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Worry about Skin Cancer Mediates the Relation of Perceived Cancer Risk and Sunscreen Use

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Abstract

BACKGROUND—Preventive health behaviors are believed to be motivated in part by a person's perception of risk for a particular health problem. Risk contains a cognitive component, beliefs about the chances of a health problem occurring, and an affective component, fear or worry about the health problem. Although both have been shown to influence behavior, the nature of their interrelation as an influence on behavior has not been examined.

METHODS—Data from the 2005 Health Information National Trends Survey, a US nationally-representative telephone survey was analyzed. Participants reported perceived absolute and comparative risk for skin cancer, feelings of worry about skin cancer, and sunscreen use behavior. Analyses examined main effects models for the relation between perceived risk, worry, and sunscreen use, as well as both moderated and mediated models.

RESULTS—For both absolute and comparative risk, the relation between cognitively-based perceived risk for skin cancer and sunscreen use was fully mediated by feelings of worry, as evidenced by significant direct effects of worry ($\beta s > .046$, $ps < .01$) and indirect effects of risk through worry ($\beta s > .19$, $ps < .01$). When worry was included in the models, direct effects of risk perceptions were non-significant ($\beta s < .11$, $ps < .10$). No evidence was found for moderated effects of worry on the relation between risk and behavior.

DISCUSSION—While cognitive risk appraisals do influence decision making and may be addressed by interventions, these findings demonstrate that affectively-based risk components play a key role in behavior regulation. Affectively-based risk might be an effective target for interventions and should be incorporated more fully in decision-making models.

Keywords

perceived risk; worry; Mediation; risk perception and behavior

A central tenet of many models of health decision making is that preventive health behaviors are motivated in part by a person's perception that she or he could potentially experience a particular health problem (Noar & Zimmerman, 2005; Weinstein, 1993). One facet of this perceived risk is a person's perception of susceptibility, or the chance that she/he might suffer from the health problem within a given period of time (e.g., what are the chances that

you will suffer from cancer in the next five years?). This conceptualization involves a cognitive framing of perceived risk that focuses on one's knowledge and beliefs about the chances of the problem occurring in either absolute terms (absolute risk) or relative to similar others (comparative risk).

Another facet of perceived risk is the degree of fear or worry a person feels about the potential health problem (Hay, Buckley, & Ostroff, 2005; Slovic, Finucane, Peters, & MacGregor, 2004). This *affectively-based* risk component is separate and distinct from both absolute and comparative perceived risk and has also been shown to influence health behaviors (Hay et al., 2005; Hay, McCaul, & Magnan, 2006; Moser, McCaul, Peters, Nelson, & Marcus, 2007). Although affectively and cognitively-based risk components tend to covary (Lipkus et al., 2000), they have been shown to be separate and distinct risk perception constructs (Hay et al., 2005; Janssen, van Osch, de Vries, & Lechner, 2013; Lipkus et al., 2000; McCaul, Schroeder, & Reid, 1996). In addition, the two are influenced by separate and distinct aspects of illness representations (Cameron, 2008) and have unique relations to behavior (Janssen et al., 2013; Janssen, van Osch, Lechner, Candel, & de Vries, 2012).

Previous studies have examined the influence on behavior of both cognitive and affective risk components; however, little work has examined their interplay. That is, how do cognitive and affective risk components jointly operate to influence behavior? Among studies that have examined both cognitively and affectively-based risk, most only examined their independent influences on behavior (i.e., only considered main effect multivariate models) or looked at the relation between the two, but did not examine the nature of their joint operation as influences on behavior (Cameron, 2008; Janssen et al., 2013; Janssen et al., 2012; Lipkus et al., 2000; Shiloh, Wade, Roberts, Alford, & Biesecker, 2012; Zajac, Klein, & McCaul, 2006).

