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Personal attributions for melanoma risk in melanoma-affected patients and family members

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Abstract

Personal attributions for cancer risk involve factors that individuals believe contribute to their risk for developing cancer. Understanding personal risk attributions for melanoma may dictate gene-environment melanoma risk communication strategies. We examined attributions for melanoma risk in a population-based sample of melanoma survivors, first degree family members, and family members who are also parents (N=939). We conducted qualitative examination of open-ended risk attributions and logistic regression examining predictors (demographics, family member type, perceived risk) of the attributions reported (ultraviolet radiation [UVR] exposure, heredity/genetics, phenotype, personal melanoma history, miscellaneous). We found a predominance of risk attributions to UVR and heredity/genetics (80% and 45% of the sample, respectively). Those reporting higher education levels were more likely to endorse attributions to heredity/genetics, as well as to phenotype, than those of lower education levels. First-degree relatives and parent family members were more likely to endorse heredity/genetic attributions than melanoma survivors; melanoma survivors were more likely to endorse personal history of melanoma attributions compared to first-degree relatives and parent family members. These findings inform the development of risk communication interventions for melanoma families.

Keywords

risk perceptions; risk attributions; melanoma families

Background

Personal attributions for illness risk involve factors that individuals believe contribute to their risk for developing an illness such as cancer (Weinstein, 1984, 1987). Perceptions of cancer risk have been heavily researched, as they are theoretically (Ajzen & Fishbein, 1980; Cameron, 2007; Cameron & Leventhal, 2003; Janz & Becker, 1984; Rogers & Mewborn, 1976; Sutton, 1982) and empirically (Edwards, et al., 2006; McCaul, Branstetter, Schroeder, & Glasgow, 1996) important in motivating cancer screening and risk reduction behaviors,

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but nevertheless are relatively resistant to change over time (Weinstein, Sandman, & Hallman, 1994; Weinstein, Sandman, & Roberts, 1991). Little is known about the attributions through which risk perceptions are formed (French & Hevey, 2008; Lipkus, et al., 2005). Such processes may involve an amalgam of a person s knowledge of personally relevant cancer risk factors as well as subjective beliefs about these risk factors. Understanding cancer risk attributions could shed light on why cancer risk perceptions might be difficult to change, clarify beliefs that may modify response to risk communication interventions, and inform communication strategies to at-risk populations that keep pace with our rapidly developing understanding of the genetic, environmental, and lifestyle risk factors associated with the development of many cancers (Rimer & Glassman, 1999).

Personal attributions for cancer risk may be a particularly fruitful area for exploration among individuals who are at risk for developing melanoma, a cancer with a number of established risk factors. Incident melanoma is expected in approximately 69,000 individuals in the United States in 2009 (American Cancer Society, 2009). Ultraviolet radiation exposure (Armstrong & Kricker, 2001; Gandini, et al., 2005), genetically-affected phenotypes such as mole number, red hair and light skin (Ford, et al., 1995) as well as genetic mutations or common genetic polymorphisms (Nelson & Tsao, 2009) can all play a role in increasing risk. Family history of melanoma also increases risk; it likely comprises all the risk elements mentioned above.

Two small studies have examined personal risk attributions for skin cancer. In 40 college students, exposure to ultraviolet radiation was noted by 20 students and genetics, skin or hair color (all coded as “genetic factors” by investigators) were noted by 14 students as important factors in determining their skin cancer risk (French & Hevey, 2008). In a second study of 31 individuals who had survived melanoma at least five years, most (58%) reported that they held a belief in a specific cause of their melanoma diagnosis. The most frequently reported attribution was sun exposure (n = 11; 35% of participants), followed by childhood sunburns (n = 2; 6%), heredity (n = 2; 6%), stress (n = 1; 3%), household chemicals (n = 1; 3%), and occupational hazards (n = 1; 3%). While sun exposure was the most likely attribution, it is important to note that the assertion of no specific cause (n = 15; 48%) was the most common response to the attribution question (Dirksen, 1995). These small studies raise important unanswered questions concerning the extent to which melanoma attributions vary across demographic groups, risk groups (i.e., melanoma survivors and first-degree relatives) and levels of perceived risk. In the current study, we examine personal attributions for melanoma risk in a large, population-based sample of individuals affected by melanoma, as well as their family members. We examine prevalence of melanoma attributions and patterns of attributions across demographic, family member type, and perceived risk groups.

Methods

Data for this study was drawn from baseline assessment in a randomized trial of a web-based intervention (“SunTalk,” R01 CA107430, Bowen, PI). The purpose of SunTalk was to increase knowledge, awareness, and communication about melanoma prevention in families affected by this disease.

