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Anxiety symptoms prior to a prostate cancer diagnosis: Associations with knowledge and openness to treatment

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Abstract

Research suggests that anxiety may be a common response to a cancer diagnosis, but research is needed to examine anxiety before diagnosis. Anxiety before diagnosis may relate to the comprehension of relevant health information or openness to potential treatments. The present study examined anxiety and these outcomes in men who were waiting to learn of a prostate cancer diagnosis.

OBJECTIVES: One goal of this study was to determine if anxiety would increase as men came closer to learning the results of their prostate cancer biopsy. Another goal was to test if anxiety was associated with knowledge about prostate cancer or openness to different treatments.

METHODS: Men (N=265) who were facing a prostate cancer diagnosis were surveyed at two time points. Time 1 occurred at the time of biopsy and Time 2 occurred immediately before men received their biopsy result. At each time point, men reported their anxiety about prostate cancer and their biopsy result. At Time 2, they completed a knowledge test of information about prostate cancer and reported their openness to different potential treatments.

RESULTS: Anxiety symptoms increased as men came closer to learning their diagnosis. Also, higher anxiety was associated with lower knowledge and greater openness to particular treatments like surgery. Interactions showed that when anxiety increased from Time 1 to Time 2, having high or low knowledge mattered less to treatment openness.

CONCLUSION: Waiting for a cancer diagnosis is an important time period in which anxiety may increase and relate to information processing and openness to treatments.

Anxiety symptoms prior to a prostate cancer diagnosis: Associations with knowledge and openness to treatment

Every day thousands of people wait for information about their health. The information may range from mild (“you have a cold”) to severe (“you have cancer”). While many people

may experience some uncertainty while they wait for this information, those waiting for serious diagnoses may experience great distress. For example, research shows that the "waiting game" for cancer diagnoses is associated with the experience of intense distress including negative emotions like anxiety (e.g., Awsare et al., 2008; Maxwell et al., 2000; Saegrov & Halding, 2004; Scott, 1983; Thorne, Harris, Hislop, & Vestrup, 1999). Although this distress has been documented, we know little about its course (Poole, 1997). For example, as people wait, do they increase in distress? Moreover, how might distress relate to other events during this time, like the processing of relevant health information? In the present study, we investigate these questions in men who were waiting to learn of a prostate cancer diagnosis.

When people receive a cancer diagnosis, research shows they experience a flood of negative emotions with anxiety being particularly prevalent (Burgess et al., 2005; Edwards & Clarke, 2004; Hughes, 1982; Linden, Vodermaier, MacKenzie, & Greig, 2012; Saegrov & Halding, 2004; Stanton & Snyder, 1993; Stark & House, 2000; van't Spijker, Trijsburg, & Duivenvoorden, 1997). While this research has examined negative emotions like anxiety after a diagnosis, research is needed to examine these emotions before a diagnosis. The phase right before a cancer diagnosis is important because it can be one of high anxiety (e.g., Maxwell et al., 2000; Saegrov & Halding, 2004; Scott, 1983; Thorne et al., 1999), with even higher levels than compared to after a diagnosis (Dale, Bilir, Han, & Meltzer, 2005; Fantini-Hauwel, Dauvier, Arciszewski, Antoine, & Manouvrier, 2011; Liao, Chen, Chen, & Chen, 2008). Assessing emotions like anxiety before diagnosis is also important because it may relate to individuals' processing and comprehension of relevant information. For example, in the area of breast cancer, one study found that increased cancer anxiety was related to biased information processing in women who had a high risk of the disease but were not yet diagnosed (Cameron & Reeve, 2006). This information processing could have effects on actual decisions one makes after a diagnosis (Denberg, Melhado, & Steiner, 2006).

Anxiety in prostate cancer diagnoses

Relative to diagnoses of breast cancer, there has been much less research on anxiety in people facing diagnoses of prostate cancer (Dale et al., 2005). The prostate cancer context is uniquely important because this cancer is specific to males, and research reveals gender differences in levels of cancer-related worry and anxiety (e.g., McQueen, Vernon, Meissner, & Rakowski, 2008). The research on anxiety in those facing prostate cancer diagnoses has also

been mixed. For example, some studies have shown that men who are undergoing screening are no more anxious than men who have never participated in screening (e.g., Carlsson, Aus, Wessman, & Hugosson, 2007; Essink-Bot et al., 1998). Little to no anxiety was found even in men who have an increased risk of prostate cancer or who have multiple screenings (Brindle et al., 2006; Carlsson et al., 2007; also see Wade et al., 2013). However, other research has painted a different picture (e.g., Gustafsson et al., 1995; Medd, Stockler, Collins, & Lalak, 2005). Some studies have found that screening increases anxiety or that men avoid screening because they are worried they will be diagnosed with prostate cancer (Cormier et al., 2002; Roumier et al., 2004). In a review of the literature, Dale and colleagues (2005) concluded that there were generally high levels of anxiety in at-risk men (e.g., age of 50 years and a first-degree relative who had been diagnosed with prostate cancer) who were undergoing screening. This finding was observed whether anxiety was measured as a state, sub-clinical or clinical levels, or as worry.

