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Testing a model of fear of cancer recurrence or progression: the central role of intrusions, death anxiety and threat appraisal

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Abstract We recently proposed a model of cancer-related anxiety to account for the etiology and maintenance of clinically significant anxiety in the context of cancer. This study tested predictions arising from the model to explain fear of cancer recurrence or progression (FCR). Patients with cancer were recruited from a research registry or outpatient hospital clinics (n = 211). In bivariate analyses, FCR was associated with metacognitive beliefs, intolerance of uncertainty, core belief disruption, less meaning in life, social constraints, death anxiety, intrusions, threat appraisal, and coping. A hierarchical regression explained 65% of the variance in FCR. FCR was predicted by younger age, intrusions, death anxiety, threat appraisal and meta-cognitions. The findings highlight the importance of both cognitive processes and content in FCR, including intrusions, fears about death and dying, beliefs about worry, and threat appraisals.

Keywords Fear of recurrence · Cancer · Theoretical model · Death anxiety · Cognitive processing

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Introduction

Fear of cancer recurrence or progression (FCR) is the "fear, worry or concern relating to the possibility that cancer will come back or progress" (Lebel et al., 2016, p. 3265). Understandably all patients with cancer have some concerns about recurrence or progression, but persistent and intense FCR is associated with high distress, impaired functioning and poorer quality of life (Simard & Savard, 2015). Currently there is no agreed definition of clinically significant FCR, but patients with high FCR are more likely to experience frequent intrusive thoughts that are difficult to control, believe more strongly that the cancer will return, describe more elaborated death-related thoughts, and feel alone in their experience (Mutsaers et al., 2016; Thewes et al., 2016; Simard et al., 2010). It has been estimated that about 49% of cancer patients experience FCR symptoms that are of moderate to high severity (Simard et al., 2013). Longitudinal studies suggest that without intervention, FCR continues over time, or decreases at the completion of medical treatment but remains stable thereafter (Simard et al., 2013).

In order to inform effective interventions for FCR, a meeting of international FCR experts in 2015 prioritized identifying the underlying features of FCR, developing theoretical models of FCR and empirically testing the proposed relationships (Lebel et al., 2017). To date, six theoretical models specific to FCR have been published (Fardell et al., 2016; Heathcote & Eccleston, 2017; Lebel et al., 2014; Lee-Jones et al., 1997; Mellon et al., 2007; Simonelli et al., 2017). These models share a number of common features. For instance, all models consider (1) triggers such as intrusive thoughts, physical symptoms or external reminders of the cancer, (2) threat appraisal or risk perception and (3) unhelpful coping responses such as rumination or avoidance. Consequently all the models consider, on some level,

the cognitive content and processes that are associated with FCR. However, the models can be differentiated by their particular focus on metacognitive beliefs about worry (Fardell et al., 2016; Lebel et al., 2014; Simonelli et al., 2017), intolerance of uncertainty (Lebel et al., 2014), cognitive biases towards physical symptoms (Heathcote & Eccleston, 2017) or the social context (Mellon et al., 2007; Simonelli et al., 2017). Surprisingly, while some models acknowledge that existential concerns including worries about death and dying may underpin FCR (Fardell et al., 2016; Lebel et al., 2014), only one model explicitly proposes that death awareness may impact on appraisal and processing responses (Simonelli et al., 2017). Further, while the original model of Lee-Jones et al. (1997) was applied to all patients across the disease trajectory, recent models have been developed for and tested on patients who have completed treatment and currently have no evidence of disease (e.g. Lebel et al., 2014). Consequently, the applicability of these models to patients in active treatment and those who have a high risk of recurrence or progression, is unclear.

Recently, a transdiagnostic model of cancer-related anxiety was developed to include issues that are likely to be relevant to all cancer patients including those with advanced disease who are experiencing realistic and ongoing threat (Curran et al., 2017). This model builds on earlier models of cancer-related anxiety, including FCR, as well as cognitive processing theories as they are applied to a life-threatening illness (e.g. Edmondson et al., 2011; Janoff-Bulman, 1992; Lepore, 2001; Park, 2010). In agreement with earlier models of FCR, the Curran model of cancer-related anxiety also proposes that pre-existing vulnerability factors (meta-cognitions, intolerance of uncertainty, need for control), contextual factors (social constraints), cognitive content (threat appraisal and intrusions) and coping responses impact FCR. However, the model places greater emphasis on existential factors in explaining individual responses to cancer, such as disruption to core beliefs, having a sense of global meaning and death-related fears. In particular, the model stresses that pre-existing schema about the self, relationships or the world may be questioned after a cancer diagnosis thereby creating feelings of instability, vulnerability and fear (Janoff-Bulman, 1992). Conversely, an overall sense that one's life is meaningful and purposeful despite the cancer, is proposed to be protective against distress (Park, 2010). The model proposes that death anxiety is more likely to emerge in response to worldview disruption and a sense that one's life is lacking meaning and purpose (c.f. Kesebir & Pyszczynski, 2014). Further, the content of death related worries, such as worries about how one may die, the impact of one's death for others or what happens after death, are expected to overlap with worries about disease recurrence or progression.