Sample

The recruitment process has been described in more detail elsewhere (Bowen, et al., in pressBowen, et al., 2010). Briefly, melanoma cases were recruited through a population-based cancer registry (Anton-Culver, et al., 2003), the Northwest Cancer Genetics Network. This registry is funded by the National Cancer Institute to act as an infrastructure for studies of cancer genetic susceptibility. Participants in the Northwest Cancer Genetics Network are people with cancer identified by state and national cancer registries, first-degree relatives of

cancer cases, people who self-referred to the Network by responding to a media campaign, and controls recruited from a random population sample. Informed Consent was obtained from prospective study participants after the nature of the procedure had been fully explained to them. Cases diagnosed with a first primary melanoma between April 1st 1998 and October 1st 2001 were identified for inclusion. The melanoma case, one first-degree relative of the case, and one parent of a child aged 18 or younger were included in the study. The eligibility criteria for the family members were as follows: 1) The Case was an individual diagnosed with melanoma, aged 18 years or older, 2) The First-Degree Relative was defined as a parent, child or sibling of the case, related biologically and/or socially. This meant biological, adoptive, half or step relationships qualified but spouses did not. 3) The Parent must have had primary responsibility for the child s health and the child must live with the parent at least 50% of the time. Both parent and child could have been related to each other and to the case via either a biological or social relationship. This means biological, adoptive, half or step relationships qualified; spouses of cases did not qualify. Parents could also be related via marriage to the case, but not on the spouse s side (for example, case s sister s husband qualifies as parent, case s spouse s sister does not qualify as parent). The parent group was included in the intervention study because of the intervention focus on the entire family unit, and the fact that a melanoma diagnosis in the family may influence cognitions and behaviors through the family system, beyond first-degree relatives.

The opportunities afforded by a cancer diagnosis may lead to increases in risk appreciation, as well as information-seeking about risk, in first-degree relatives as well as other relatives. In the case of melanoma risk, in particular, sun exposure in childhood is likely to be more highly related to subsequent melanoma diagnosis than adulthood sun exposure (Veierod, Adami, Lund, Armstrong, & Weiderpass, 2010; Whiteman, Whiteman, & Green, 2001), so inclusion of relatives who are in a position to encourage and support sun protection in young children in the family is likely informative in planning for a family-focused intervention for melanoma risk reduction. We include the parent group in the current analyses given that a melanoma diagnosis in the family may impact personal risk attributions in different family members in similar or dissimilar ways, but this has not been examined in prior studies. All study participants had to have access to the Internet from a place that would be comfortable for accessing the study website. If the case was eligible and interested, project staff then collected relative names, relationships, contact information, and permission to contact all possible first-degree relatives and parents. Specifically, we told participating families that we were recruiting them to an intervention study to help them reduce their melanoma risk. Overall, 939 participants (313 families) completed a baseline survey and were included in the present study and family member type involved case, first-degree relative, or parent for each study participant.

We conducted a baseline telephone survey administered by trained interviewers prior to randomization and intervention delivery. All measures were self-report and those relevant to the current paper are described below.

Measures

Personal risk perceptions and attributions for melanoma risk. We asked participants to report their risk for developing melanoma compared to others of the same age and sex with the following question, “Compared to other people your age and sex, your chances of having melanoma in the future are…” (Response categories: Much lower [1]; A little lower [2]; Average [3]; A little higher [4], Much higher [5]…than other people your age and sex (Weinstein, 1980; Weinstein & Lachendro, 1982), and then to report, in an open-ended response, those personal attributions for increased melanoma risk, using the following question, “Overall, what do you think contributes to your risk for developing melanoma?”

(Weinstein, 1984, 1987). We allowed them to report up to four separate personal attributions for their melanoma risk.

We measured risk perceptions as comparative risk because it is a widely utilized measure of risk perception in the cancer context and early work examining the link between perceived risk and causal attributions used comparative risk perceptions as an initial "prompt" for causal attributions (Weinstein, 1984, 1987), and because responses on comparative risk measures tend to be somewhat more normally distributed and less positively skewed than measures of absolute likelihood (see Hay, Coups, & Ford, 2006), which is particularly important for examining risk perceptions regarding cancers with low actual incidence rates such as melanoma.

We collected background information from all participants using standard questions on age, gender, ethnic/racial background (White/Caucasian, Black or African-American, Native American or Aleut or Eskimo, Asian, Pacific Islander, Hawaiian, Spanish, Hispanic or Latino, other), education level (8 years or less, some high school, high school graduate, some college or technical school, graduated from college or beyond), and marital status (never married, married or living as married, separated, divorced, widowed), income (less than $15k, $15k–$30k, $31k–$50k, $51k–$70k, $71k–$99k, $100k or above). Information obtained from the Northwest Cancer Genetics Network database for each case included diagnosis date and stage at diagnosis.

