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Examining intuitive risk perceptions for cancer in diverse populations

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Abstract

In this article we examine intuitive dimensions of personal cancer risk likelihood, which theory and empirical evidence indicate may be important elements in the risk perception process. We draw on data from a study of risk perceptions in three social groups, university students, men living in the community, and primary care patients living in urban area. The study took place in 2007-2011, in New York State (Garden City and New York City) and Boston, Massachusetts. This study used items developed from categories identified in prior qualitative research specifying emotions and attitudes activated in cancer risk determination to examine perception of cancer risks. Across three samples - university students (N=568), community men (N=182), and diverse, urban primary care patients (N=127) - we conducted exploratory factor and construct analyses. We found that the most reliable two factors within the five-factor solution were Cognitive Causation, tapping beliefs that risk thoughts may encourage cancer development, and Negative Affect in Risk, assessing negative feelings generated during the risk perception process. For these factors, there were high levels of item endorsement, especially in minority groups, and only modest associations with established cancer risk perception and worry assessments, indicating novel content. These items may prove useful in measuring and comparing intuitive cancer risk perceptions across diverse population subgroups.

Keywords

intuition; risk; risk perceptions; diverse populations; measure development; cancer risk perceptions; decision-making

Introduction

In this article we describe the development and evaluation of a novel set of self-report items to assess intuitive risk perceptions for cancer. Our objectives are to examine the

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endorsement of these items across diverse participant samples, to examine the underlying dimensions or themes represented by the items, and finally to compare the newly developed items to established scales of cancer risk perception and worry. We included racially, culturally, and socioeconomically diverse samples to examine the functioning of the items to enhance their applicability for future research in such populations.

Cancer and risk perception

Beliefs about cancer underpin cancer risk perceptions and are key components of decisions regarding both screening and preventive behaviour (Slovic *et al*., 2005). This assertion is consistent with most individual-level theories of health behaviour (Conner and Norman, 2005), and with extensive empirical research (Woloshin *et al*., 2000, Watts *et al*., 2003). In fact, risk perceptions are often better predictors of health actions than objective risk status (Aiken *et al*., 1995, Lipkus *et al*., 2000).

Almost always, the only beliefs considered by these theories and investigations are the perceived likelihood (that is probability) and severity of cancer. This focus follows from a view of health behaviour as the outcome of a deliberative analysis that weighs the costs and benefits of action. These cancer risk perceptions are typically measured using one or more face-valid questions (Weistein, 1980, Weinstein, 1982, Diefenbach *et al*., 1993, Lipkus and Hollands, 1999). Implicitly equating risk perceptions with magnitude judgments for likelihood and severity is based on the assumption that people respond to cancer risk in a rational, rule-based manner.

Yet, commentators drawing on recent theoretical development and empirical evidence question the exclusive focus of past research on rational deliberation, and highlight the importance of gut-level, intuitive processes, both thoughts and feelings, in the risk perception process. Cameron and Leventhal (Cameron and Leventhal, 2003) outlined the Self-Regulation Model based on the processing of health information, both through rational and deliberative processes as well as affective processes. Social psychologists have identified the importance of emotion in the rapid, automatic formulation of cancer risk judgements and other decisions as the affect heuristic (Finucane *et al*., 2000, Slovic *et al*., 2002, Slovic *et al*., 2005, Peters *et al*., 2006) as well as fuzzy trace theory (Reyna and Brainerd, 2011). They highlight the key role of emotion and thoughts in the rapid, automatic formulation of cancer risk judgements and other decisions, which represent short-cuts used to avoid the time and cost of rational analysis. The Risk-as-Feelings hypothesis (Loewenstein *et al*., 2001) proposes that both feelings generated while risk information is being processed and feelings associated with the hazard itself are important to the risk assessment. Researchers have shown that a feelings-of-risk measure is more effective in predicting risk-prevention behaviour than a probability magnitude measure (Weinstein *et al*., 2007, Dillard *et al*., 2012). Finally, superstitious thinking surrounding risk assessments has been examined in the social psychological literature (Wegner and Wheatley, 1999, Subbotsky and Quinteros, 2002, Pronin *et al*., 2006, Risen and Gilovich, 2008) but has not been examined in the health context, yet may represent another intuitive process activated in risk perceptions. Accordingly, intuitive risk perceptions may involve gut-level reactions as well as feelings or affect.

Despite growing recognition of the importance of intuition in the risk perception process, there have been few efforts to fully explore and assess these potentially important constructs. Less restrictive research in cancer risk perception requires the development of novel measures that go beyond typical probability and severity judgments. It is critically important, as well, that these measures be developed and validated with input *at the outset* from diverse populations, since approaches to managing uncertainty in general (Hofstede, 2001), and the health risk perception process in particular, probably differ across cultures (Huerta and Macario, 1999, Francois *et al*., 2009, Joseph *et al*., 2009, Pasick *et al*., 2009, Lee, 2010).