The aim of the current study was to test the assumptions of the Curran model of cancer-related anxiety to specifically predict FCR, regardless of illness stage or treatment trajectory. A diagrammatic representation of how the model was operationalised for this study is presented in Fig. 1. The following hypotheses were tested: First, higher FCR will be associated with existential factors (core belief disruption and less meaning in life), pre-existing vulnerabilities (metacognitive beliefs, intolerance of uncertainty, need for control) and contextual factors (social constraints) in bivariate analyses and these variables will each contribute unique variance to the prediction of FCR in a regression model. Second, the addition of variables that Curran et al. argued were central to the experience of FCR, namely death anxiety, threat appraisal and intrusions, would increase the variance accounted for in the model. Finally, it was predicted that maladaptive coping (rumination) and less engagement with valued activities (values based coping) would add unique variance to the statistical prediction of FCR.

Methods

Sample and procedure

Eligibility criteria for the study included (1) a previous or current diagnosis of cancer; (2) aged over 18, and (3) able to complete the questionnaires in English. Participants were recruited regardless of cancer site, stage or treatment phase. Participants were recruited from two sources. (1) Members of an online Australian research registry for people with breast cancer (BCNA Research & Survey Group) were invited to participate by email. The email included a detailed description of the study and a link was provided to allow participants to complete the questionnaire online. Recruitment was closed from the research registry when 150 people were recruited into the study. Of the 150 people who consented to participate, 136 completed the questionnaire (91% response rate). (2) Participants were also recruited from outpatient clinics at a public hospital cancer service. Potential participants were approached when they were attending haematology or oncology appointments. 179 potential participants were approached, 102 consented (57% recruitment rate) and 75 completed the questionnaire (42% response rate). The total combined sample included 211 responses.

Measures

In addition to demographic and treatment information, participants completed the following measures which have been previously established as having valid psychometric properties and demonstrated high internal consistency in the current sample (see Table 1 for Cronbach Alphas, see Supplement for more detailed information about each measure).