Analyses

Our analysis plan involved qualitative and quantitative examination of personal risk attributions. First, we report descriptive statistics for all demographic variables (See Table 1). Then we conducted a thematic analysis that allowed us to code all personal risk attributions into 14 categories (See Table 2). We use these 14 qualitatively-generated categories of personal risk attributions to construct more global attribution types. Next, we quantitatively examine predictors of each category, using univariate Chi-Square (Table 3) and multivariable logistic regression models (Table 4). Finally, we examine interactions between predictors for each attribution type. In order to incorporate the potential correlations introduced within family clusters, we used generalized estimating equations to derive all significance tests and logistic regression parameters.

Results

Of the 939 participants in the study, more than half (61.7%) were female, about half (48%) were under age 50, most (96.6%) were white and most (81.4%) were married. They were highly educated, with most (61.7%) reporting a college degree or more. They were equally distributed over income levels. Most of the cases had been diagnosed with localized disease. Most participants (60.1%) reported that their risk for developing melanoma was a little higher or much higher than others of their age and sex. Risk perceptions differed between all family member types ($F(2,935)=25.18$; $p<.001$), with cases reporting the highest risk perceptions, followed by parents, followed by first-degree relatives ($M\underline{s}$ =3.87; 3.44; 3.25 respectively on 5-point scales); all ps<.05 as assessed through Fisher s least significant difference tests.

We first examined the four open-ended risk attribution responses provided by each participant. To make the analyses more manageable, we thematically organize the raw text (1908 responses) into one of the following 14 descriptive categories: "sun exposure", "sun exposure as a child", "heredity/genetics", "phenotype", "many moles", "personal history of melanoma", "many tanning experiences", "use of tanning booths or beds", "stress", "age", "combination of risks", "miscellaneous comments", "don t feel at risk", or "unknown" (see

Table 2). Two coders separately coded each of the open-ended responses using the 14 categories above with good reliability (1st response: $\kappa = 0.92$; 2nd response: $\kappa = 0.86$; 3rd response: $\kappa = 0.74$; 4th response: $\kappa = 0.81$). Discrepancies were resolved by a third coder. All but nine participants (2 cases; 3 first-degree relatives, 4 parents) responded to the open-ended risk attribution questions.

We created five dichotomous attribution types, which identified whether participants (at any point in their open-ended responses) attributed their risk to a particular type of attribution. The five types of attributions included: (1) UVR exposure (consisting of attributions related to sun exposure, sun exposure as a child, many tanning experiences, use of tanning booths or beds); (2) heredity (consisting of attributions related to heredity/genetics); (3) phenotype (consisting of attributions related to phenotype and many moles); (4) personal history of melanoma, and (5) miscellaneous (consisting of attributions related to stress, combination of risks, age, miscellaneous, not at risk, and unknown). For example, participants who provided an attribution that was coded as a "UVR exposure" attribution were assigned a "1" (presence) for the dichotomous UVR exposure attribution variable. If they did not, then they were given a "0" (absence) for this variable. Similarly, the original fourteen categories were also used to establish presence or absence of heredity attributions, phenotype attributions, personal melanoma history attributions, and miscellaneous attributions. Concordance between the two coders for these five dichotomous attribution variables was excellent (UVR exposure: $\kappa = 0.94$; heredity: $\kappa = 0.95$; phenotype: $\kappa = 0.90$; personal melanoma history = κ 0.98; miscellaneous: $\kappa = 0.88$). Discrepancies were resolved by a third coder.

We then re-examined the responses of 54 participants whose open-ended responses were coded as a "combination of risks" (e.g., because they may have attributed their melanomas to "both family history and sun exposure"). In total, responses from 49 participants were recoded and reclassified as either "UVR exposure," "heredity," or "phenotype" where appropriate.

We then investigated which factors best predicted the participants endorsements of these five types of attributions (UVR exposure, heredity, phenotype, personal melanoma history and miscellaneous, see Table 3). Predictors included: family member type, gender, age (dichotomized using a median split of below 50 and above 50), education (trichotomized into "up to and including a high school education", "some college or technical school", and "college graduate or graduate education"), marital status (dichotomized into "married" or "not married'), income (dichotomized into either "up to $70,000" or "over $70,000"), and perceived risk (dichotomized into above or below a median split of the standardized perceived risk score).

None of the predictor variables were associated with UVR exposure which may reflect a "ceiling effect," as approximately 80% of the overall sample attributed their melanoma risk to some type of UVR exposure (by far the most common attribution). With so few other people (approximately 20%) not attributing their risk to UVR exposure, it may have been difficult to isolate any underlying associations with our predictors.