Given that both cognitively and affectively-based risk can influence behavior, how might they operate together to influence actions? Although it is possible that the two are independent, albeit related, influences and that each has a main effect relation on behavior, models of cognitive-affective interactions in other aspects of health decision making suggest other hypotheses. Our hypotheses for the interrelation of cognitively and affectively-based risk components is based on the behavioral affective associations model (Kiviniemi & Bevins, 2007; Kiviniemi, Voss-Humke, & Seifert, 2007), which describes the interplay of cognitively-based beliefs about health behaviors (e.g., perceived benefits, perceived barriers) and affectively-based associations with behavioral practices (e.g., associating positive affect with certain foods). According to the model, the relation between cognitively-based beliefs about health behaviors and actual behavioral practices is mediated by affective associations with the behavior. This mediational relation has been demonstrated in several health domains (Kiviniemi & Duangdao, 2009; Kiviniemi et al., 2007). Although the behavioral affective associations model focuses on thoughts and feelings associated with behavioral practices as opposed to the risk-perception focus on thoughts and feelings associated with a health problem, the decision making interplay of thought and feeling suggests the hypothesis that affectively-based risk perceptions may mediate the relation between cognitively-based risk perceptions and behavior. In addition to the inference based on the behavioral affective

associations model, this hypothesis is also consistent with extensive theorizing arguing that affective cues serve as an immediate, proximal indicator of risks and benefits (Bechara, Damasio, & Damasio, 1997; Damasio, 1994; Frijda, 1988). The current study tested this mediational hypothesis in the realm of sunscreen use. In addition to the mediational model specified in the hypothesis, we also tested an alternative hypothesis that affectively based risk might moderate the relation between cognitive risk and behavior. Consistent with this moderator hypothesis, Klein et al. (2009) found that there was an interaction between perceived risk and feelings of worry in smokers' intentions to quit in the future; the relation between perceived risk and quit intentions was stronger at low levels of worry relative to high worry.

Sunscreen use as a strategy for preventing skin cancer is an ideal behavioral model for examining the interactive effects of cognitively-based risk and affectively-based worry as influences on behavioral outcomes. Theoretically, risk perceptions have a greater influence on behavior when the behavior is individually controlled (e.g. adult sunscreen use) and intended to protect against a specific (e.g. skin cancer), rather than diffuse, health risk (Brewer et al., 2007). Several studies have demonstrated that levels of sunscreen use and other skin protection behaviors are influenced by cognitively-based risk perceptions; this has been demonstrated in both observational (Bränström et al., 2010; de Vries, van Osch, Eijmael, Smerecnik, & Candel, 2012; Douglass, McGee, & Williams, 1997; Turrissi, Hillhouse, Gebert, & Grimes, 1999; Wichstrøm, 1994) and experimental studies (Rimal & Real, 2003). Similarly, worry about skin cancer has been shown to be related to decision making for sunscreen use (Hedeker, Mermelstein, & Weeks, 1999; Janssen, van Osch, de Vries, & Lechner, 2011).

The purpose of the current study was to utilize a national, population-representative survey to examine the interplay between cognitively and affectively-based perceived risk for skin cancer as predictors of sunscreen use behavior. The survey included questions about cognitively-based risk perceptions for skin cancer, affectively-based worry about skin cancer, and current sunscreen use. We tested our hypothesis that worry mediates the effect of cognitively-based risk on sunscreen use, as well as an alternative moderation model in which worry served as a moderator of the risk-behavior relation.

Methods

This study used data from the National Cancer Institute's 2005 Health Information National Trends Survey (HINTS), a nationally representative survey of persons over age 18. The 2005 dataset was collected from February to August 2005 using a list-assisted, random digit dial telephone technique. Responses were weighted to produce a representative sample of adults. The final response rate for the survey was 20.9% (N=5,586 completed interviews). Detailed reports about the sample, sampling framework, and methodology are published elsewhere (Davis, Park, Covell, Rizzo, & Cantor, 2005). Participants were randomly assigned to receive questions about skin, colon, or lung cancer. The analyses reported here are based on the third of the participants who were randomly selected to answer questions about skin cancer, provided valid responses to all analysis variables, and reported no personal history of skin cancer (n=1,476).

Measures

Participants reported their sunscreen use behavior; “When you go outside for more than 1 hour on a warm, sunny day, how often do you wear sunscreen?” (1=*always* to 5=*never*). Perceived *absolute risk* for skin cancer was assessed with “How likely do you think it is that you will develop skin cancer in the future?” using a 5-point scale ranging from 1 (*very low*) to 5 (*very high*). Perceived *comparative risk* was assessed with “Compared to the average person your age, would you say that you are...” using a 3-point scale: *more likely to get skin cancer*, *less likely*, and *about as likely*. Comparative risk was recoded so that higher scores indicated greater perceived risk. Perceived *worry* was assessed with the question “How often do you worry about getting skin cancer?” (1=*rarely/never* to 4=*all the time*). Participants also reported their age, gender, race/ethnicity, and level of education.