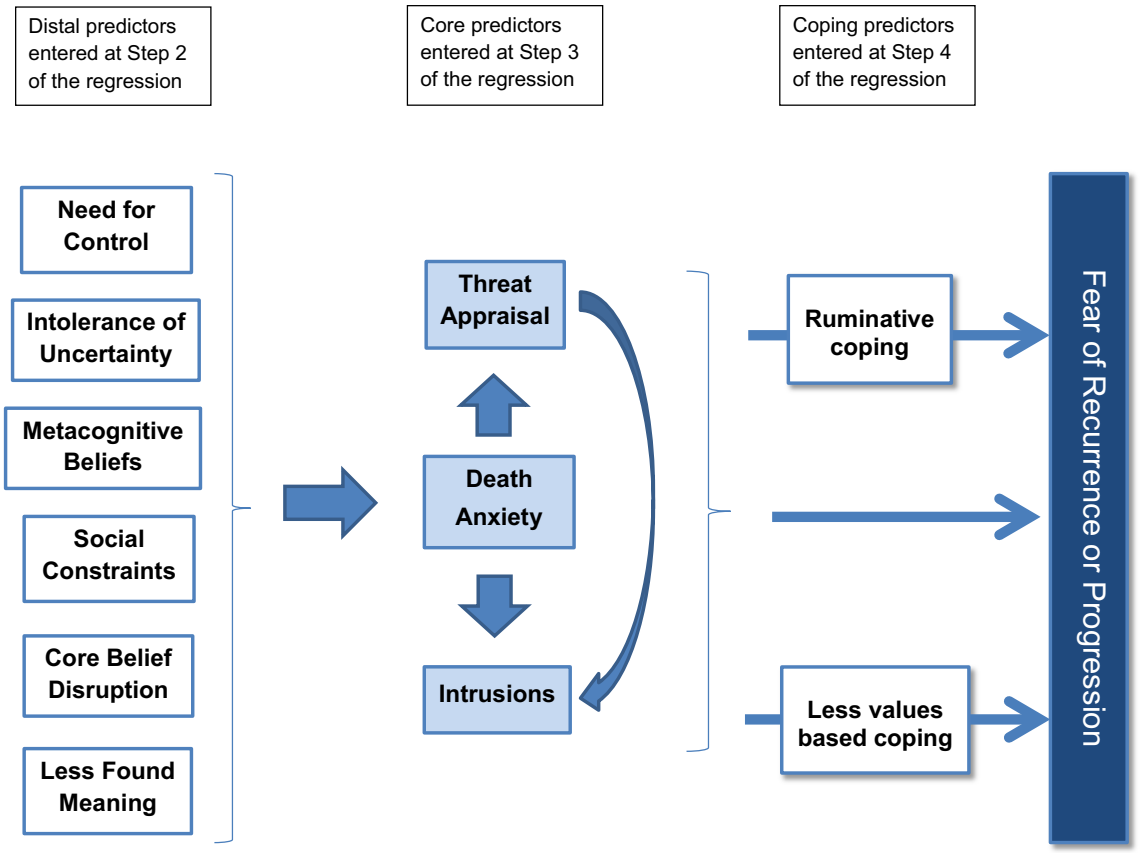

Fig. 1 Proposed model of fear of recurrence or progression

Fear of cancer recurrence or progression was assessed with the Fear of Progression Questionnaire—Short Form (FoP-Q-SF, Mehnert et al., 2006). The longer 43-item FoP-Q (Herschbach et al., 2005) received the highest rating in a review of FCR measures and is recommended for patients with advanced disease (Thewes et al., 2012). We used the 12-item short-form to decrease burden on participants. Possible scores range from 12 to 60 with higher scores reflecting more severe FCR. While a clinical level of FCR has not been established, a cutoff score of ≥ 34 on the FOP-Q-SF has been suggested (Sarkar et al., 2014).

Death anxiety was assessed with Death Anxiety Questionnaire (DAQ, Conte et al., 1982). The 15-item measure assesses worries about the process of dying and death. Possible total scores range from 0 to 30, with higher scores reflecting more death anxiety.

Disruption to core beliefs was assessed with the Core Beliefs Inventory (CBI, Cann et al., 2010). This 9-item measure assesses the degree to which core beliefs about the self, world or others are disrupted by a major life event. Possible total scores range from 0 to 45 with higher scores reflecting more core belief disruption. The items were worded to orientate the respondent to the cancer experience.

Found Meaning, or a sense that one's life has subjective meaning, was measured with the Meaning in Life Questionnaire—found meaning 5-item subscale (Steger et al., 2006). This measure received the highest rating in a review of meaning instruments (Brandstatter et al., 2012). Possible total scores range from 5 to 35 with higher scores reflecting greater found meaning in life.

Intrusions about the cancer was measured with the intrusions subscale of the Impact of Events Scale—revised (Weiss & Marmar, 1997). Participants were asked to consider the 8 scale items in respect to their cancer (range 0 to 32), with higher scores reflecting more frequent and intrusive thoughts about the cancer.

Threat appraisal was assessed with the threat subscale of the Appraisal of Life Events Scale (Ferguson et al., 1999). The six item subscale assesses primary appraisal and was worded to orientate participants to their cancer experience. Possible total scores range from 0 to 30, with higher scores indicating that the cancer experience was evaluated as more threatening.

Metacognitive Beliefs The Metacognitions Questionnaire (MCQ), short-form (Wells & Cartwright-Hatton, 2004) includes 5 subscales that assess beliefs about the utility of

Table 1 Demographic and medical characteristics

Variable	Sample range	Mean	SD
Age[b]	28.25–88.33	60.32	10.88
Time since diagnosis (years)[a]	.05–25.11	5.87	4.98
Frequency (percentage)			
Gender			
Female			177 (83.9)
Male			34 (16.1)
Cancer site/type			
Breast			150 (71.1)
Haematological			20 (13.7)
Colorectal			9 (4.3)
Prostate			9 (4.3)
Upper GI			5 (2.4)
Lung			3 (1.4)
Other			5 (2.4)
Stage at diagnosis[b]			
Localised			110 (52.4)
Locally spread			54 (25.7)
Metastatic			23 (11.0)
Do not know			23 (11.0)
Recent change in cancer?			
Yes			13 (6.2)
No			181 (85.8)
Do not know			17 (8.1)
Currently having treatment?			
No			95 (45.0)
Hormonal therapy			86 (40.8)
Radiotherapy			22 (10.4)
Chemotherapy			17 (8.1)
Herceptin			11 (5.2)
Immunotherapy			5 (2.4)
Other			2 (.9)
Currently making treatment decisions?[a]			
Yes			33 (15.8)
No			176 (83.2)
Marital status[b]			
Married/defacto			164 (78.1)
Single			23 (11.0)
Divorced/separated			14 (6.7)
Widowed			9 (4.3)
Live alone?[b]			
Yes			41 (19.5)
No			169 (80.5)
Education level[b]			
Year 10 or below			12 (5.7)
Year 12/HSC			25 (11.9)
TAFE certificate/diploma			44 (21.0)
University degree			67 (31.9)
Postgraduate degree			62 (29.5)
Employment status[b]			
Retired/pensioner			85 (40.5)
Part-time			60 (28.6)
Full-time			45 (21.4)
Home duties			11 (5.2)
Unemployed			7 (3.3)
Student			2 (1.0)
Country of birth[b]			
Australia			159 (75.7)
Other			51 (24.3)