Family member type, gender, age, education, and perceived risk were all significantly associated with making a heredity attribution for melanoma, although cases were significantly less likely to make such an attribution compared to first-degree relatives and parents. This is understandable because all first-degree relatives, by definition, have a family history since they are related to the cases. The cases, on the other hand, may or may not have a family history. We also found that both females and those younger than 50 were more likely to make a heredity attribution. Those with a high school education were significantly less likely to attribute their risk to heredity compared to those with a college or graduate

education. Finally, we found that those reporting a low risk for melanoma were less likely to attribute heredity than those reporting a high risk. This seems to be because those with a family history are likely to both report higher perceived risk and attribute their risk to heredity.

Several factors were found to predict phenotype attributions. Family member type, gender, age, education, and perceived risk were all significantly related to making a phenotype attribution for melanoma. Specifically, females, those under age 50, and those with higher perceived risk were more likely to report that their phenotype contributed to their melanoma risk. First-degree relatives were significantly less likely to attribute their risk to their phenotype compared to cases and parents. Those with a high school education or less were also significantly less likely to attribute their risk to their phenotype compared to those with a college or graduate education.

Next, we examined the relationship between our set of predictors and making an attribution to personal melanoma history. Not surprisingly, we found that cases were more likely to attribute melanoma risk to their personal melanoma history. Those in the 50 and older age group, as well as those with higher perceived risk, were also more likely to attribute to a history of having melanoma. Finally, we examined the relationship between our set of predictors and making a miscellaneous attribution. Only family member type was significant. Cases were significantly more likely to provide a miscellaneous attribution than parents.

Next, in a series of five logistic regressions, we investigated the simultaneous effect of our predictors on each of our five attributional categories (see Table 4). Non-dichotomous categorical variables (e.g., study type, education) were dummy coded, age was also coded dichotomously (under 50 versus 50 and older) while perceived risk was left as continuous. Since none of the univariate crosstab analyses were significant, it is not surprising that the overall model predicting UVR exposure attribution was not significant. The overall model predicting heredity was significant, with family member type, education, and perceived risk as the only significant predictors. The overall model predicting phenotype attributions was also significant with gender, education, and perceived risk as significant predictors. The overall model predicting personal melanoma history attributions was also significant, with family member type, gender, marital status, and perceived risk as significant predictors. Of note, we also ran the same model among cases only, and this was not significant, given that attributions to personal melanoma history were almost universally limited to cases, rather than first-degree relatives or parents. The overall model predicting miscellaneous attributions was not significant.

Finally, we examined whether attribution type (UVR exposure, heredity, phenotype, personal melanoma history, miscellaneous) differed based on interactions between family member type (case, first-degree relative, parent) and gender, age, education, marital status, income or perceived risk level, and found two significant interactions ($p < .05$) out of 30 interactions such that family member type interacted with gender and marital status. Accordingly, female parents were more likely than male parents to make heredity attributions; female and male cases and first-degree relatives did not differ in their heredity attributions. Additionally, unmarried parents were more likely to make miscellaneous attributions than married parents; no marital status effect was evident for first-degree relatives and cases. There were no significant interactions between family member type and personal melanoma history attributions. We also examined whether attributions (UVR exposure, heredity, phenotype, personal melanoma history, miscellaneous) differed based on interactions between perceived risk level (lower, higher) and gender, age, education, marital status and income, and found two significant interactions ($p<.05$) out of 25 interactions.

Here, age modified perceived risk such that among those who perceived higher melanoma risk, those in the younger age group (<50) were more likely to endorse phenotypic attributions than older (≥50) participants; those who perceived lower melanoma risk did not differ by age on phenotypic attributions. Income modified the relation of perceived risk on personal melanoma history such that lower income participants with higher perceived melanoma risk were much more likely to endorse personal melanoma history attributions, but this relationship did not exist among those in the higher income group.

Discussion

To our knowledge, this is the first study of personal risk attributions and predictors of risk attributions for melanoma in a large general population sample of families affected by melanoma. Overall, our findings indicate a predominance of melanoma risk attributions to sun exposure, with about 80% of participants endorsing that their UVR exposure histories or current behavior increases their risk of developing melanoma. Melanoma risk attributions to hereditary or genetic factors were common as well, with slightly less than half of participants (45%) noting that heredity increased their melanoma risk. About a quarter (24%) endorsed phenotypic risks.