In this article we aim to contribute to the development of valid measures that do justice to this health research priority. Accordingly we describe the development and evaluation of a novel set of self-report items to assess intuitive risk perceptions for cancer, our objectives are to examine the endorsement of these items across diverse participant samples, to examine the underlying dimensions or themes represented by the items, and finally to compare the newly developed items to established scales of cancer risk perception and worry. This expanded study of the risk appraisal process – both thoughts and feelings - may improve current interventions that seek to raise risk awareness, and may suggest new strategies to motivate cancer screening and cancer risk reduction behaviours, particularly in diverse populations where standard, risk-based interventions have not necessarily been useful (Vernon *et al*., 2011).

Methodology

In this article we draw on a study that developed out of our earlier work on risk perception. We start this section with a discussion of this earlier study and the ways its findings informed the subsequent study.

Initial work on cancer perception

In a study of smokers' perceptions of cancer risk Hay, the lead author of this article, and her colleagues Shuk, Cruz, and Ostroff (Hay *et al*., 2005a) utilised qualitative semi-structured interviews to examine the thought processes used by diverse, inner city, primary care smokers (N=15) as they considered their cancer risk. We used a variety of cancer risk likelihood questions as prompts to elicit participants' spontaneous thoughts and feelings generated during cancer risk deliberation. The findings of this study suggested that participants were not exclusively evaluating objective risk factors to judge their risk likelihood. Instead, many participants expressed a desire to maintain optimistic feelings in order to reduce their risk. They said, for example, 'You're never going to get me to say that I'm likely to get cancer, because I'm not going to put (out) that negative energy', or, 'I have a general philosophical practice to stay away from extremes...to not jinx myself'. Additionally, in-the-moment we found that participants frequently voiced emotions. Thus, one participant said that trying to quantify his cancer risk was too dangerous and frightening. Another stated that thinking about her risk made her feel 'very sad', like she was, 'letting somebody down'.

Using a grounded theory approach to guide systematic coding of this data, we (Hay *et al*., 2005a) developed a heuristic model describing the risk perception process, which includes a cognitive, deliberative process where established risk factors are considered, and an intuitive, emotional process that engages feelings and beliefs, and serves to shift risk perceptions either up or down. The model helps explain how and why individuals come to hold cancer risk perceptions that diverge from an exclusively rational assessment of their risk factors, helping to explain why risk perceptions for cancer do not always motivate health behaviour change. Category names and content describing these intuitive processes are summarised in Table 1.

Follow-up study

Given the relative lack of measurement strategies for intuitive risk perceptions, the objective of the follow-up study was to describe the development and evaluation of a novel set of self-report items to assess intuitive risk perceptions for cancer. This includes examination of the endorsement of these items across diverse participant samples, examination of the underlying dimensions or themes represented by the items, and finally comparison of the newly developed items to established scales of cancer risk perception and worry. We included a highly racially, culturally, and socioeconomically diverse sample for scale validation to enhance the applicability of future research in such populations.

Item Development

We based our initial item pool on our prior qualitative work (Hay *et al*., 2005a). To develop the item pool we conducted the following steps (DeVellis, 2003). First, two coders (qualitative methodologist, clinical health psychologist) used primary transcript data in Atlas.ti to re-read material coded within the following identified categories described in depth in our prior work (Hay *et al*., 2005a), philosophies about cancer risk, the power of thought, emotions/affect related to cancer risk, and personalised reactions to the risk perception. Each coder used primary source material to develop a set of items that closely matched the intent and language in the transcripts. Second, the coders convened to reconcile their item lists, and to confirm that they had sampled across the relevant categories – intuitive processes in cancer risk determination. Third, we convened a telephone conference with our expert panel, which included individuals with expertise in item development, risk perception assessment, public health disparities, qualitative methods and health psychology (See Acknowledgments for a full list of expert panel members). The panel was charged with reading the combined item pool and transcript material and providing suggested additions and improvements to the items. Fourth, the resulting item pool was presented to a focus group comprised of eight primary care patients (66 per cent male, aged 30-66) from diverse racial/ethnic backgrounds. Participants assessed item readability and comprehensibility, and suggested wording and item improvements. Finally, we brought the item pool back to the expert team for final suggestions. Response options for all items were: strongly disagree (1), disagree (2), agree (3) and strongly agree (4). A total of 47 items were moved to the item evaluation phase.

Item Evaluation

We evaluated the 47 items across three samples diverse in terms of age and socioeconomic background. We included a highly diverse sample to enhance the applicability of our work for future research in such populations.