[a]N = 209; [b]N = 210; otherwise N = 211

worry (positive beliefs), the perceived dangerousness or uncontrollability of worry (negative beliefs), beliefs about the need to control thoughts, confidence about one's memory abilities, and cognitive self-awareness. Previous research suggests that cancer-related anxiety and FCR are associated specifically with positive, negative and control beliefs (Butow et al., 2015; Cook et al., 2014). A composite score of only these three subscales was used in the current study. Possible total scores range from 18 to 72 with higher scores reflecting higher endorsement of maladaptive positive, negative and control metacognitive beliefs.

Intolerance of uncertainty was assessed with the short-form of the Intolerance of Uncertainty scale (Carleton et al., 2007). The scale includes 12 items (total scale range 12–60) with higher scores reflecting greater difficulty coping with future uncertainty including greater impacts on functioning.

Need for control over external events was assessed with the Desirability of Control Scale (Burger & Cooper, 1979). This 20-item scale measures the extent to which individuals like to make their own decisions, lead others and exert control with higher scores reflecting a greater need for control (total scale range 20–140).

Social constraints was measured with the Social Constraints Scale (Lepore & Ituarte, 1999). This 15-item measure was developed specifically for cancer patients and assesses the degree to which significant others attempt to suppress, minimize or ignore the expression of cancer-related concerns. Possible total scores range from 15 to 60 with higher scores reflecting more perceived experience of social constraints.

Rumination was assessed with the Perseverative Thinking Questionnaire (PTQ, Ehring et al., 2011). The 15-item PTQ assesses the assumed characteristics of repetitive negative thinking which may be differentiated from purposeful and productive processing (Ehring et al., 2011). Three scale items assess the intrusive nature of worrying thoughts so these items were removed from the total score to prevent

over-inflation of the PTQ with intrusions in the regression analysis. In the reduced 12-item scale, possible total scores range from 0 to 48 with higher scores reflecting more ruminative, unproductive thinking.

Engagement with values based coping Engagement with values as a way of coping was assessed with the Multidimensional Psychological Flexibility Inventory, five-item values subscale (Rolffs et al., 2018). Possible total scores range from 5 to 30, with higher scores reflecting more engagement with priorities and values.

Data analysis

Analyses were conducted using SPSS 22 software. Data was checked for missing data. Missing data was minimal and were computed as the mean of available items for that individual. One participant did not have their age recorded and was substituted with the average age of the sample. Skewness and kurtosis statistics were generated and indicated that all model variables were normally distributed. To test for multicollinearity, Variance Inflation Factor (VIF) scores were generated. A cut-off score < 1/(1-model R^2) was calculated (i.e. < 2.86) to ensure that the correlation between predictors was weaker than the regression relationship (Vatcheva et al., 2016). All model VIF scores were ≤ 2.71 suggesting that multicollinearity was not a problem. A power calculation was conducted using G*power (Faul et al., 2009). At $p < .05$, power was .85 to detect an effect size of $f^2 \geq .10$ (or an R^2 of .09) and .80 to detect an effect size of $f^2 \geq .09$ (or an R^2 of .08). This suggests that the study had power to detect at least medium effect sizes ($f^2 \geq .15$ corresponds to medium effect sizes; $f^2 \geq .02$ corresponds to small effect sizes; see Cohen, 1988).

Bivariate correlations, *T*-tests and one way ANOVAs were conducted to determine the relationship between FCR and demographic, disease and model variables. Hierarchical regression was used to test the study hypotheses. The order by which variables were entered into the regression was based on the Curran model as operationalized for this study (see Fig. 1). Demographic variables found to be associated with FCR were entered in the first step. The second step included the following predictors: intolerance of anxiety, metacognitions, core belief disruption, social constraint, found meaning, and desire for control (testing hypotheses 1). The core variables, death anxiety, threat appraisal and intrusions, were entered in the third step (testing hypotheses 2). Lastly, the fourth step included the coping variables: rumination and values based coping (testing hypothesis 3).