While infrequent, it is important to highlight endorsement of melanoma risk attributions to factors that lack epidemiological evidence to date–including stress, pollution, and occupational exposures such as paint fumes–as well as assertions of a lack of knowledge or denial of risk attributions. Studies examining risk attributions for other cancers, including breast cancer (Arman, Rehnsfeldt, Carlsson, & Hamrin, 2001; Baider & Sarell, 1983; Friedman, et al., 2007; Glinder & Compas, 1999; Kulik & Kronfeld, 2005; Lavery & Clarke, 1996; Lowery, Jacobsen, & DuCette, 1993; Rabin & Pinto, 2006; Stewart, et al., 2001; Taylor, Lichtman, & Wood, 1984; Wold, Byers, Crane, & Ahnen, 2005) have revealed beliefs about similar attributions, and dictate the importance of proactively addressing the lack of evidence for the role of these risk factors for cancer where such evidence exists. While uncommon, these beliefs may impede individuals efficacy in addressing actual risks via lifestyle behavior change (via sun protection and increased screening efforts), especially if these beliefs lead to increased fatalism or reduced perceived control over risk for melanoma.

There were some consistent predictors of endorsement of melanoma risk attributions across type of attribution. Specifically, those with higher levels of educational attainment (but not higher income), and those with higher perceptions of risk were more likely to endorse hereditary or phenotypic attributions for melanoma risk, and women were more likely than men to report phenotypic attributions. These findings likely reflect documented knowledge gaps in cancer risk awareness where those with lower education levels are less aware of skin cancer risk factors and methods of prevention (Hay, Coups, Ford, & DiBonaventura, 2009), as well as documented gender effects in illness risk perceptions showing heightened risk awareness in women (Finucane, 2000) and gender effects regarding awareness of the role of genetic factors in cancer (Parrott, Silk, & Condit, 2003). The current investigation documents that more highly educated individuals are more likely to link these risk factors to their own personal risk. Furthermore, younger participants with higher perceived risk tended to endorse phenotypic attributions; this relationship was not as pronounced for those aged 50 and older, which may reflect greater knowledge of the melanoma risk-sensitive phenotype relationship in younger family members. We expected there to be greater salience of all attributions in those with higher perceptions of risk given the role of attributions in shaping level of perceived risk (Kelly, et al., 2005; Lipkus, Biradavolu, Fenn, Keller, & Rimer, 2001; Lipkus, et al., 2005; Ponder, Lee, Green, & Richards, 1996). It is likely that heredity was a particularly salient attribution among first-degree relatives because of their position as

a melanoma first-degree relative, and knowledge of this as a risk factor for melanoma, and that personal history of melanoma was a salient attribution among cases because of their recent diagnosis of melanoma. We did not identify significant predictors of miscellaneous attributions.

The inclusion of the parent family member type - those family members who had primary responsibility for the health of a child in the family who was also related to the case - has not been assessed in prior studies of personal risk attributions for melanoma risk. Parents beliefs were distinct in the following ways. First, parents were as likely to report personal attributions to heredity as were first-degree relatives, and this effect was largely due to the heredity attributions of female parents. Second, parents were more likely to endorse phenotypic attributions than were first-degree relatives. Third, parents risk perceptions for melanoma exceeded levels reported by first-degree relatives, although both groups reported significantly lower melanoma risk perceptions compared to cases. Taken together, these findings indicate that parents were aware of the heightened risk status of their family and may even overestimate their heredity attributions. While parents attributions for personal risk may differ from the risk attributions they have for their children, these findings may potentially be useful in guiding their personal sun protection choices for their families, and should be addressed in the development of melanoma family interventions. These findings highlight the potential impact of a family melanoma diagnosis on family members beyond first-degree relatives, and that interventions to inform accurate risk perceptions and prevention opportunities may be well-received by these family members.

These findings specifically inform the development of risk communication interventions for melanoma survivors, melanoma first-degree relatives, and other members of families that have been affected by melanoma in the following ways. First, the role of UVR exposure as a risk attribution was noted in such a high proportion of participants in melanoma-affected families that it may not be necessary to focus on it in risk communication interventions targeted to these families. Second, attributions to heredity, while common, were only noted by 58% of first-degree relatives in this population, making this a useful focus for attention in risk communication interventions with this at-risk population. This may be because they are unaware that family history or genetic factors are risk factors for melanoma (Kasparian, Butow, Meiser, & Mann, 2008) or because they do not necessarily appreciate their own heightened risk due to family history (Bergenmar & Brandberg, 2001), especially when they do not share the same skin type as the index patient (Hay, et al., 2008). At the same time, given that a large proportion of first-degree relatives who are aware that their family history increases their risk, strategies for risk communication may usefully focus on issues of risk overestimation as well, as it may be important to point out to these first-degree relatives that their relative likely does not have a hereditary melanoma that would dictate dramatically increased risk. Third, while most of those who attributed their risk to their personal history of melanoma were indeed cases, only 29% of cases made this attribution, indicating that a large proportion of these population-based melanoma cases may not be aware that their melanoma history places them at increased melanoma risk. Finally, attributions to phenotype may be an important area to address in intervention as many factors were reported–including frequency of moles, and skin, eye, and hair color - but these factors were reported much less frequently than sun exposure per se, raising concern that those who may have sun-sensitive phenotypes may underappreciate these risk factors that may increase risk even if they are not chronically sun exposed. Intervention strategies that involve elicitation of these melanoma risk attributions will help participants identify and overcome tacit beliefs that may moderate reactions to risk communication interventions. The intervention priorities outlined above may be usefully integrated into existing skin cancer risk reduction interventions.

