3.49**	(3.49 – 3.51)	-
Mean days exercise, weekly	**2.63**	(2.50 – 2.76)	**1.94**	(1.93 – 1.95)	-
% overweight/obese (BMI>24.9)	**72.23**		**66.38**		
Among overweight/obese, % dieting	**42.82**	(39.51 – 46.13)	**84.19**	(0.84 – 0.85)	-

Table 2

Lagged Relationships of Information Seeking with Dieting, Fruit and Vegetable Consumption, and Exercise

	Dieting, yes/no (Logistic Regression)				Fruit & Vegetable, 0–10/day (OLS Regression)				Exercise, 0–6 days/week (OLS Regression)			
	Model 1 OR (95% CI)	**Model 2 OR (95% CI)**	**Model 3 OR (95% CI)**	**Model 4 OR (95% CI)**	**Model 1 b (95% CI)**	**Model 2 b (95% CI)**	**Model 3 b (95% CI)**	**Model 4 b (95% CI)**	**Model 1 b (95% CI)**	**Model 2 b (95% CI)**	**Model 3 b (95% CI)**	**Model 4 b (95% CI)**
Baseline media + interpersonal seeking	**2.70 (2.14 to 3.42)**	**1.85 (1.43 to 2.39)**	**1.51 (1.04,2.20)**	1.49 (0.95, 2.33)	**1.14 (0.91,1.37)**	**0.39 (0.21, 0.58)**	**0.46 (0.19, 0.72)**	**0.60 (0.28, 0.91)**	**0.97 (0.74,1.21)**	**0.40 (0.19, 0.60)**	**0.37 (0.16, 0.57)**	**0.36 (0.12, 0.60)**
Baseline dieting, F&V, or exercise behavior		**4.35 (3.37, 5.60)**	**3.62 (2.57, 5.09)**	**3.62 (2.58, 5.09)**		**0.63 (0.59, 0.67)**	**0.60 (0.54, 0.65)**	**0.60 (0.54, 0.66)**		**0.58 (0.56, 0.61)**	**0.59 (0.53, 0.64)**	**0.59 (0.53, 0.64)**
Baseline MD seeking				1.02 (0.76, 1.37)				−0.22 (−0.48, 0.04)				0.01 (−0.18,0.20)
N	1282	1282	1243	1243	1780	1780	1751	1751	1795	1795	1754	1754

Model 1: Lagged association, uncontrolled

Model 2: Lagged association, adjusting for baseline behavior

Model 3: Lagged association, adjusting for baseline behavior and propensity quintiles

Model 4: Lagged association, adjusting for baseline behavior, propensity quintiles, and seeking from doctors and medical professionals