- University students In 2007-2009, we surveyed 568 undergraduate psychology students at Adelphi University in Garden City (New York State) who participated in the study voluntarily during class time. All potential participants were given full information about the study and then provided informed consent before they completed a written questionnaire that included the 47 items and demographic questions. The participants were mainly women (78 per cent), predominantly young (median age was 19 years), White (69 per cent with 11 per cent Hispanic, 10 per cent African-American and 5 per cent Asian). The study underwent Institutional Review Board review and approval at Adelphi University and Memorial Sloan-Kettering Cancer Center (Approval 2001, IRB number 121).
- Community Men. In 2008, we sampled 182 men (aged 50 and older) drawn from a population of men who were participating in an unrelated study on screening for prostate cancer. The population and our sample was limited to men as prostate cancer only affects men. We mailed a study introduction letter to participants in the screening study with information about our study and inviting them to complete a consent form and a questionnaire that included the 47 items, plus questions on colorectal cancer risk perception and worry issues (described below) and demographic questions. We focused on risk perceptions and worry about colorectal cancer since colorectal cancer is common in the United States (American Cancer Society, 2014). For risk perceptions, we used a percent likelihood scale (0 to 100 per cent chance of developing colorectal cancer, (Weinstein and Nicolich, 1993, Weinstein *et al*., 2007). For worry, we used a four-point face-valid assessment of the frequency of worry about cancer (never to all the time) heavily used in the cancer prevention and control literature (Hay *et al*., 2005b). Most of the participants in the study were older (median age 60, age range 50 to 86), White (82 per cent), in a high income bracket (60 per cent earned over 70,000 US dollars a year) and had further or higher education and qualifications (71 per cent). The study underwent Institutional Review Board review and ethical approval in 2006 at Harvard School of Public Health.
- Primary care patients. In 2009-2011, we surveyed 127 urban primary care patients at Queens Hospital Center in New York City, New York. We approached patients in a hospital-based medical office waiting room with a flyer describing our study and requesting patients' participation. Research staff also provided verbal information to those who had questions about the study. Individuals who agreed to participated signed informed consent forms and completed a questionnaire that included the 47 items, colorectal cancer risk perception items and demographic questions. We used three different single-item scales to assess perceived risk (Weinstein and Nicolich, 1993) because colorectal cancer is common in the United States (American Cancer Society, 2011). The scales used for risk perceptions

included the percent likelihood scale (0 to 100 per cent chance of developing colorectal cancer) used in the Community Men sample described above, as well as a seven-point verbal likelihood scale (ranging from no chance to certain to happen), and a feeling-at-risk scale (strongly disagree to strongly agree; Weinstein *et al*., 2007). This group of participants was very different to the other two samples, most were immigrants (72 % born outside the USA); from ethnic minorities (only 3% were non-Hispanic white and most were either African-American, 32 per cent or Black Caribbean 31 per cent); were women (63 per cent); and middle aged (median age 46 years, ranging from 18 to 88 years). Most of the participants in this group reported that they had not attended college (68 per cent) and were in lower income brackets (of the 67 per cent who reported household income, 75 per cent reported it was less than 30,000 US dollars a year). The study underwent Institutional Review Board review and approval at Adelphi University and Memorial Sloan-Kettering Cancer Center (Approval 2001, IRB number 121).

Analysis

To examine the endorsement of these items across diverse participant samples and to examine the underlying dimensions or themes represented by the items, we used exploratory factor analysis (EFA) using the University sample with Mplus software version 6.11 (Muthen and Muthen, 2011) using weighted least squares means-and-variance adjusted estimation (WLSMV) given the ordinal nature of the items. Parallel analysis (Hoyle and Duvall, 2004, Raiche, 2010) was used a priori to suggest the number of factors to retain in the final EFA solution. An oblique (geomin) rotation was applied to the EFA solution to yield more easily interpretable factors. Items were grouped onto scales according to their highest factor loading, with each item belonging to a single scale. Scales were scored by first subtracting 1 from each item and then taking the average of each scales' constituent item scores, yielding scales with theoretical ranges from 0 to 3. Cronbach's alpha coefficients for each of the resulting scales were calculated using polychoric instead of Pearson correlations to account for the ordinal nature of the items (Zumbo *et al*., 2007). We tabulated the percentage of respondents answering 'agree' or 'strongly agree' to assess item endorsement levels. In order to compare the newly developed items to established scales of cancer risk perception and worry, we conducted construct analysis in the Community Men and Urban Primary Care surveys. The focus was on discriminant validity using Pearson Product-Moment correlations between the two strongest factors and established assessments of perceived risk and cancer worry.