While our findings are most relevant for populations at-risk for melanoma, they may also be useful for a broader segment of the general population, as well. In prior work, (French & Hevey, 2008) examined personal attributions for skin cancer in 40 college students unselected for risk status, and found that half (20 students) reported attributions to UVR exposure, and a third (14 students) endorsed either heredity, genetic, or phenotypic characteristics as attributions. These rates of endorsement are lower than for the comparable attributions reported in our at-risk families, accordingly in a general population sample we would anticipate that overall rates of personal attributions would be lower, with higher endorsement of no personal attributions, and very few personal attributions to heredity. We would also anticipate that UVR exposure is likely a well-understood personal risk attribution that may best translate to general population samples.

Our findings document that these individuals have multiple attributions with which they justify their melanoma risk that represent an amalgam of prior knowledge, their own family and medical experiences with the disease, as well as individual differences in the salience of qualitatively different risks (Hay, et al., 2007). Knowledge of the causes of cancer is likely an important determinant of personal risk attributions, with documented low levels of cancer risk factor knowledge in the general population (Breslow, Sorkin, Frey, & Kessler, 1997; Goldman, et al., 2006; Keighley, et al., 2004). Yet even though individuals may know the actual risk factors for the type of cancer in question, they may also resist acknowledging that those factors are important in influencing *their* risk (Cerully, Klein, & McCaul, 2006; Shiloh, Drori, Orr-Urtreger, & Friedman, 2009; Weinstein, 1980; Weinstein, 1984, 1987; Weinstein & Lachendro, 1982). Exposure to colorectal cancer risk communication interventions that aim to increase individuals risk perceptions have not been fully successful (Blalock, DeVellis, Afifi, & Sandler, 1990; Lipkus, et al., 2005; Lipkus, et al., 2004). Accordingly, our results highlight the need to address risk attributions that may be subjectively important to the formulation of risk perceptions, rather than to impose accurate information with the hopes that it will trump the subjective perceptions of risk. A clear understanding of the risks as well as one s subjective beliefs about the applicability of risks to one s personal circumstances is a necessary (albeit insufficient) condition to support behavior change related to melanoma risk reduction. However, we have confidence in our findings since the study was conducted in a large, general population sample, and also because self-referred individuals tend to have *greater* knowledge of cancer risk factors than the general public (Henrikson, Harris, & Bowen, 2007).

The inclusion of qualitative and quantitative research methods employed is an important strength of the study. Qualitative assessment of open-ended responses to risk attribution questions tap beliefs that come to mind with ease; this inductive approach imposes fewer a priori assumptions concerning attribution content and thus may be most relevant to individuals risk perceptions, awareness of health risks, and spontaneous behavioral decision-making. Alternatively, checklist methods provide participants with an a priori list of causal attributions where participants are asked to endorse factors from the list, or rate their level of agreement via a Likert-type item (Moss-Morris, et al., 2002; Weinman, 1996). Closed-ended approaches may overestimate the frequency of attributional beliefs and may not tap a full range of participants responses (Ostroff, Hay, Schantz, & Maher, 2000). In future work, the use of multiple assessment strategies in studies examining cancer risk attributions and behavioral outcomes may provide the clearest picture concerning which attributions are most salient, or the most motivating, in the melanoma context.

There are some study limitations that are important to note. First, our study was cross-sectional. We suggest that future work to examine whether melanoma risk attributions change over time, could provide valuable insights into the stability (or not) of these notions– something that may be particularly important to understand better within the realm of

intervention research in this area. Additionally, heredity attribution rates might have been inflated in this study due to the salience of the study rationale (to help them reduce melanoma risk); individuals with comparable risk profiles in the general population may have lower levels of appreciation of their heredity melanoma risks than we report in this sample, and this requires further study.