Results

The demographic and medical characteristics of the combined sample ($N = 211$) are presented in Table 1. Participants had a mean age of 60.3 years. The majority were female (84%), had a diagnosis of breast cancer (71%) and were university educated (61%). On average, time since diagnosis was 5.9 years. Around half of the sample (54.5%) was currently receiving treatment for their cancer and about 11% had metastases at diagnosis. The means, standard deviations, and correlations for all the variables considered in the model are presented in Table 2. The average FOP-Q-SF score was

Table 2 Descriptive statistics and correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Fear of recurrence or progression	.88											
2. Intrusions	.72	.90										
3. Death anxiety	.67	.62	.88									
4. Threat appraisal	.62	.58	.60	.92								
5. Need for control	− .04	.05	− .03	.01	.81							
6. Intolerance of uncertainty	.51	.50	.50	.38	.07	.91						
7. Metacognitive beliefs	.62	.59	.53	.52	− .01	.61	.80					
8. Social constraints	.49	.56	.49	.48	.04	.36	.40	.94				
9. Core belief disruption	.58	.53	.57	.47	.04	.51	.53	.37	.92			
10. Found meaning	− .34	− .39	− .42	− .34	.22	− .35	− .32	− .36	− .25	.92		
11. Rumination	.60	.65	.60	.63	− .05	.59	.64	.46	.51	− .47	.96	
12. Values based coping	− .17	− .28	− .26	− .25	.26	− .19	− .19	− .25	− .04	.57	− .30	.90
Mean	29.03	6.53	11.06	11.66	93.80	25.12	28.47	27.00	17.05	25.79	15.67	17.64
SD	9.40	5.89	6.25	8.34	15.41	8.89	6.86	10.60	11.76	6.83	9.40	4.42

$N = 211$, $r \geq .14$, $p < .05$; $r \geq .19$, $p < .01$; $r \geq .23$, $p \leq .001$

Internal consistency of measures (Cronbach Alpha) are shown on the diagonal

29.04 ($SD = 9.40$) and 55 participants (26%) scored in the clinically significant range for FCR.

In preliminary analyses, need for control was not significantly correlated with FCR. All other proposed model variables were significantly correlated with FCR. In assessing demographic variables, age was negatively associated with FCR ($r = -.24$, $p = .001$) and women, on average, had higher FCR scores than men ($t = 2.47$, $p = .02$). Therefore, age and gender were included in the first step of the regression model. No other demographic or medical variables were significantly associated with FCR, including cancer type (breast cancer compared to all other cancer groups), time since diagnosis, disease stage at diagnosis or whether patients were currently making treatment decisions.

Table 3 outlines the results of the hierarchical regression analysis. In step 1, younger age, but not gender, predicted FCR, suggesting that the association between gender and FCR could be explained by women in the sample being, on average, younger. Younger age continued to significantly predict FCR in each subsequent step of the regression model. Step 2 of the regression model explained 52.3% of the variance in FCR. Consistent with hypothesis 1, FCR was significantly predicted by metacognitions, core belief disruption and social constraints. However, desire for control, intolerance of uncertainty and found meaning did not predict FCR in any step of the regression model. Consistent with hypothesis 2, the addition of death anxiety, threat appraisal and intrusions to the model explained an additional 12.4% of the variance in FCR and this change was significant ($p < .001$). Interestingly, after the addition of these three core variables to the regression model, the associations between core belief disruption and FCR and social constraints and FCR were no longer significant. Contrary to expectations, the addition of coping variables to the regression did not explain any additional variance in FCR (hypothesis 3). The final regression model explained 65% of the variance in FCR. In the final regression model, FCR was predicted by intrusions ($\beta = .36$, $p < .001$), death anxiety ($\beta = .20$, $p < .01$), threat appraisal ($\beta = .16$, $p < .01$), metacognitions ($\beta = .17$, $p < .01$), and age ($\beta = -.09$, $p < .05$).

Discussion

The aim of the study was to test the predictions arising from a model of cancer-related anxiety as applied to fear of cancer recurrence or progression. Several predictions of the model were supported. As hypothesized, all variables were correlated with FCR, except need for control. However, only metacognitions, core belief disruption and social constraints explained a significant proportion of the variance in FCR in the regression analyses, hence hypothesis 1 is partly supported. The addition of death anxiety, threat appraisals, and intrusions to the model explained additional variance in FCR (hypothesis 2). These three variables each explained unique variance in FCR, as did metacognitions. Interestingly, core belief disruption and social constraints no longer contributed additional unique variance to FCR when the three central predictor variables were included in the regression model. Contrary to hypothesis 3, the addition of coping responses to the regression model did not contribute additional variance to FCR.

Intrusions were a significant independent predictor of FCR, which is consistent with previous models of FCR (Fardell et al., 2016; Simonelli et al., 2017) and the model tested in the present study (Curran et al., 2017). Horowitz (1992) proposed that intrusions are adaptive if they prompt effective processing, but are associated with maladaptive coping and psychopathology if they are excessive or prolonged. In our sample, where the average time since diagnosis was 5.9 years, the ongoing presence of intrusions indicated difficulties processing the cancer experience and hence more FCR. Death anxiety was also an important predictor of FCR, supporting its inclusion in the Curran model of cancer-related anxiety and the model by Simonelli et al. (2017). Our study included patients with both early and late stage disease, suggesting that death anxiety is associated with FCR across the disease spectrum. Threat appraisal also predicted FCR, which was expected given that perceived threat underpins fear responses (Barlow, 2000).

