Patient-Reported Self-Efficacy, Anxiety, and Health-Related Quality of Life During Chemotherapy: Results From a Longitudinal Study

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Purpose/Objectives: To explore changes over time in self-efficacy and the predictive ability of changes in state anxiety and health-related quality of life during chemotherapy.

Design: Secondary analysis of a longitudinal dataset derived from a larger, multicenter study.

Setting: Outpatient oncology clinics across eight general hospitals in England, Scotland, and Northern Ireland.

Sample: 137 patients scheduled to receive adjuvant chemotherapy for breast or colorectal cancer.

Methods: At the beginning of each of six chemotherapy cycles, participants completed the Strategies Used by People to Promote Health questionnaire, the State-Trait Anxiety Inventory, and the Functional Assessment of Cancer Therapy–Breast or –Colorectal questionnaire. Multilevel model analysis was used to analyze longitudinal data, adjusted for demographic and clinical variables.

Main Research Variables: Self-efficacy, anxiety, and health-related quality of life.

Findings: No significant time effects were found for patients' overall perceived self-efficacy or self-efficacy parameters. A trend toward greater self-efficacy was evident as chemotherapy progressed. Self-efficacy was significantly associated with decreased state anxiety throughout chemotherapy. Increases in overall self-efficacy and perceived ability to maintain a positive attitude were significantly associated with over-time increases in physical, emotional, and functional well-being, as well as with fewer cancer-related concerns.

Conclusions: Findings highlight the importance of clinical assessments throughout treatment that focus on patients' perceived self-efficacy as a positive regulator of mood and well-being.

Implications for Nursing: The current study suggests self-efficacy enhancement should be a key component of psycho-behavioral programs designed to support patients with cancer throughout chemotherapy.

A shift in cancer services from traditional tertiary care to care delivered within communities has occurred (McCorkle et al., 2011). This shift has increased the need for patients to engage in self-management activities to prevent or reduce the severity of numerous and often complex side effects (McCorkle et al., 2011). This involvement in self-management education activities can enhance patients' engagement in self-care to further guide important healthcare decision making when at home in the absence of clinicians (Butow et al., 2012). The degree of patients' engagement in self-management may depend on their perceived competence or self-efficacy to perform such activities (Fenlon, Khambhaita, & Hunter, 2015). Self-efficacy

has been defined as "a person's belief to execute courses of action required to deal with a prospective situation" (Bandura, 1982, p. 122). One's beliefs in the capability to successfully manage tasks and influence situations affecting life constitutes a central part of human agency (Bandura, 1989, 2001) and can be influenced by four major factors, which are performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal.

In the context of cancer care, self-efficacy is defined as a person's belief in the ability to "manage the health implications of cancer and its treatment" (Davies & Batehup, 2010, p. 42). In this context, the potential impact of self-efficacy on symptom self-management and the overall symptom experience has been well described during (Watson et al., 2015; Zhang, Zheng, et al., 2015) and after (Fenlon et al., 2015; Wagland, Fenlon, Tarrant, Howard-Jones, & Richardson, 2015) active treatment. Self-efficacy has also been explored in conjunction with other parameters, including psychological adjustment (Hirai, Arai, Tokoro, & Naka, 2009) and health-related quality of life (HRQOL) (Cheng et al., 2012; Heck, Thomas, & Tabata, 2013; Yeung, Liu, & Lin, 2014). What is evident is that the psychological sequelae of cancer, such as anxiety, depressed mood, or fear of recurrence and/or dying, remain prominent during and after the end of treatment (Baucom, Porter, Kirby, Gremore, & Keefe, 2005; Oh & Kim, 2010; Segrin, Badger, Dorros, Meek, & Lopez, 2007; Trask, 2004) and seem to co-occur with decreased self-efficacy and deficits in HRQOL (Badger, Segrin, Meek, Lopez, & Bonham, 2004; Badger, Braden, & Mishel, 2001; Longman, Braden, & Mishel, 1999).