Findings

Exploratory factor analysis and item description

We started our analysis with the pool of 47 potential items administered to the University sample. We examined the response frequencies, number of missing responses, and the wording and content of each item. As a result of this preliminary analysis, we dropped 18 items from the pool that had redundant content, confusing item wording, and/or a large number of missing responses (suggesting respondents had difficulty understanding the items). The remaining 29 items were entered into a pre-exploratory factor analysis (EFA)

parallel analysis that suggested that 5 factors be extracted from the data. We next examined 2- to 8-factor EFA solutions, using a 0.30 item loading cutoff for salience. The 5-factor solution (Table 2) yielded the most interpretable solution, consistent with the parallel analysis. These 5 factors included 28 of 29 items; DP1 was dropped due to poor loadings, and these accounted for 60.6 per cent of the variance in the items.

The first and strongest factor, *Cognitive Causation*, includes items that tap the belief that thoughts about cancer risk may encourage the development of disease, and that minimising such thoughts could actually reduce cancer risk. Accordingly, some of these items have a superstitious or magical nature. These items include the following: 'If I think too hard about the possibility of getting cancer, I could get it' (CC1), 'If I don't believe I will get cancer, I won't' (CC2), 'Negative thoughts about getting cancer might make me get it' (CC3), 'Considering that I could get cancer might bring on bad luck' (CC4), 'Too much thought about cancer risk could encourage the disease' (CC5), 'Being hopeful about my cancer risk might protect me from getting it' (CC6), 'Thinking that I am likely to get cancer may give me cancer' (CC7), 'In general, if a person thinks about the possibility of getting cancer they are more likely to get it' (CC8), 'In general, people who don't think too much about getting cancer tend to avoid it' (CC9), and 'For those who already have cancer, limiting their thoughts about cancer risk helps them avoid it' (CC10).

The second and next strongest factor, *Negative Affect in Risk*, taps feelings generated during the risk perception process. They include the following: 'I get frightened when I think I could get cancer' (NA1), 'Thinking about getting cancer makes me afraid' (NA2), 'I get a bad feeling just thinking about the possibility of getting cancer' (NA3), 'Thinking about my chances of getting cancer makes me uncomfortable' (NA4), 'I dread getting cancer' (NA5), and 'I can't think about getting cancer without feeling afraid' (NA6).

The third factor, *Unpredictability of Cancer*, keys into beliefs about irreducible uncertainties regarding whether any one person might get cancer. These items include the following: 'Anybody can get cancer no matter what they do' (UC1), 'Cancer can strike anyone at any time' (UC2), 'You never know who is going to get cancer' (UC3), 'Cancer is a random thing' (UC4), and, 'There is no way to know whether I might get cancer in the future' (UC5). The fourth factor, *Preventability*, assesses beliefs around the extent to which cancer development is controllable. These items include: 'If I follow my doctor's advice, I can greatly reduce my chances of getting cancer' (PR1), 'There isn't much anyone can do to control whether they get cancer or not' (PR2), 'Those who lead healthy lives get cancer just as often as those who don't have healthy lifestyles' (PR3), 'I don't believe there is much I can do to avoid getting cancer' (PR4), and 'There are a lot of things I can do to reduce my cancer risk' (PR5). Finally, the fifth factor, *Defensive Pessimism*, taps beliefs around the potential negative outcomes associated with being too optimistic about avoiding cancer. These items include: 'Believing that I won't get cancer could be risky' (DP2), and 'I don't want to be over-confident that I can avoid cancer' (DP3).

The descriptive findings for each item are shown in Table 3. Of note, three items (CC8-CC10) were not included in the Community Men sample as this survey was in the field when these items were suggested by the expert team. Endorsement (agree/strongly agree)

was highest for items relating to Unpredictability of Cancer and lowest for items concerning Cognitive Causation. Yet, endorsement for Cognitive Causation items was greater than expected. Cognitive Causation items were endorsed most highly in Urban Primary Care group and at lower, but not negligible, levels in the University and Community Men groups. For example, a sizable minority of participants agreed that if they think too hard about the possibility of getting cancer, they could get it (19 per cent, Urban Primary Care; 13 per cent, University; 6 per cent, Community Men). As well, nearly a fifth (18 to 20 per cent across University and Community Men samples) agreed that being hopeful about their cancer risk might protect them from getting it, as well as nearly half of Urban Primary Care participants (46 per cent).