Importantly, these empirical inconsistencies may relate to the problem of measuring anxiety at only one time point. In other words, researchers may assess individuals only at screening but then as they wait for their diagnoses, their anxiety changes. This idea would fit with predictions stemming from the model of uncertainty navigation, which offers insight into how people respond to threatening, but not yet known, information (Sweeny & Cavanaugh, 2012). According to the model, as individuals approach uncertain, potentially threatening health information, they will increase in anxiety. Increases in anxiety may motivate bracing, a coping strategy in which individuals become more pessimistic in their expectations of the potentially threatening feedback (Shepperd, Grace, Cole, & Klein, 2005; Sweeny & Shepperd, 2007). To date, bracing has been investigated in mostly non-health domains (e.g., Shepperd, Ouellette, & Fernandez, 1996; Sweeny & Andrews, 2014) or hypothetical health domains (Taylor & Shepperd, 1998). In the present study, we were not assessing bracing per se, but rather testing its underlying mechanism – that is, will anxiety increase as people come closer to receiving an actual threatening diagnosis?

To date, only a handful of studies have measured anxiety more than once as men wait for a prostate cancer diagnosis. Zisman and colleagues assessed men's anxiety about biopsy at two time points before they learned their diagnosis (Zisman, Leibovici, Kleinmann, Siegel, & Lindner, 2001). They found that anxiety peaked at the second time point, immediately before the men learned their results. Another study found that men's anxiety levels (as measured by the

State-Trait Anxiety Inventory) before biopsy and then again right before they learned their results were similar with both being significantly higher than when they had decided to have a biopsy (Saraçoğlu, Ünsal, Taşkın, Sevinçok, & Karaman, 2012). Two other studies have assessed whether clinical anxiety (using the Hospital Anxiety and Depression Scale) was present in men having biopsies (Awsare et al., 2008; Macefield et al., 2009). Although clinical anxiety was not present in either study (even for men with higher PSA levels; Macefield et al., 2009), as men approached diagnosis, they were more likely to say waiting for results was the most stressful aspect of the biopsy process (Awsare et al., 2008).

In the present study, we test the basic idea that men will increase in anxiety as they come closer to learning their cancer diagnosis. We measured anxiety in terms of the men's intrusive thoughts about prostate cancer and their fear about the biopsy result revealing cancer. Along with possibly replicating others' findings (e.g., Zisman et al., 2001), we extend the existing research by addressing the question of whether there may be associations with this anxiety. For example, when individuals undergo a screening process, they are given information about the screening test, the cancer, and available treatment options should they have cancer. How might anxiety be associated with the processing of this information? Historically, researchers have debated about how negative affective states influence information processing, with some experimental research showing it leads to more careful processing (e.g., Schwarz, 2000; Schwarz, Bless, & Bohner, 1991), and others showing it leads to less careful processing (e.g., Conway & Giannopoulos, 1993; Lewinsohn & Mano, 1993; Raghunathan & Pham, 1999). Unfortunately, this research has not examined specific negative emotions or actual health contexts. Of the few studies of this nature, evidence is growing to suggest that higher anxiety will be associated with lower attention and comprehension (e.g., Cameron & Reeve, 2006; Lerman, Seay, Balshem, & Audrain, 1995). In the present study, we examine if anxiety is associated with participants' knowledge of information presented in a decision aid about prostate cancer. Examining this association in the context of waiting to learn of a cancer diagnosis would represent a novel contribution to research on negative emotions and information processing.

Along with information processing, anxiety may be associated with wanting to do particular cancer treatments. Generally, research supports the notion that when people feel worry or anxiety about cancer, they are motivated toward preventive action (e.g., Cameron & Reeve, 2006; Dillard et al., 2013; McCaul, Schroeder, & Reid, 1996), including prostate cancer

screening (Consedine, 2012). Although in prostate cancer, there is no one "best" treatment, some treatments may be perceived as more action-oriented. For example, surgery may be viewed as a more problem-focused approach while watchful waiting may be viewed as a more emotion-focused approach (Pickles et al., 2007). Related to this, research suggests that more invasive treatments for prostate cancer, like surgery, are preferred when people perceive internal and external pressure to 'fight' their cancer (Chapple et al., 2002). In the present study, if anxiety motivates an action-oriented approach to treatment, men who have more anxiety may evidence greater openness to a treatment like surgery and less openness to a treatment like watchful waiting.

Overview and hypotheses

In the present study, we examined men's symptoms of anxiety as they waited to learn whether they had prostate cancer. Symptoms of anxiety about prostate cancer and the biopsy result were assessed at two time points, both occurring before the men received a diagnosis of prostate cancer. We also examined whether anxiety at these two time points related to the men's knowledge of prostate cancer or their openness to different treatments. Based on the research described above, we had three hypotheses. First, we hypothesized that symptoms of anxiety would increase as men came closer to receiving their diagnosis. In other words, from Time 1 (i.e., having their biopsy) to Time 2 (i.e., right before they learned their biopsy result), men would significantly increase in anxiety. Second, we hypothesized a negative association between anxiety and knowledge. For example, at Time 2, men who had higher anxiety would have less knowledge of information we gave them about prostate cancer. Third, we hypothesized that anxiety may be associated with openness to particular treatments such that higher anxiety would be associated with a greater openness to surgery and a lower openness to watchful waiting.