In conclusion, in work showing that risk factor information did not consistently affect risk attributions for colorectal cancer, Lipkus noted, “It may be premature to try to affect risk perception via colorectal risk attributions without a more comprehensive understanding of these processes”(Lipkus, et al., 2004). In our future research, we will examine changes in attributions prospectively in these groups (cases, first-degree relatives, parents) as they are affected by the web-based educational intervention. Further work examining the nature of subjective risk perceptions for various cancers–including within-subject variation in these attributions across time and in the context of intervention - will provide important information concerning novel approaches to intervening on cancer risk perceptions, and highlight basic processes that contribute to the stability of individuals beliefs about their cancer risk.

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Table 1

Demographic information (N = 939)

Demographic variable	n	%
Family member type		
Case	313	33.3
First-degree relative	313	33.3
Parent	313	33.3
Gender		
Female	579	61.7
Male	360	38.3
Age		
Under 50	451	48.0
50 and older	488	52.0
Income[a]		
< $15K	21	2.2
$15K – $30K	48	5.1
$31K – $50K	138	14.7
$51K – $70K	192	20.4
$71K – $99K	185	19.7
>$99K	296	31.5
Race[b]		
White	907	96.6
Bi- or Multi-racial	28	3.0
Hispanic origin		
No	934	99.5
Yes	5	0.5
Education[c]		
< High school (HS)	3	0.3
Some HS	6	0.6
HS/GED	82	8..7
Some college	268	28.5
College degree	579	61.7
Marital status		
Never married	62	6.6
Married/living as married	764	81.4
Separated	9	1.0
Divorced	76	8.1
Widowed	28	3.0
SEER summary stage		
Not applicable	626	67.7
In situ	38	4.0
Localized	247	26.3

Demographic variable	n	%
Regional, direct extension only	2	0.2
Regional, regional lymph nodes only	17	1.8
Unstaged	2	0.2
Year of diagnosis		
Not applicable	626	66.7
1998	44	4.7
1999	64	6.8
2000	70	7.5
2001	41	4.4
2005	94	10.0

[a] Seven participants (0.7%) reported that did not know their income and 52 participants (5.5%) refused to answer.

[b] Four participants (0.4%) refused to provide their race.

[c] One participant (0.1%) reported that they did not know their highest level of education.

[d] Four participants (0.4%) did not have any tumor information and two participants (0.2%) had non-skin melanoma.

Table 2

Frequencies of risk attribution categories organized by response order (N = 939)

	1st Response		2nd Response		3rd Response		4th Response		Total Responses		Total Participants	
Risk Attribution Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Sun exposure	372	40.0	212	32.8	62	24.5	19	24.4	665	34.9	574	61.1
"I work outside in the yard a lot and haven't been good about covering up in the past"												
Heredity/genetics	232	24.9	145	22.4	56	22.1	11	14.1	444	23.3	418	44.5
"Melanoma runs on both sides of my family"												
Sun exposure as a child	86	9.2	86	13.3	36	14.2	7	9.0	215	11.3	205	21.8
"I was raised on a lake and ran around all day without sunscreen"												
Phenotype	70	7.5	64	9.9	21	8.3	7	9.0	162	8.5	155	16.5
"Blonde hair, blue eyes"												
Personal history of melanoma	69	7.4	31	4.8	18	7.1	1	1.3	119	6.2	114	12.1
"The fact that I've already had it"												
Stress	6	0.6	8	1.2	-	-	-	-	14	0.7	14	1.5
"Stress in my life is a big factor"												
Many moles	15	1.6	17	2.6	15	5.9	8	10.3	55	2.9	54	5.8
"I have tons of moles"												
Combination of risks	31	3.3	19	2.9	5	2.0	4	5.1	59	3.1	54	5.8
"Melanoma in the family and many precancerous moles removed"												
Many tanning experiences	6	0.6	-	-	-	-	-	-	6	0.3	6	.6
"Too much tanning; I love the feeling of sun on my skin"												
Use of tanning booths or beds	3	0.3	5	0.8	1	0.4	1	1.3	10	0.5	10	1.1
"Definitely my use of tanning booths increases risk"												
Age	2	0.2	1	0.2	3	1.2	-	-	6	0.3	6	.6
"My age"												
Miscellaneous comments	16	1.7	47	7.3	29	11.5	16	20.5	108	5.7	93	9.9
"Pollution is my biggest concern; paint etc"												
Not at risk	13	1.4	3	0.5	2	0.8	-	-	18	0.9	16	1.7
"I do not feel I'm at risk."												
Don t know/no response	9	1.0	9	1.4	5	2	4	5.1	27	1.4	21	2.2