Analysis Strategy

All reported analyses were conducted in Stata version 12 (Stata Corp., College Station, TX). Analyses used Stata's survey design features to incorporate the HINTS sampling weights, which account for the sampling design, population oversampling, and non-response patterns in the dataset, in order to provide estimates for the adult population of the United States. To aid in interpretation, variables were recoded as needed so that for all variables higher numbers indicated higher levels of the construct. Few respondents ($n=63$; 4%) endorsed the highest level of absolute risk, so it was recoded into a 4-point scale with scores of 4 and 5 combined.

Linear regression was used to examine the main effects of absolute risk, comparative risk, and worry on sunscreen use. To test whether demographic factors (age, gender, race, education) and family history of skin cancer moderated these effects, the risk/worry variables were mean centered and interaction terms were computed and entered at the final step of the models (Aiken & West, 1991). Factors that produced significant main effects and did not moderate the relation between risk/worry and behavior were controlled for in all analyses.

Path analysis was utilized in order to test the extent to which the effects of absolute and comparative risk were mediated by worry. This allowed for the simultaneous testing of direct, indirect, and total effects. To test an alternative moderation model, the risk/worry variables were mean-centered and interaction terms were computed and entered at the final step of linear regression models (Aiken & West, 1991).

Results

Frequency of sunscreen use varied, with 32% reporting “never” using it, and 14% “always” using it. Sunscreen use was associated with most demographic characteristics; education was associated with increased sunscreen use, and men and non-White participants were both less likely to use sunscreen (all slope t -tests > 3.64 , all $ps < .001$).

When examined separately, absolute risk, comparative risk, and worry were all significantly associated with sunscreen use (controlling for gender, race, and education). In each case, increasing degrees of risk/worry were associated with increased sunscreen use; absolute

$b=0.10$, $p<0.05$; comparative $b=0.15$, $p<0.05$; worry $b=0.23$, $p<0.001$. Additionally, increasing absolute and comparative risk were both associated with increasing worry; $bs=0.27$ and 0.24 , respectively; both $ps<0.001$. Neither family history nor the demographic variables (age, race, gender, education) moderated any of these relations, as evidenced by nonsignificant interaction terms ($ps>0.05$).

Mediated and Moderated Relations

We utilized path analysis techniques in order to test a mediational pathway in which worry was entered as a mediator, demographics entered as covariates (gender, race, and education), and sunscreen use was entered as the outcome variable. In the first model, absolute risk was entered as the independent variable. As can be seen in Figure 1, results yielded a significant direct effect of worry on sunscreen use, $b=0.19$, $p<0.01$, 95% CI (0.058, 0.32). There was also a significant indirect effect of absolute risk through worry on sunscreen use ($b=0.050$, $p<0.01$, 95% CI [0.015, 0.084]), but a non-significant direct effect ($b=0.055$, $p=.25$, 95% CI [-0.039, 0.15]). Similarly, when comparative risk was entered as an independent variable, there was a significant direct effect of worry on sunscreen use, $b=0.20$, $p<0.01$, 95% CI (0.066, 0.33). There was also a significant indirect effect of comparative risk on sunscreen use through worry ($b=0.047$, $p=.01$, 95% CI [0.012, 0.081]), but a non-significant direct effect ($b=0.11$, $p=.11$, 95% CI [-0.023, 0.24]). The non-significant direct effects of absolute and comparative risk suggest that worry fully mediated their effect on sunscreen use.

We also examined an alternative model in which worry served as a moderator of the risk-behavior relation by adding the interactions of absolute risk and worry, as well as comparative risk and worry, to the respective linear regression models that included their main effects. Neither accounted for additional variance over and above main effects; absolute risk: $F(1,1469)<1$, ns ; comparative risk: $F(1,1470)<1$, ns .

Discussion

The relation between cognitively-based risk constructs, both absolute risk and comparative risk for skin cancer, and sunscreen use behavior was fully mediated by affectively-based risk. There was no evidence for moderated relations, nor was there a remaining direct effect of cognitively-based risk on behavior once the mediated relation with affectively-based risk was accounted for.