Endorsement for the Negative Affect in Risk items was much higher than for Cognitive Causation items. Most participants agreed that thinking about their chances of getting cancer made them uncomfortable (56 per cent to 70 per cent across samples). Similarly, some items tapping the factor Defensive Pessimism were endorsed by most participants. For instance 70 per cent to 79 per cent across samples agreed that they did not want to be over-confident that they could avoid cancer. Finally, study participants saw cancer as both unpreventable and preventable, in seemingly contradictory ways. Thus, 85 per cent or more within each sample agreed that anybody could get cancer no matter what s/he does; yet a similar proportion (83 per cent or more) agreed that there were a lot of things s/he could do to reduce cancer risk.

Items comprising factors 3-5 (Unpredictability of Cancer, Preventability, and Defensive Pessimism) showed consistent agreement across samples that cancer was unpredictable or unknowable. More than 85 per cent of participants across samples agreed that: ‘anybody can get cancer, no matter what they do’. More than 90 per cent of participants across samples agreed that:‘cancer can strike anyone at any time’. Here again, there appeared to be a simultaneous acceptance of contradictory beliefs. In Urban Primary Care, for example, 91 per cent agreed that: ‘there are a lot of things I can do to reduce my cancer risk’ yet 51 per cent of this group agreed that: ‘there isn’t much anyone can do to control whether they get cancer or not’.

Construct analysis

Our construct validation findings concerning the two most reliable factors, Cognitive Causation and Negative Affect in Risk, are reported in Table 4. Cognitive Causation was significantly negatively related to percent likelihood but not verbal or feelings of risk perceived likelihood assessments in Community Men, although this correlation was small. In contrast, Cognitive Causation was related to higher levels of all perceived risk likelihood assessments in the sample drawn from Urban Primary Care, indicating that those who think their risk is higher may also be more superstitious concerning their thoughts about their risk. Negative Affect in Risk was positively related to cancer worry in Community Men. In each case, however, the correlations were not high enough to indicate that either of these constructs were highly confounded with established assessments of risk perceptions or worry.

Discussion

In this article we identified two reliable dimensions of intuitive cancer risk perceptions, with a novel set of items to assess them. We described endorsement rates for the items generated and the initial factor structure and internal reliability of the factors. We examined the consistency of the resulting strongest factors, Cognitive Causation and Negative Affect in Risk, across diverse samples, and finally we reported the relation of these factors to established risk perception measures. We included a racially, culturally, and socioeconomically diverse sample for scale validation to enhance the applicability of future research in such populations. Our ability to capture intuitive elements of the risk appraisal process could potentially improve current approaches toward raising cancer risk awareness that focus narrowly on raising statistical likelihood estimates. This may be particularly important, but not limited to, populations with lower levels of acculturation, health literacy, and lower educational attainment.

Cognitive Causation items tap the belief that thoughts about cancer risk may encourage the development of disease, and that minimising such thoughts could actually reduce cancer risk. Cognitive Causation was internally reliable across all four samples assessed, and these items received endorsement across all three samples, even in highly educated samples such as our University and Community Men samples. We found that Cognitive Causation was related to heavily used risk perception measures (likelihood and feelings of risk) in the small to moderate range, indicating minimal overlap with existing assessments of risk.

The role of superstition and magical thinking as a specific type of cognitive heuristic that surrounds risk assessments has been examined in the social psychological literature (Wegner and Wheatley, 1999, Subbotsky and Quinteros, 2002, Pronin *et al*., 2006, Risen and Gilovich, 2008). The widespread acceptance of superstitions concerning risk is evidenced by the lack of 13th floors in many hospitals and hotels, the continued presence of horoscopes in magazines and newspapers, the ubiquity of ‘knock on wood’ and ‘crossing fingers’ to avoid tempting fate (Sherman *et al*., 1985, Risen and Gilovich, 2008), and mental efforts and rituals meant to gain the best outcome among sports figures and fans, and gamblers (Cartwright-Hatton and Wells, 1997, James and Wells, 2002, Torgler, 2007). Prior assessments of African-American acculturation has included items tapping superstitious thinking (Landrine and Klonoff, 1994). Beliefs that certain thoughts or behaviours ward off negative events are quite common in the United Kingdom as well (Wiseman and Watt, 2004). Our findings indicate that they are important in spontaneous responses to cancer, specifically (Windschitl, 2002). The current work represents an application of these ideas in the context of health risk.

Negative Affect in Risk was also highly reliable across all samples assessed. This factor was significantly positively correlated with cancer worry in the Community Men sample, but this correlation was modest enough to indicate discrimination among these constructs. The Risk-as-Feelings hypothesis (Loewenstein *et al*., 2001) states that feelings generated while risk information is being processed (anticipatory affect), in addition to the emotions associated with a hazard (anticipated affect) are both uniquely important in the risk assessment. We propose that Negative Affect in Risk examines anticipatory affect, or emotions generated

during risk information processing. Recently Negative Affect in Risk has been found to be highly reliable and associated with reduced intentions for colorectal cancer screening in first-degree family members of colorectal cancer patients (Boonyasiriwat *et al*., 2013).