	1st Response		2nd Response		3rd Response		4th Response		Total Responses		Total Participants	
Risk Attribution Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total attributions for each response	930		647		253		78		1908			

Table 3

Frequencies of attributions by predictor (N =939)

	UVR Exposure		Heredity		Phenotype		Personal Hx Melanoma		Miscellaneous	
Predictor	**n**	**%**	**n**	**%**	**N**	**%**	**n**	**%**	**n**	**%**
Family member type										
Case	242	77.3	76	24.3[a]	79	25.2	90	28.7[a]	43	13.7[a]
FDR*	253	80.8	180	57.5[b]	64	20.4 a	18	5.7[b]	35	11.2
Parent	256	81.8	184	58.8[b]	87	27.8 b	6	1.9[c]	26	8.3[b]
Gender										
Female	465	80.3	297	51.3[a]	164	28.3[a]	75	12.9	71	12.3
Male	286	79.4	143	39.7[b]	66	18.3[b]	39	10.8	33	9.1
Age										
Below 50	362	80.3	254	56.3[a]	124	27.5[a]	35	7.8[a]	45	10.0
50 and older	389	79.7	186	38.1[b]	106	21.7[b]	79	16.2[b]	59	12.1
Education										
Up to HS	72	79.1	27	29.7[a]	11	12.1[a]	10	11.0	9	9.9
Some college	207	77.2	127	47.4[b]	73	27.2[b]	32	11.9	33	12.3
Graduate	472	81.5	286	49.4[b]	146	25.2[b]	71	12.3	61	10.5
Marital status										
Not married	137	78.3	81	46.3	42	24.0	18	10.3	22	12.6
Married	614	80.4	359	47.0	188	24.6	96	12.6	82	10.7
Income										
Up to 70K	315	78.9	176	44.1	102	25.6	52	13.0	45	11.3
Over 70K	396	82.3	233	48.4	115	23.9	55	11.4	51	10.6
Perceived risk										
Low risk	365	80.0	167	36.6[a]	81	17.8[a]	39	8.5[a]	51	11.2
High risk	379	80.3	267	56.6[b]	148	31.4[b]	73	15.5[b]	51	10.8

Notes:

*First-degree relative. Within each predictor, significant differences ($p < .05$) between levels are denoted by different letters (levels with the same letter are not significantly different). Significance tests calculated using GEE to correct for clustering.

Table 4

Logistic regression results of the demographic predictors regressed on the five attribution types

	UVR Exposure	Heredity	Phenotype	Personal HX Melanoma	Miscellaneous
Predictor	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Family member type					
FDR* vs Case	1.26 (0.83–1.89)	5.77 (3.92–8.49)*	0.74 (0.50–1.12)	0.16 (0.09–0.28)*	0.86 (0.51–1.48)
Parent vs Case	1.24 (0.80–1.93)	4.78 (3.08–7.42)*	0.97 (0.62–1.50)	0.04 (0.01–0.10)*	0.58 (0.30–1.12)
Gender					
Female vs Male	1.09 (0.75–1.59)	1.38 (1.00–1.91)	1.53 (1.07–2.18)*	1.64 (1.02–2.66)*	1.38 (0.83–2.27)
Age					
Under 50 vs	0.96 (0.65–1.42)	1.22(0.87–1.69)	1.17 (0.81–1.70)	0.86 (0.50–1.48)	0.92 (0.54–1.58)
50 and over					
Education					
≤ High School vs College graduate	0.85 (0.47–1.54)	0.42 (0.25–0.71)*	0.40 (0.21–0.79)*	0.61 (0.28–1.32)	0.92 (0.42–2.00)
Some college vs College graduate	0.77 (0.52–1.14)	0.76 (0.54–1.08)	1.07 (0.76–1.55)	1.10 (0.63–1.93)	1.17 (0.72–1.90)
Marital status					
Not married vs Married	0.92 (0.59–1.46)	0.89 (0.60–1.32)	0.89 (0.57–1.39)	0.52 (0.28–0.95)*	1.13 (0.64–1.99)
Income					
≤ 70K vs > 70K	0.87 (0.60–1.26)	0.88 (0.65–1.21)	1.17 (0.84–1.64)	1.08 (0.68–1.71)	0.93 (0.57–1.50)
Perceived risk	1.08 (0.80–1.34)	1.84 (1.55–2.18)*	1.57 (1.31–1.89)*	1.61 (1.24–2.09)*	1.07 (0.82–1.39)

Notes:

*First-degree relative. Each three-level categorical variable (family member type and education) was recoded into a pair of dichotomous variables prior to their inclusion into the regression models to reflect the most relevant comparisons. The direction of each dichotomous variable is noted below, with the reference category listed second.