Along with testing these three hypotheses, we also explored whether anxiety would interact with knowledge to influence openness to treatments. To date, anxiety has interacted with knowledge to influence behavior intentions in two previous studies, both done in the context of breast cancer (Cameron & Reeve, 2006; Dillard et al., 2013). Both studies suggested that when anxiety about cancer is high, individuals may be less likely to use knowledge to inform their behavior intentions.

Method

Participants

Men (N=1,552) facing a prostate cancer biopsy were approached to participate in the current study. Of the 1,028 who agreed, 1,023 completed the Time 1 survey (99%). Of this group, 334 men (33%) were later diagnosed with localized prostate cancer and therefore eligible to complete the Time 2 survey. Of these men, 265 (79%) completed the Time 2 survey which was just before they received their prostate cancer diagnosis from their physician, about one month (M=35.5 days) after Time 1.[1]

Of participants who received a diagnosis of prostate cancer, the average age was 63 years, 73% were White/Caucasian (of which 2% were Hispanic), 25% were Black/African American, and 2% American Indian, Asian/Asian American, or of Middle Eastern origin. Approximately 18% of the men reported a family history of prostate cancer.

Procedure

Participants were recruited from four VA Health Systems: Ann Arbor, MI, Durham, NC, Pittsburgh, PA, and San Francisco, CA. Institutional Review Board approval was obtained from all places. Clinical coordinators at the different sites identified patients who were either going to learn about an elevated prostate specific antigen (PSA) level and need for a biopsy or were being biopsied. Men completed Time 1 at either an appointment with their urologist when they were told they needed a biopsy (n=125) or at their actual biopsy appointment (n=140).[2] During reception, participants provided informed consent. They then reported their anxiety about prostate cancer and their test result. At this time point, participants were also randomized to receive one of two decision aids to take home.[3] Approximately one month later, at Time 2, participants completed the anxiety measures again as well as measures that assessed their knowledge from the decision aid and openness to treatments. Immediately after the Time 2 survey, participants received their diagnosis result from their urologist. In exchange for participating, men received a $20 gift card.

Measures

Anxiety symptoms. To assess symptoms of anxiety about prostate cancer, we used five items that participants completed as part of the Memorial Anxiety Scale for Prostate Cancer (MAX-PC; Roth et al., 2003). The five items were combined to create a scale of intrusive thoughts. Intrusive thoughts represent unwanted and repetitive thoughts focused on a stressor or stressful event (Horowitz, 1986; Horowitz, Wilner, & Alvarez, 1979). Many previous studies

have used intrusive thoughts to measure cancer-related psychological distress, including some as a proxy for anxiety (e.g., Antoni et al., 2006; Baider & De-Nour, 1997; Devine, Parker, Fouladi & Cohen, 2003; Dupont, Bower, Stanton, & Ganz, 2014; Johnson Vickberg, Bovbjerg, DuHamel, Currie, & Redd, 2000; Lepore & Helgeson, 1998; Lerman et al., 1995; Macefield et al., 2010). The items were, "Any reference to prostate cancer brought up strong feelings in me", "I thought about prostate cancer even though I didn't mean to", "Just hearing the words 'prostate cancer' scared me", "Other things kept making me think about prostate cancer", and "I had more trouble falling asleep because I couldn't get thoughts of prostate cancer out of my mind." Participants were asked to indicate how frequently they experienced these symptoms in the past week and response options were "not at all" (0), "rarely" (1), "sometimes" (2), or "often" (3). The five items were averaged at Time 1 (α =.82) and Time 2 (α =.82).

Test-result anxiety. As a measure of anxiety about the test-result specifically, we used one item from the MAX-PC (Roth et al., 2003), "I am afraid that the results from my PSA test will show that I have prostate cancer". Participants could respond to this statement with the options "not at all" (0), "rarely" (1), "sometimes" (2), or "often" (3). They answered the question at Time 1 and Time 2.

Knowledge. At Time 2, participants completed a test of information that had been presented in the decision aid they had received. The eight questions were adapted from a survey developed for use with newly diagnosed prostate cancer patients in the state of Michigan (Holmes-Rovner, 2005) and from a prostate cancer decision quality measure (Sepucha et al., 2011; also see Lee et al., 2010). Many of the questions were about the benefits and risks of prostate cancer treatments. Examples include, "With treatment, about how many men diagnosed with early stage prostate cancer will eventually die of prostate cancer?", and "For most men with early stage prostate cancer, how much would waiting 4 weeks to make a treatment decision affect their chances of survival?". All questions were multiple-choice format. Participants' responses were scored as correct (coded as 1) or incorrect (0), and were then averaged for a knowledge score (α =.70).

Treatment openness. At Time 2, participants answered six questions related to their openness to potential treatments if they should receive a cancer diagnosis. Participants were told, "Although you may not have cancer, we would like to know what treatment you think you might have if you were to have prostate cancer." Participants were then presented with a list of

treatments (surgery, external beam radiation, brachytherapy, watchful waiting, adjuvant hormone therapy, and experimental therapies such as cryotherapy) and answered yes (coded as 1) or no (0) to each treatment. Participants could select "yes" to multiple treatments and they could decline to answer.