Importantly, the psychometrics of Cognitive Causation and Negative Affect in Risk were strong across our Urban Primary Care sample, an inner-city, highly diverse group of mostly foreign born participants. In general endorsement levels for the items were higher in this urban sample than in the other samples, indicating the particular relevance of the items for this group.

In fact, superstitious thinking about the occurrence of future events may be embedded in cultural beliefs systems (Darke and Freedman, 1997, Subbotsky and Quinteros, 2002), but in general, risk perceptions in diverse populations are under-researched (Huerta and Macario, 1999). Our commitment to conducting this work in a primary care population with exceptionally rich demographic diversity will ultimately enhance the generalisability of the scales, as it will allow us to document differences in cancer risk beliefs across different population subgroups. Further work in diverse populations is warranted, as well as comparison across racial/ethnic groups, education levels, and among those who were and were not born in the United States.

The beliefs associated with item endorsement for factors 3-5 (Cancer Unpredictability, Preventability and Defensive Pessimism) showed lower reliabilities, but warrant further examination. These beliefs may hamper individuals' abilities to formulate judgments about the actual size of the risk. Perhaps this same inability to think quantitatively about risk likelihood explains the simultaneous acceptance of contradictory beliefs such as cancer being preventable, but uncontrollable. The perceptions that cancer risk is unknowable, or a 'toss up', may explain the frequency of '50 per cent' responses on percentage likelihood scales (de Bruin *et al*., 2000, Cameron *et al*., 2009, Bruine de Bruin and Carman, 2012) and high rates of responding 'I don't know' to risk perception questions (Waters *et al*., 2013). Future work could usefully examine whether these beliefs are a specific manifestation of fatalism in the context of cancer risk determination, and could extend this work to nationally representative and international participant samples.

Conclusion

Both Cognitive Causation and Negative Affect in Risk show strong psychometrics and represent novel dimensions of cancer risk perceptions. These factors may play important roles in the adoption of risk reduction behaviours and cancer screening. Critical next steps in the research involve examination of behavioural manifestations of Cognitive Causation and Negative Affect in Risk. The particularly high levels of endorsement of these items in the lower-income and minority groups studied suggests that these beliefs may be operative when cancer control and prevention interventions that prompt personal cancer risk assessments are conducted. Awareness of the diverse range of beliefs about cancer will ultimately result in effective intervention strategies that will benefit everyone.

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Table 1

Affect and Attitudinal (Intuitive) Processes of Risk Perception*

Category Name	Definition	Content summary
Philosophies about cancer risk	Global beliefs about how cancer risk works for self and others	• Unknowability • Unpredictability
The power of thought	Thoughts that directly influence probability of developing cancer	• Superstitious thinking about risk • Reluctance to be confident • Risk thoughts are dangerous • Importance of optimism
Emotions/affect in cancer risk	Emotions prompted by cancer risk determination	• Negative feelings • Loneliness or isolation
Personalised reactions to risk perception scales	Subjective reactions to risk perception scales	• Discomfort with numbers • Efforts to personalise numbers • Comfort with inconsistent numerical risks

* From (Hay *et al.*, 2005a)

Table 2

Rotated Exploratory Factor Analysis Solution (University Students, N=568)