Interestingly, core belief disruption was no longer a significant predictor of FCR after the addition of the three central constructs (intrusions, death anxiety and threat appraisal) to the regression model. Also, as shown in Table 2, core belief disruption was significantly associated with intrusions, death anxiety and threat appraisals. One possibility for these findings, although not tested directly in this cross-sectional study, is that participants who experienced their core beliefs being shattered were more likely to experience FCR because they were also more likely to fear death, see cancer as threatening and/or experience intrusions. This supposition is consistent with models of FCR and cancer-related anxiety (Curran et al., 2017; Simonelli et al., 2017) and the theories on which they are based including cognitive processing theories (e.g. Janoff-Bulman, 1992), Terror Management Theory (TMT, Solomon et al., 1991) and its later application to anxiety in life-threatening events, Anxiety Buffer Disruption Theory (Pyszczynski & Kesebir, 2011). TMT posits that core beliefs may provide a stable and secure sense of the world and buffer against anxiety when one's mortality is threatened (Solomon et al., 1991). For instance, one's worldview may include beliefs about symbolic or literal immortality, that is, that life continues beyond death through family, cultural endeavors, life works and/or a spiritual afterlife. Further, one's worldview may include

Table 3 Hierarchical regression of the model variables predicting FCR

Predictors	Fear of cancer recurrence or progression															
	Step 1				Step 2				Step 3				Step 4			
	B (SE)	*β*	Adj. R^2	ΔR^2	*B* (SE)	*β*	Adj. R^2	ΔR^2	*B* (SE)	*β*	Adj. R^2	ΔR^2	*B* (SE)	*β*	Adj. R^2	ΔR^2
Age	−.18 (.06)**	−.21	.06	.06	−.09 (.04)*	−.11	.53	.47***	−.08 (.04)*	−.09	.65	.12***	−.08 (.04)*	−.09	.65	< .01
Gender	3.14 (1.75)	.12			1.01 (1.27)	.04			.03 (1.13)	< .01			−.07 (1.13)	< .01		
Metacognitions					.46 (.09)***	.34			.23 (.08)**	.17			.24 (.08)**	.17		
Core belief disruption					.20 (.05)***	.24			.08 (.04)	.10			.06 (.05)	.08		
Social constraints					.19 (.05)***	.21			.03 (.05)	.04			.04 (.05)	.04		
Intolerance of anxiety					.08 (.07)	.08			.04 (.06)	.04			.05 (.06)	.05		
Found meaning					−.03 (.03)	−.05			.08 (.07)	.06			.02 (.08)	.01		
Desire for control									−.04 (.03)	−.07			−.05 (.03)	−.08		
Intrusions									.53 (.10)***	.33			.56 (.10)***	.35		
Death anxiety									.30 (.09)**	.20			.30 (.09)***	.20		
Threat appraisal									.17 (.07)**	.15			.19 (.07)**	.17		
Rumination													−.03 (.07)	−.03		
Values based coping													.17 (.11)	.09		

Step 1: F(2208) = 7.70***; Step 2: F(7203) = 34.19***; Step 3: F(10,200) = 39.16***; Step 4: F(12,198) = 32.80***

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$

an overarching meaning structure that provides a feeling of stability in the face of existential uncertainty. When these core beliefs are "shattered" by a traumatic event, feelings of vulnerability, uncontrollability and unpredictability are expected to be magnified and may manifest in anxiety disorders (Janoff-Bulman, 1992; Pyszczynski & Kesebir, 2011). Further, intrusions may occur in response to core belief disruption because they prompt processing of the event and, ultimately, if successful processing occurs, the re-establishment of helpful core beliefs (Janoff-Bulman, 1992). These interesting and complex possible relationships between core belief disruption and the variables: death anxiety, threat appraisal and intrusions, need to be tested in a future study.

Also, social constraints was no longer a significant predictor of FCR after the addition of the three central constructs (intrusions, death anxiety and threat appraisal) to the regression model. Social constraints were also significantly associated with intrusions, death anxiety and threat appraisal. It is therefore possible that those who felt hindered from processing their cancer concerns with significant others were more likely to experience FCR because they also experienced intrusions, appraised the cancer as more threatening and/or experienced more death anxiety. This possibility is consistent with Lepore's (2001) theory of social constraints that posits that social constraints hinder the processing of cancer-related concerns and encourage suppression of difficult thoughts and feelings, thereby maintaining intrusions and high arousal over time. Indeed, Cohee et al. (2017), found that social constraints were associated with more intrusions, and higher intrusions predicted more FCR. Our findings are also consistent with TMT and other cognitive processing theories that posit that social support buffers anxiety in the face of potentially life-threatening events, while feeling disconnected from significant others is expected to magnify feelings of vulnerability and anxiety (Janoff-Bulman, 1992; Pyszczynski & Kesebir, 2011).