Analytic strategy

The following analyses were conducted for both intrusive thoughts and test-result anxiety. To examine change in anxiety from Time 1 to Time 2, we used GLM Repeated Measures Analysis of Variance (ANOVA) with Time as a within-subjects factor with two levels: Time 1 intrusive thoughts/test-result anxiety and Time 2 intrusive thoughts/test-result anxiety. To examine associations with knowledge, we first examined the bivariate correlations between the anxiety measures and knowledge. We then conducted hierarchical linear regressions in which Time 1 anxiety was entered in Step 1 and Time 2 anxiety was entered in Step 2. Because this analysis tests the ability of the residuals of anxiety at Time 2 in predicting knowledge, it may be interpreted as an association between change in anxiety and knowledge (Cohen, Cohen, West, & Aiken, 2003). Analyses followed the same method of entry to examine associations with openness to treatment variables except logistic regression was used because these variables were coded dichotomously. Logistic regression was also used to test anxiety x knowledge interactions on openness to treatment variables.

Results

Descriptives

Descriptive analyses showed that, on average, participants answered about one-half of the knowledge questions correctly (M = .52, SD = .27). Of treatment options, participants were most open to surgery (42% said yes; SD = .50) and least open to experimental therapies (21%; SD = .41). Approximately 39% of participants said "yes" to only one treatment, 38% said "yes" to more than one treatment (the majority of these said "yes" to 2 treatments), 15% said "no" to all treatments, and the remaining 8% declined to answer.

Table 1 presents the correlations between intrusive thoughts and test-result anxiety at Time 1 and Time 2, knowledge, and openness to treatments. Intrusive thoughts at Time 1 and Time 2 were significantly correlated, $r = .71$, $p < .001$, as was test-result anxiety at Time 1 and Time 2, $r = .45$, $p < .001$.[4] Not surprisingly, the two measures of anxiety were positively correlated with each other at both time points. Both measures were negatively associated with

knowledge. While neither anxiety measure at Time 1 was associated with openness to the treatment options, both measures at Time 2 were positively associated with openness to surgery. Time 2 test-result anxiety was also positively associated with openness to experimental therapies.

Primary analyses

Change in anxiety from Time 1 to Time 2. Repeated measures ANOVAs were conducted to test whether participants' reports of anxiety at Time 2 increased from their reports of anxiety at Time 1. For intrusive thoughts, results showed that participants reported greater symptoms at Time 2 (M = 1.11, SD = .78) compared to Time 1 (M = 1.01, SD = .77), and this difference was significant, $F(1,263) = 6.68$, $p = .01$, $d = 0.12$. Test-result anxiety was also significantly higher at Time 2 (M = 1.17, SD = 1.12) than Time 1 (M = .97, SD = 1.06), $F(1,263) = 8.77$, $p = .003$, $d = 0.19$. Together, these findings show that as participants came closer to receiving their feedback, both their intrusive thoughts about cancer and their anxiety about their test result significantly increased.

Association between anxiety and knowledge. We next used linear regression to examine whether Time 2 anxiety was associated with knowledge, while controlling for Time 1 anxiety. Recall, we were testing the hypothesis that higher anxiety would be associated with lower knowledge. Analyses showed that Time 2 intrusive thoughts were significantly, negatively associated with knowledge, $\beta = -.21$, $t(252) = -2.36$, $p = .02$. This anxiety explained a significant proportion of variance in knowledge, $R^2 = .06$, change in $F(1,252) = 5.54$, $p = .02$. The findings for test-result anxiety were similar such that there was a significant, negative association with knowledge, $\beta = -.14$, $t(252) = -2.00$, $p < .05$, and the change in variance was significant, $R^2 = .05$, change in $F(1,252) = 3.99$, $p < .05$. Thus, across both measures, higher anxiety right before learning one's diagnosis was associated with less knowledge of the risks and benefits of the treatment options.

Association between anxiety and treatment openness. To test the hypothesis that an increase in anxiety would be associated with openness to different types of treatments, logistic regressions were conducted for the six treatments. Table 2 presents the regression coefficients for all of these analyses. The findings revealed that higher intrusive thoughts and test-result anxiety at Time 2 were significantly associated with greater openness to surgery. Higher test-result

anxiety was also significantly associated with greater openness to hormone therapy, and marginally significantly associated with greater openness to experimental therapies.

Secondary analyses

Interactions of anxiety and knowledge on treatment openness. Logistic regressions were conducted to examine if anxiety (i.e., intrusive thoughts or test-result) and knowledge interacted to influence treatment openness. For these analyses, we first computed a continuous change score of anxiety by subtracting Time 1 anxiety from Time 2 anxiety. We then centered these change scores and participants' knowledge scores. To create the interaction terms, the centered anxiety change scores were multiplied by the centered knowledge scores. In Step 1 of the regressions, the centered anxiety and knowledge scores were entered and in Step 2 of the regressions, the interaction terms were entered.

Analyses revealed that intrusive thoughts and knowledge did not interact to influence any of the openness to treatment variables. However, test-result anxiety interacted with knowledge to influence openness to three treatments: surgery, B=-1.70, OR=.18, p=.003, experimental therapies, B=-1.31, OR=.27, p=.03, and radiation, B=-.99, OR=.37, p=.04. Figures 1, 2, and 3 present the graphs of these interactions. The pattern was similar across the three openness variables: When participants showed little to no increases in anxiety from Time 1 to Time 2, having low knowledge relative to high knowledge was associated with being more open to each treatment. However, when participants showed high increases in anxiety across the time points, having low or high knowledge was less likely to show these differences in openness.