Factor Name	Cognitive Causation	Negative Affect	Unpredict-ability	Prevent-ability	Defensive Pessimism
Cognitive Causation					
CC1 - If I think too hard about the possibility of getting cancer, I could get it.	0.827	0.050	0.168	0.061	−0.082
CC2 - If I don't believe I will get cancer, I won't.	0.644	−0.173	0.001	−0.012	−0.095
CC3 - Negative thoughts about getting cancer might make me get it.	0.835	0.104	0.002	−0.134	−0.105
CC4 - Considering that I could get cancer might bring on bad luck.	0.708	0.192	0.002	−0.032	0.038
CC5 - Too much thought about cancer risk could encourage the disease.	0.830	0.014	−0.019	0.053	0.072
CC6 - Being hopeful about my cancer risk might protect me from getting it.	0.703	−0.007	−0.018	0.156	0.005
CC7 - Thinking that I am likely to get cancer may give me cancer.	0.857	−0.002	−0.023	−0.105	0.016
CC8 - In general, if a person thinks about the possibility of getting cancer, they are more likely to get it.	0.736	−0.010	−0.043	−0.059	0.282
CC9 - In general, people who don't think too much about getting cancer tend to avoid it.	0.684	−0.125	−0.024	0.015	0.338
CC10 - For those who already have cancer, limiting their thoughts about cancer risk helps them get better.	0.511	−0.070	0.055	0.029	0.083
Negative Affect in Risk					
NA1 - 1 get frightened when I think I could get cancer.	−0.016	0.779	0.073	0.092	−0.089
NA2 - Thinking about getting cancer makes me afraid.	0.029	0.910	0.031	−0.024	−0.153
NA3 - 1 get a bad feeling just thinking about the possibility of getting cancer.	−0.035	0.823	−0.015	−0.027	0.007
NA4 - Thinking about my chances of getting cancer makes me uncomfortable.	0.010	0.871	−0.062	−0.029	0.060
NA5 - I dread getting cancer.	−0.043	0.747	−0.005	−0.001	0.028
NA6 - 1 can't think about getting cancer without feeling afraid.	0.090	0.750	0.029	0.047	0.085
Unpredictability of Cancer					
UC1 - Anybody can get cancer, no matter what they do.	−0.061	0.017	0.710	0.064	0.010
UC2 - Cancer can strike anyone at any time.	0.023	0.022	0.774	0.096	−0.029
UC3 - You never know who is going to get cancer.	−0.053	0.077	0.648	−0.072	−0.068
UC4 - Cancer is a random thing.	0.070	−0.121	0.513	−0.179	0.136
UC5 - There is no way to know whether I might get cancer in the future.	0.046	−0.078	0.483	−0.103	0.086
Preventability					
PR1 - If I follow my doctor's advice, I can greatly reduce my chances of getting cancer.	−0.050	0.113	0.000	0.527	0.010
PR2 - There isn't much anyone can do to control whether they get cancer or not.	0.028	−0.019	−0.393	0.517	0.040
PR3 - Those who lead healthy lives get cancer just as often as those who don't have healthy lifestyles.	0.095	−0.025	−0.351	0.373	−0.092

Factor Name	Cognitive Causation	Negative Affect	Unpredict-ability	Prevent-ability	Defensive Pessimism
PR4 - I don't believe there is much I can do to avoid getting cancer.	−0.005	−0.008	−0.335	0.616	0.008
PR5 - There are a lot of things I can do to reduce my cancer risk.	−0.048	0.016	0.000	0.633	0.011
Defensive Pessimism					
DP1 - 1 avoid thinking too positively about my cancer risk.	0.113	0.255	−0.094	−0.183	0.220
DP2 - Believing that I won't get cancer could be risky.	0.221	0.240	0.018	0.136	0.406
DP3 - I don't want to be overconfident that I can avoid getting cancer.	−0.088	0.122	0.116	−0.013	0.585
Geomin-Rotated Factor Correlations					
Cognitive Causation	1	0.123	−0.235	−0.114	0.197
Negative Affect in Risk	0.123	1	0.271	0.067	0.099
Unpredictability of Cancer	−0.235	0.271	1	−0.195	−0.027
Preventability	−0.114	0.067	−0.195	1	−0.027
Defensive Pessimism	0.197	0.099	−0.027	−0.027	1
Eigenvalues	6.59	4.97	3.30	1.42	1.29
Variance accounted for by factor (%)	22.71	17.15	11.38	4.91	4.44
Cumulative variance accounted for by solution (%)	22.71	39.86	51.24	56.15	60.59

Note. CA = Cancer; Dark shading: Loading greater than .45; Light shading: Loading less than .45 but greater than .30; No shading: values have a loading less than .30.