These findings have implications for our understanding of the nature and operation of perceived health risk as an influence on behavior, as well as for behavior change interventions. First, cognitive and affective factors are often treated as separate and distinct constructs (e.g., cognitive versus affective attitude components) or are pitted against one another as “rational” versus “irrational” influences (e.g., hot versus cold cognition models). The results reported here suggest that, although cognitive and affectively based risk components are conceptually separate and distinct, their associations with behavior stem from a more complex, mediational relation. Because the evidence for a mediational relation is consistent with previous work showing that the relation between cognitive beliefs about behavior (e.g., perceived benefits) and behavioral practices is mediated by affective associations with the behavior (Kiviniemi & Duangdao, 2009; Kiviniemi et al., 2007), these

findings also suggest that there may be a common set of mechanisms by which cognitive and affective factors work together to guide behavior (a position consistent with other work on affect and decision making; e.g., Damasio, 1994).

The understanding of how people conceptualize, process, and use risk information in making decisions has implications for developing communications tools to intervene around risk perception and to use risk perception to encourage behavior change (Klein & Stefanek, 2007). Many behavioral interventions assume that people underestimate the risks surrounding unhealthy behaviors and that behavior change can be prompted by increasing individuals' cognitive perceptions of risk. However, knowledge about the health risks of not using sun protection and the efficacy of sunscreen as a protective measure is relatively high (Douglass et al., 1997; Rimal & Real, 2003). Our findings suggest that, although cognitive risk appraisals relate to behavioral outcomes and therefore are a valid target for interventions, their relation to behavior is indirect. The more direct relations to decision making come from affectively-based risk components, such as feelings of worry. Given this, interventions may have stronger and more immediate effectiveness by addressing affective factors as optimal targets for interventions. One strategy for doing so might be to target aspects of participants' beliefs about illness that are uniquely associated with affectively-based risk perceptions (Cameron, 2008). If feasible, affective factors could be added to existing cognitively-based intervention strategies, thus addressing both the direct and the indirect influences on decision making.

There are, of course, limitations to the work reported here. First, the measures are self-report. However, self reports of sunscreen use have been found to be strongly related to objective measures of actual use (Glanz et al., 2009). Second, the data are cross-sectional, so the results should be thought of as relations between constructs; direct causal conclusions about interrelations cannot be drawn from the data reported here. However, conceptually, it seems unlikely that the reverse association would be true, with greater sunscreen use causing higher perceptions of risk.

Also, one-item measures were used to assess each construct. Although not ideal, this is a common limitation when using national survey data (e.g., NHIS; Coups, Manne, & Heckman, 2008), and findings on the predictors of sunscreen use are similar between studies that use one- and multi-item measures (Alberg, Herbst, Genkinger, & Duszynski, 2002; Azzarello, Dessureault, & Jacobsen, 2006). Finally, it is important to note that only one affective risk component (worry) was assessed. Other studies have examined other conceptualizations of affectively-based risk (e.g., fear, anger). Future work examining whether the affect-behavior relation is consistent across different ways of conceptualizing affectively-based risk would be valuable to better understand the relation to behavior.

In addition, we examined one set of inputs (risk perceptions) to the decision-making process. Because decisions about health behaviors are multi-determined, although this single set of inputs does significantly relate to behavioral outcomes, the magnitude of the effect is relatively small. While this relatively small magnitude does not have implications for this paper's key focus on the nature of the interrelations of risk constructs, it should be

considered in evaluating the clinical/practical significance of the effects reported here (Kirk, 1996; Thompson, 2002).

Finally, it is important to note that specific aspects of sunscreen use as a behavior and skin cancer as a health domain should be considered in thinking about the generalizability of the results. First, sunscreen use is a prevention behavior and may have different perceived risk reduction properties than a screening behavior (e.g., mammography, colonoscopy) or a more globally health-related behavior (e.g., diet, exercise). Although recent work on the behavioral affective associations model shows that the relations specified in the model generalize to screening behaviors (Kiviniemi, Jandorf, & Erwin, under review), the degree to which this would generalize to screening-related risk perceptions remains to be seen. Second, the nature of the health domain (e.g., perceived severity, perceived prevalence, perceived controllability) might impact the interplay of cognitive and affective factors and their relation to behavior. Future work examining relations across different types of risk domains would be valuable to address this question.

Conclusion

Both cognitively-based beliefs about one's risk and affectively-based feelings of worry and fear about health problems are known influences on behavioral practices. The findings suggest that there are important complexities to the interplay of the two in relation to risk-reduction behavior; affectively-based risk mediated the relation between cognitively-based risk and behavior. This relation is important for understanding the nature and operation of risk perception as an influence on behavior and also suggests multiple routes to intervene using risk as a tool to encourage behavioral change.

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Figure 1. Mediational pathways with unstandardized regression coefficients and standard errors. * $p < .01$