Discussion

In the present study, men's symptoms of anxiety increased as they came closer to receiving feedback of whether they had prostate cancer. Higher anxiety was significantly associated with less knowledge about prostate cancer and greater openness to particular treatments like surgery. Secondary analyses further showed that anxiety interacted with knowledge in associations with openness to the different treatments. These findings provide insight into the trajectory of anxiety as well its associations as individuals wait for serious health feedback.

From the time they first presented for their prostate biopsy to the time, about one month later, when they returned to learn their results, men increased in self-reported anxiety. Although the overall increase was small, it was significant across two measures of anxiety including

intrusive thoughts about prostate cancer and anxiety about the test-result. Because normative prevalence data of anxiety symptoms in men at-risk for prostate cancer do not exist (Dale et al., 2005), it is difficult to determine how "normal" the levels of symptoms in our participants were. In fact, our findings not only contribute to a small area of research but also to an area of mixed results: To date, studies have found evidence of both low and high anxiety in men undergoing prostate cancer screening (e.g., Carlsson et al., 2007; Dale et al., 2005). Our findings show that anxiety may change while waiting for a diagnosis, suggesting it is important to measure symptoms at more than one time point during the screening process.

At both time points and across two measures, higher anxiety was significantly correlated with less knowledge. Higher order analyses then showed that increased anxiety symptoms were significantly associated with lower knowledge. These findings fit with previous experimental research showing that negative affective states lead to less attention and comprehension of information (e.g., Raghunathan & Pham, 1999). Given this previous work, one interpretation of our study's findings is that anxiety led participants to pay less attention to the information in the decision aid. This interpretation would also fit with theoretical perspectives that suggest that negative affect biases information processing in predictable ways. For example, according to the affect as a spotlight model (Peters, Lipkus, & Diefenbach, 2006), when individuals are making a health decision, their anxiety about different options acts as a spotlight, leading them to give greater attention to some information and less attention to other information. This selective processing ultimately favors the option the individual has the least anxiety about. While this theory and research may support the idea that anxiety inhibited information processing, our study was correlational. Thus alternative interpretations cannot be ruled out. For example, one possibility is that having lower knowledge caused anxiety. Although all participants reported reading the decision aid, some may not have given it their complete attention or had difficulty understanding the information. Then, because of their low knowledge, they increased in anxiety.

Increased anxiety was also associated with greater openness to the treatments of surgery, hormone therapy and experimental therapies. Because in prostate cancer treatment decisions, there is no best treatment, these associations are difficult to interpret. It could be that higher anxiety increased openness to treatments like surgery and experimental therapies because these treatments are perceived as action-oriented (e.g., Chapple et al., 2002). While the converse association with watchful waiting was consistent with this idea, it was not significant. Although

interpreting these associations requires further research, the findings are meaningful if only to show that anxiety during this time period is related to treatment openness. To the extent that this openness leads to preferences, actual treatment decisions could be affected (e.g., Denberg et al., 2006).

Some of the associations above were qualified by interactions. For example, when participants' anxiety about their test-result showed little to no increase from Time 1 to Time 2, having high knowledge was associated with being less open to the different treatments. However, when they increased in anxiety from Time 1 to Time 2, having higher or lower knowledge was not distinctly related to openness. While these findings are consistent with interactions found in other studies of cancer anxiety, knowledge and behavior (Cameron & Reeve, 2006; Dillard et al., 2013), the present study is the first to show this interaction in the context of prostate cancer. Together, these studies suggest that cancer anxiety may motivate behavior, but not through increased knowledge.

Implications and future directions

Our finding that anxiety increased as individuals came closer to receiving feedback about a cancer diagnosis replicates one study in the area of prostate cancer (e.g., Zisman et al., 2001) and several in the area of breast cancer (e.g., Benedict, Williams, & Baron, 1994; Keyzer-Dekker, de Vries, Mertens, Roukema & van der Steeg, 2014; Lang et al., 2006; Lang, Berbaum, & Lutgendorf, 2009; Liao et al., 2008). Some researchers have recommended shortening the anticipation period between biopsy and result disclosure. In further showing that anxiety at this time may be associated with worse knowledge, the present study strengthens this recommendation.

One question for future research is why was knowledge negatively associated with openness to all of the treatments except watchful waiting? These associations could possibly indicate a general relationship between knowledge and preference for treatments. For example, it is possible that people who are more knowledgeable feel more comfortable taking a "wait and see" approach while those with less knowledge are more eager to have action-oriented treatment. Familiarity may also play a role in these associations. A treatment like surgery may seem familiar to people and thereby those with less knowledge are more open to that treatment.

To provide more insight into anxiety's relationship with knowledge, future studies should integrate more comprehensive measures. Amount of effort used to learn information might be

one such measure. Also, assessing knowledge at multiple time points may provide insight as to when anxiety influences knowledge (e.g., during initial information processing or recall of information, or both?).