As expected, metacognitions contributed unique variance to the prediction of FCR in the regression model. Maladaptive metacognitions, that is, beliefs that worry is protective, dangerous and/or uncontrollable, are a transdiagnostic phenomenon that contributes to emotional difficulties (Wells & Matthews, 1996). Consistent with prior research (Thewes et al., 2013; Butow et al., 2015), these results confirm the importance of metacognitions specifically to FCR. Interestingly, the association between metacognitions and FCR was weakened when intrusions, death anxiety and threat appraisal were included in the model. This suggests possible mechanisms whereby metacognitions may impact on FCR. For instance, one possibility is that when internal experiences are evaluated as dangerous or important, intrusions become more salient and frequent, thereby maintaining FCR. Secondly, maladaptive metacognitions may lead to more engagement with death-related worries or possibly increase the salience and reactivity associated with normally occurring and understandable death related concerns, thereby inflating death anxiety and in turn FCR. Thirdly, maladaptive metacognitions may lead to threat monitoring as a way of coping (Wells & Matthews, 1996), thereby inflating threat appraisals and in turn FCR. However, these possible mechanisms can only be surmised from the study findings and need to be tested in further research.

Need for control did not correlate with FCR in univariate or regression analyses. Our expectation that need for control would predict higher FCR was based on previous research that suggests that adjusting to the uncontrollability inherent in the cancer setting is difficult for many patients (Lagerdahl et al., 2014) and that persons with a high need for control may find it more difficult to adjust to uncertainty (Mishel, 1990) and are more likely to be anxious in situations where they perceive low control (Wallston et al., 1991). Therefore, effective adaptation may be hindered if there is a mismatch between need for control and the controllability of the external environment (Shapiro et al., 1996). No previous studies have examined the association between need for control and FCR, but rather perceived control over illness or treatment, which relates to causal attributions and efficacy (e.g. Corter et al., 2013). One possibility for the null findings in our study is that it is the *discrepancy* between need for control and perceived control that contributes to FCR. Another consideration is the lack of valid measures of need for control. The measure chosen for this study, which was developed in 1979, included some items that were outdated. Future research could explore control discrepancy as a potential predictor of FCR using a valid, updated instrument.

Found meaning was associated with less FCR in bivariate analysis but did not predict FCR in multivariate analyses. This is consistent with a recent meta-analysis that reported that found meaning was associated with less distress in cancer patients, but this is based on cross-sectional and correlational research (Winger et al., 2016). In our study, found meaning was significantly correlated with all the other predictor variables, suggesting that found meaning may have been associated with FCR indirectly. For instance, one mechanism whereby found meaning may be associated with less FCR is by buffering death anxiety as predicted by TMT (Solomon et al., 1991).

Similarly, intolerance of uncertainty was associated with FCR in univariate analyses but did not predict FCR in the regression. Interestingly, Lebel et al. (2018) also found that intolerance of uncertainty did not significantly predict FCR in a complex path model that also included metacognitions. One possible explanation is that intolerance of uncertainty may explain the etiology of anxiety while metacognitions explain the maintenance of anxiety (see Thielsch et al., 2015). Given that our study included patients that were many years post diagnosis, intolerance of uncertainty may

no longer have been relevant to understanding patient's current level of FCR. Another possibility is that intolerance of uncertainty interacts with metacognitive beliefs, so that even low levels of intolerance of uncertainty are associated with high levels of FCR, but only if worry is believed to be dangerous or uncontrollable (see Ruggiero et al., 2012). Alternatively, intolerance of uncertainty may interact with current levels of uncertainty, so that intolerance of uncertainty becomes a predictor of FCR only when patients are going through periods of greater uncertainty. The proposed associations between intolerance of uncertainty, current uncertainty, metacognitions and FCR requires further investigation in a longitudinal study.

Our hypothesis that ruminative coping and values-based coping would be associated with unique variance in FCR was not supported, although these variables did correlate with FCR. All existing models of FCR posit that maladaptive coping, including rumination, plays a role in maintaining FCR. FCR is also argued to be maintained by a tendency for individuals experiencing FCR to engage less with valued activities as their focus is consumed by worry and threat monitoring (Fardell et al., 2016). Consistent with our findings, Lebel et al. (2018) also found that FCR was not predicted by maladaptive coping in a complex path analysis. A possible explanation is that adaptive or maladaptive coping occurs in response to FCR and subsequently diminishes or maintains FCR over time, but this longitudinal relationship could not be determined by our cross-sectional design.