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Table 3

Item endorsement labels and scale reliabilities

Factor name	University Students	Community Men	Urban Primary Care
Cognitive Causation			
CC1 - If I think too hard about the possibility of getting cancer, I could get it.	12.9	6.0	19.1
CC2 - If I don't believe I will get cancer, I won't.	9.6	9.6	22.0
CC3 - Negative thoughts about getting cancer might make me get it.	8.5	8.2	17.9
CC4 - Considering that I could get cancer might bring on bad luck.	8.1	3.3	21.5
CC5 - Too much thought about cancer risk could encourage the disease.	9.9	10.4	23.0
CC6 - Being hopeful about my cancer risk might protect me from getting it.	18.3	19.8	45.5
CC7 - Thinking that I am likely to get cancer may give me cancer.	7.8	5.5	13.9
CC8 - In general, if a person thinks about the possibility of getting cancer, they are more likely to get it.†	10.6	-	16.0
CC9 - In general, people who don't think too much about getting cancer tend to avoid it.†	10.6	-	35.3
CC10 - For those who already have cancer, limiting their thoughts about cancer risk helps them get better. †	34.6	-	48.7
Scale Internal Consistency Reliability	α = 0.92	α = 0.92	α = 0.90
Scale Mean (Standard Deviation)	0.57 (0.51)	0.47 (0.49)	0.83 (0.67)
Scale Median (25th - 75th percentile)	0.5 (0.1 - 0.9)	0.29 (0.0 - 0.84)	0.65 (0.3 - 1.35)
Negative affect in risk			
NA1 -1 get frightened when I think I could get cancer.	79.4	63.5	70.2
NA2 - Thinking about getting cancer makes me afraid.	76.2	45.1	71.9
NA3 -1 get a bad feeling just thinking about the possibility of getting cancer.	70.9	50.6	68.9
NA4 -Thinking about my chances of getting cancer makes me uncomfortable.	70.4	56.0	67.8
NA5 -1 dread getting cancer.	81.0	62.2	71.7
NA6 -1 can't think about getting cancer without feeling afraid.	60.4	43.9	60.9
Scale Internal Consistency Reliability	α = 0.92	α = 0.89	α = 0.91
Scale Mean (Standard Deviation)	1.93 (0.7)	1.54 (0.61)	1.92 (0.84)
Scale Median (25th - 75th percentile)	2.0 (1.5 - 2.5)	1.5 (1.17 - 2.0)	2.0 (1.5 - 2.5)
Unpredictability of cancer			
UC1 - Anybody can get cancer, no matter what they do.	86.7	85.4	88.0
UC2 - Cancer can strike anyone at any time.	90.8	93.2	92.7

Factor name	University Students	Community Men	Urban Primary Care
UC3 - You never know who is going to get cancer.	91.9	91.2	92.7
UC4 - Cancer is a random thing.	50.6	48.1	71.4
UC5 - There is no way to know whether I might get cancer in the future.	68.8	70.7	70.0
Scale Internal Consistency Reliability	α = 0.76	α = 0.78	α = 0.78
Scale Mean (Standard Deviation)	2.1 (0.52)	2.07 (0.52)	2.32 (0.6)
Scale Median (25th - 75th percentile)	2.0 (1.8 - 2.6)	2.0 (1.8 - 2.4)	2.4 (1.8 - 2.8)
Preventability			
PR1 - If I follow my doctor's advice, I can greatly reduce my chances of getting cancer.	84.9	82.9	87.3
PR2 - There isn't much anyone can do to control whether they get cancer or not. ‡	48.6	27.6	50.8
PR3 - Those who lead healthy lives get cancer just as often as those who don't have healthy lifestyles. †	55.6	29.1	66.4
PR4 - 1 don't believe there is much I can do to avoid getting cancer. ‡	37.8	20.6	41.2
PR5 - There are a lot of things I can do to reduce my cancer risk.	83.4	90.6	90.8
Scale Internal Consistency Reliability	α = 0.73	α = 0.71	α = 0.54
Scale Mean (Standard Deviation)	1.76 (0.53)	1.99 (0.5)	1.79 (0.62)
Scale Median (25th - 75th percentile)	1.8 (1.4 - 2.2)	2.0 (1.8 - 2.4)	1.8 (1.2 - 2.3)
Defensive pessimism			
DP2 - Believing that I won't get cancer could be risky.	37.7	43.1	64.7
DP3 - 1 don't want to be over-confident that I can avoid cancer.	77.7	78.9	70.0
Scale Internal Consistency Reliability	α = 0.47	α = 0.42	α = 0.39
Scale Mean (Standard Deviation)	1.53 (0.67)	1.60 (0.66)	1.80 (0.89)
Scale Median (25th - 75th percentile)	1.5 (1.0 - 2.0)	1.5 (1.0 - 2.0)	2.0 (1.25 - 2.5)

† *Note*. Not included in the Community Men sample.

‡ These items were reversed to calculate Preventability subscale scores and alpha coefficient reliabilities.

Table 4

Associations of Cognitive Causation and Negative Affect in Risk with Established Colorectal Cancer Risk Perceptions and Worry Measurements

	Cognitive Causation†		Negative Affect in Risk	
	Community Men	Urban Primary Care	Community Men	Urban Primary Care
Perceived CRC risk				
verbal likelihood	−0.10	0.33†	0.10	0.05
percent likelihood	−0.16†	0.20†	0.16†	0.03
feelings of risk	−0.11	0.23†	0.05	0.14
CRC Worry	0.08	–	0.33*	–

Note. CRC = Colorectal Cancer. Results indicate Pearson's r correlation value and significance. Colorectal Cancer Worry was not assessed for Urban Primary Care.

† Cognitive Causation is based on the 7-item version. The 10-item correlation results for Urban Primary Care are even smaller with 0.26 for verbal likelihood, 0.17 for percent likelihood, and 0.18 for feelings of risk; none were significant.

* $p \leq .05$.

** $p \leq .01$.