Limitations

The correlational design of the present study is a limitation, and future research should attempt to determine the causal direction of the observed associations. One caveat is that true experimental designs in contexts similar to the present study may be difficult or impossible. For example, as people wait for a cancer diagnosis, it may not be ethical to randomly assign them to have more versus less knowledge to then determine the effects on anxiety. Similarly, this time period is not one in which researchers would want to increase anxiety to then determine what happens to information processing. However, experimental research in a hypothetical cancer feedback context could shed light on our correlational findings.

Another limitation related to the correlational design is that unmeasured variables could have played a role in our findings. For example, we did not measure trait anxiety which can relate to anxiety about cancer and information processing (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Keyzer-Dekker et al., 2014).

Conclusion

In the present study, as men waited for a prostate cancer diagnosis, they increased in both intrusive thoughts about prostate cancer and anxiety about their test result. Increased anxiety was associated with lower knowledge and more openness to particular treatments. Some of these associations were qualified by interactions showing that when anxiety increased, knowledge was not systematically connected to treatment openness. This study highlights the need for more research on specific negative emotions and their implications in individuals waiting for diagnoses.

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Footnotes

1. Electronic medical records were used to learn diagnoses. Only those who had cancer returned for Time 2.
2. Analyses were conducted to test whether participants who were completing the Time 1 survey at the urologist's office when learning a biopsy was needed versus those who were completing the survey at the time of biopsy differed in their baseline anxiety. Analyses showed no significant differences for intrusive thoughts, Ms = 1.01 vs. 1.02, $F(1,263)=.03$, p=ns, or test-result anxiety, Ms = .88 vs. 1.05, $F(1,262)=1.72$, p=.19.
3. One aim of this overall project was to compare two decision aids [Blinded]. Both decision aids described localized prostate cancer, but they differed in literacy level, emphasis on shared decision making, and inclusion of statistical information. When controlling for type of decision aid, the association between test-result anxiety and knowledge becomes marginal, $\beta=-.11$, $t=-1.68$, p=.09. All of the other analyses remain the same as reported in the paper.

4. To test for multicollinearity in knowledge analyses, we examined the variance inflation factors. The values were 1.00 and 1.25 for test-result anxiety, and 1.00 and 2.03 for intrusive thoughts, suggesting no multicollinearity issue. For the analyses with treatment options, we examined the two highest correlations and then conducted regressions in steps (first examining Time 1 as the only predictor, and then adding Time 2) to see if the standard errors changed significantly. The analyses showed no multicollinearity issue.

Table 1

Bivariate correlations among primary measures

	1	2	3	4	5	6	7	8	9	10
1. Time 1 intrusive thoughts	---									
2. Time 2 intrusive thoughts	**.71****									
3. Time 1 test-result anxiety	**.67****	**.49****	---							
4. Time 2 test-result anxiety	**.49****	**.65****	**.45****	---						
5. Openness to surgery	.12	**.21****	.05	**.16***	---					
6. Openness to radiation	.06	.07	.00	.08	**.23****	---				
7. Openness to brachytherapy	.04	.05	.00	.04	**.23****	**.48****	---			
8. Openness to hormone therapy	.07	.11	-.07	.11	**.27****	**.43****	**.43****	---		
9. Openness to watchful waiting	-.04	-.07	-.01	-.07	.00	.05	**.14***	.09	---	

10. Openness to experimental therapies	.08	.09	.04	**.13***	**.35****	**.38****	**.49****	**.50****	**.26****	---
11. Knowledge	**-.21****	**-.25****	**-.18****	**-.19****	**-.29****	**-.18****	**-.16***	**-.20****	**.18****	**-.13***

Note. *p <.05, **p <.01.

Table 2

Openness to treatments as a function of change in intrusive thoughts and test-result anxiety

			Openness to surgery		
Independent variables	B	SE	Wald	Sig	Exp(B)
Time 1 intrusive thoughts	-.13	.24	.30	.59	.88
Time 2 intrusive thoughts	.63	.24	7.16	.01	**1.89****
Overall model			11.28	.00	
Time 1 test-result anxiety	-.05	.14	.13	.72	.95
Time 2 test-result anxiety	.31	.13	5.53	.02	**1.36***
Overall model			6.23	.04	
			Openness to external beam radiation		
Independent variables	B	SE	Wald	Sig	Exp(B)
Time 1 intrusive thoughts	.06	.23	.06	.81	1.06
Time 2 intrusive thoughts	.13	.23	.32	.57	1.14
Overall model			1.15	.56	
Time 1 test-result anxiety	-.07	.14	.29	.59	.93
Time 2 test-result anxiety	.18	.13	1.90	.17	1.20
Overall model			1.91	.38	
			Openness to brachytherapy		
Independent variables	B	SE	Wald	Sig	Exp(B)
Time 1 intrusive thoughts	.03	.24	.02	.90	1.03
Time 2 intrusive thoughts	.10	.24	.19	.67	1.11
Overall Model			.56	.76	
Time 1 test-result anxiety	-.04	.14	.08	.78	.96
Time 2 test-result anxiety	.10	.14	.51	.48	1.10
Overall model			.51	.78	
			Openness to hormone therapy		
Independent variables	B	SE	Wald	Sig	Exp(B)
Time 1 intrusive thoughts	-.03	.27	.01	.91	.97