Study limitations

It is important to consider a number of limitations in the interpretation of our results. Firstly, the data was cross-sectional so the causal direction of these relationships cannot be determined. Secondly, only total effects of the predictors on FCR, and not indirect effects, could be explored with the current study design. Thirdly, the generalizability of our findings may be limited. The final sample was well educated (61% had completed a university degree) and the majority were women (84%) with breast cancer (71%) and therefore the sample is not likely to be representative of all cancer patients. Lastly, while the model explained a substantial proportion of the variance in FCR, it is possible that constructs that were not considered in this model, may also be important in explaining FCR.

Clinical implications

The regression analysis suggests that clinical interventions for FCR should target intrusions, metacognitions, death anxiety and threat appraisal. To date there have been several interventions developed that have demonstrated significant improvements in FCR in randomized controlled studies (Butow et al., 2017; Dieng et al., 2015; Herschbach et al., 2010; Humphris & Rogers, 2012; Lengacher et al., 2009; van de Wal et al., 2017). In addition, promising pilot studies have been published (Arch & Mitchell, 2016; Fisher et al., 2017; Lebel et al., 2014; Lengacher et al., 2018; Lichtenthal et al., 2017) and further clinical trials are currently underway (Maheu et al., 2016; Wagner et al., 2017). However, even in the most successful approaches to date, a substantial proportion of patients still remain in the clinical range after treatment (e.g. Butow et al., 2017; Dieng et al., 2015; van de Wal et al., 2017). This may be because interventions to date have variously targeted some, but not all, of the above constructs. Broadly speaking, interventions have tended to focus primarily on cognitive *processes*, such as unhelpful responses to intrusions, using components of Metacognitive Therapy, Acceptance and Commitment Therapy or Mindfulness (e.g. Butow et al., 2017; Lengacher et al., 2009) or have focused primarily on cognitive *content* with Cognitive Behavior Therapy approaches (e.g. Herschbach et al., 2010; van de Wal et al., 2017). Our findings raise the question as to whether interventions would be more efficacious if they addressed both cognitive processes *and* content in the treatment of FCR.

Our study is one of the few studies to investigate death anxiety in relation to FCR (see Sharpe et al., 2018). Our findings suggest that death anxiety is a strong contributor to FCR, even in a sample that included a large proportion of patients with early stage disease. Therefore, it is possible that interventions that directly target death anxiety may improve the efficacy of interventions for FCR. A recent meta-analysis of death-anxiety interventions identified that Cognitive Behavior Therapy, which typically included some element of exposure, was the most effective (Menzies et al., 2018). However it should be noted that the three studies identified in the review that used exposure were conducted with students who would be expected to be healthy and not living with a realistic threat of death. There is preliminary evidence that writing out one's worst case scenario, which may include scenarios about death, and reading it daily as a form of exposure is helpful in reducing FCR (Moran et al., 2017). However, this study was a small, uncontrolled trial conducted with cancer "survivors" who currently had no evidence of disease. The efficacy of exposure to imagined future scenarios for patients with a poor prognosis who are facing an actual life threat is unknown. On the other hand, there is evidence that exposing patients to their fears by confronting and working through the content of their worries is efficacious in reducing FCR in patients with both early and late stage disease (e.g. Herschbach et al., 2010; Humphris & Rogers, 2012; Maheu et al., 2015).

An intervention that has been shown to be effective for patients with cancer that are experiencing moderate death anxiety is the Managing Cancer and Living Meaningfully (CALM) intervention (Rodin et al., 2018). As well as targeting meaning and specific concerns about mortality, CALM also targeted changes in self-concept and relationships. As such, CALM may impact on the core belief disruption and social constraints identified by our model. Our model suggests that also addressing unhelpful metacognitions and providing strategies for responding to death related intrusive thoughts, such as detached mindfulness, may improve the efficacy of interventions for death anxiety and FCR.

Conclusion

In conclusion, the aim of the present study was to test the hypotheses arising from a recent trans-diagnostic model of cancer-related anxiety to FCR. The predictors arising from the proposed model explained a large amount of variance in FCR (65%). As expected, the key determinants of FCR in the model were: intrusions, death anxiety, and threat appraisals. Metacognitions also contributed unique variance to the prediction of FCR in the final model. Although some hypotheses, such as the role of need for control, intolerance of uncertainty, found meaning and ruminative and values-based coping were not confirmed, the results are consistent with the major tenets of the Curran model of cancer-related anxiety as applied to FCR. Our results suggest that interventions that explicitly target intrusions, threat appraisal and death anxiety would be appropriate for FCR and may improve existing psychological interventions for FCR. Future research should centre on replicating the findings in longitudinal designs with representative samples of the cancer population.

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Compliance with ethical standards

Conflict of interest L. Curran, L. Sharpe, C. MacCann and P. Butow declares that they have no conflict of interest.

Human and animal rights and Informed consent All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and nations research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained for all individual participants included in the study.

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