Time 2 intrusive thoughts	.33	.27	1.51	.22	1.39
Overall model			2.72	.26	
Time 1 test-result anxiety	-.32	.17	3.76	.05	.72
Time 2 test-result anxiety	.37	.16	5.64	.02	**1.44****
Overall model			6.83	.03	

	Openness to watchful waiting				
Independent variables	B	SE	Wald	Sig	Exp(B)
Time 1 intrusive thoughts	.04	.24	.02	.88	1.04
Time 2 intrusive thoughts	-.21	.24	.75	.39	.82
Overall model			1.19	.55	
Time 1 test-result anxiety	.05	.14	.13	.72	1.05
Time 2 test-result anxiety	.16	.13	1.43	.23	.85
Overall model			1.48	.48	

	Openness to experimental therapies				
Independent variables	B	SE	Wald	Sig	Exp(B)
Time 1 intrusive thoughts	.27	.28	.95	.33	1.31
Time 2 intrusive thoughts	-.02	.28	.00	.96	.98
Overall model			1.78	.41	
Time 1 test-result anxiety	-.04	.16	.06	.80	.96
Time 2 test-result anxiety	.31	.16	3.77	.05	1.36†
Overall model			4.28	.12	

Note. * p < .05, ** p <.01, † p < .10. All Time 2 statistics control for Time 1.

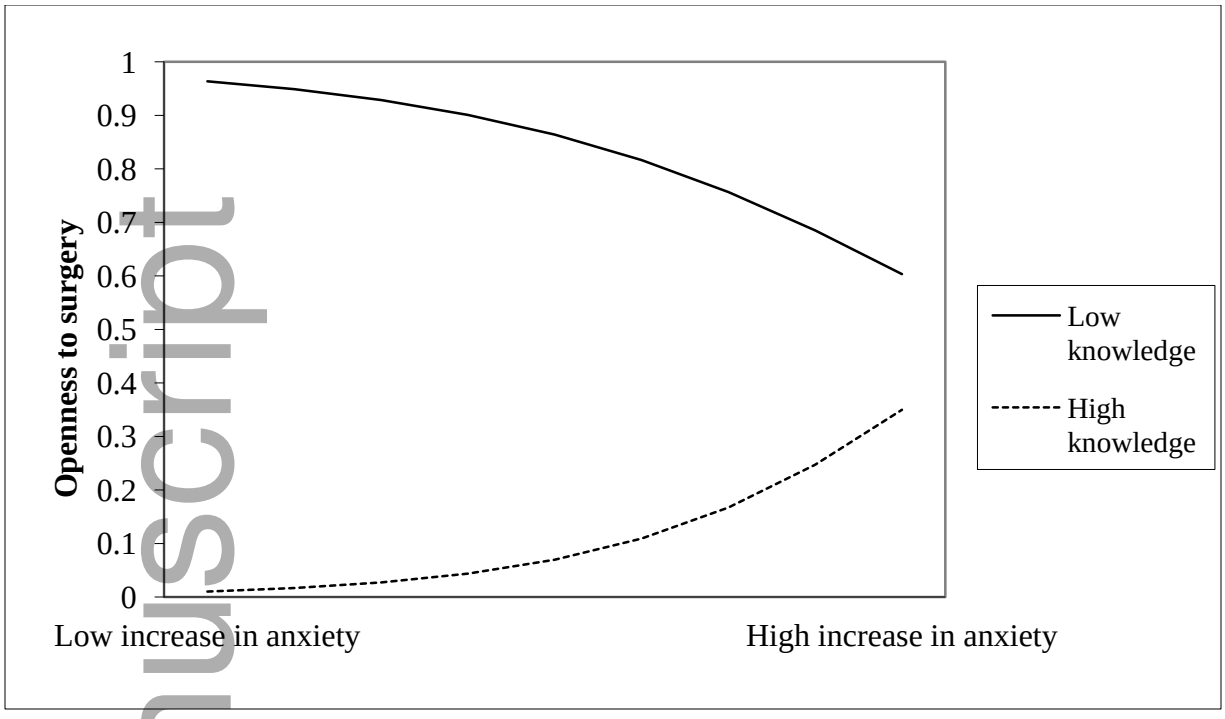

Figure 1. Test-result anxiety x Knowledge on openness to surgery (with higher numbers representing greater openness). Note that "low increase in anxiety" represents little to no increase in anxiety as well as a decrease from Time 1 to Time 2.

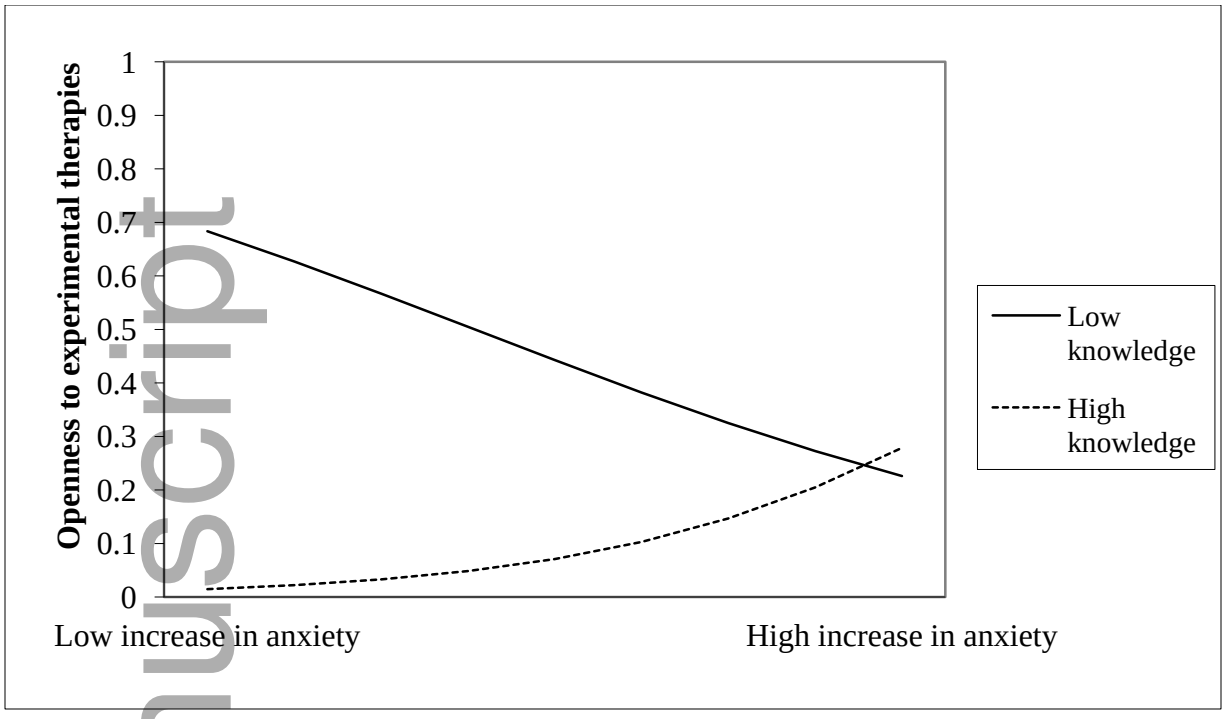

Figure 2. Test-result anxiety x Knowledge on openness to experimental therapies (with higher numbers representing greater openness).

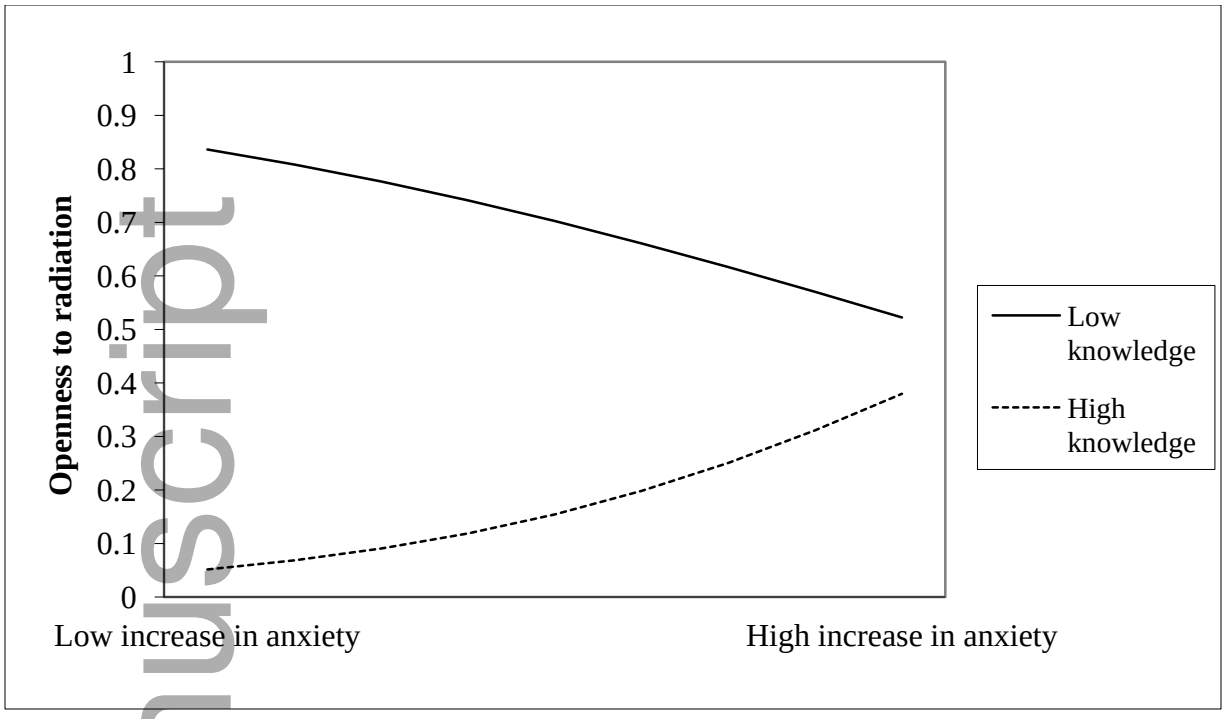

Figure 3. Test-result anxiety x Knowledge on openness to radiation (with higher numbers representing greater openness).