Bandura's (2004) social cognitive theory postulates that self-efficacy can act as a "cognitive regulator" of stress, and the self-regulation of other cognitive processes, such as thought, can increase emotional well-being after trauma-like experiences, such as a cancer diagnosis (Bandura & Wood, 1989; Benight & Bandura, 2004; Mystakidou et al., 2010). Accumulating evidence suggests that self-efficacy and anxiety may be negatively correlated (Mystakidou et al., 2010) and, together with anxiety, self-efficacy may be a significant predictor of HRQOL in the short- (beginning of treatment) and long-term (six months post-treatment) (Zhang, Kwekkeboom, & Petrini, 2015). However, longitudinal research to investigate how patients' perceived self-efficacy changes within and across the different treatment phases is lacking, as is research to clarify whether self-efficacy is a longitudinal predictor of such patient outcomes as anxiety and HRQOL (Zhang et al., 2014; Zhang, Zheng, et al., 2015). In this secondary analysis of longitudinal data on self-efficacy, anxiety, and HRQOL, the authors aimed to answer the following research questions:

- How is self-efficacy characterized throughout adjuvant chemotherapy in terms of levels of self-efficacy, changes with time, and moderators (e.g., age, gender, type of cancer, disease staging, comorbid illnesses, performance status)?
- Is self-efficacy a predictor of lower levels of anxiety throughout adjuvant chemotherapy?
- Is self-efficacy a predictor of improved HRQOL throughout adjuvant chemotherapy?

Methods

Population and Sample

Eligible patients were male and female adults (aged 18 years or older) who were scheduled to receive adjuvant chemotherapy for breast or colorectal cancer. All patients were recruited from outpatient clinics at eight general hospitals in England, Scotland, and Northern Ireland as part of a large-scale, before-and-after intervention study that involved repeated measures of patient outcomes and examined feasibility and acceptability parameters of the use of the Advanced Symptom Management System (ASyMS). ASyMS is a mobile phone–based, real-time, remote patient-monitoring system for the assessment and management of chemotherapy-related toxicity (Kearney et al., 2009). The before phase entailed a longitudinal, survey-like study, where patients received standard care and completed self-reported measures of such outcomes as symptom severity, self-efficacy, and HRQOL. In the after phase, a separate group of patients used ASyMS during adjuvant chemotherapy and completed the same set of self-reported measures as in the before phase. The current study reports findings from a secondary analysis of data collected during the before phase. Results of the primary analysis will be published separately.

Measures and Instrumentation

Information on participants' demographic and clinical characteristics (including age, gender, stage of cancer, type of cancer, comorbidities, and Eastern Cooperative Oncology Group [ECOG] performance status) was collected at baseline from patients' case notes using an author-developed case note review form. To assess self-efficacy, anxiety, and HRQOL, three validated questionnaires were used.

The Strategies Used by People to Promote Health (SUPPH) is a 29-item self-report measure of confidence in and performance of specific self-care strategies (Lev & Owen, 1996). Each item is rated on a five-point scale ranging from 1 (very little) to 5 (quite a lot). Scoring the scale involves summing the responses. Higher scores indicate more positive perceptions of self-efficacy. Different factor solutions have been proposed for the SUPPH (Yuan et al., 2015),

but the most parsimonious model includes three factors (stress reduction = items 1–10, making decisions = items 11–13, positive attitude = items 14–29) (Lev et al., 2001, 2004). In the current study, internal consistency of the SUPPH was good to very good, with Cronbach alphas of 0.95–0.98 for the total SUPPH score, 0.94–0.97 for positive attitude, 0.9–0.94 for stress reduction, and 0.7—0.85 for making decisions.

The State-Trait Anxiety Inventory (STAI) contains 40 items measuring trait anxiety (20 items) and state anxiety (20 items) (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). For the purposes of this analysis, the authors focused on state anxiety as a measure of current levels of anxiety, amenable to changes over time. The state anxiety scale assesses intensity of feelings "at this moment," ranging from 1 (not at all) to 4 (very much so). Summing the responses yields a total score. The STAI has confirmed psychometric properties in patient populations with different forms of cancer (Alacacioglu et al., 2010; Eskelinen & Ollonen, 2011). Internal consistency of the state anxiety scale was very good in this study, with Cronbach alphas ranging from 0.94–0.97.

The Functional Assessment of Cancer Therapy–Breast (FACT-B) and –Colorectal (FACT-C) were used to address aspects of HRQOL. Both measures are based on the original FACT–General measure, which assesses four primary domains of HRQOL (i.e., physical, social and family, emotional, and functional well-being) (Cella et al., 1993). The FACT-B and FACT-C are 37-item measures that combine the FACT-G with a disease-specific subscale. Each item is rated from 0 (not at all) to 4 (very much) to yield a total score, with higher scores denoting better HRQOL. Both measures have demonstrated good psychometric properties (Brady et al., 1997; Ward et al., 1999). Internal consistency was good for the four primary domains of HRQOL, with Cronbach alphas ranging from 0.79–0.83 for physical well-being, 0.86–0.9 for social and family well-being, 0.62–0.76 for emotional well-being, and 0.77–0.84 for functional well-being. Internal consistency was moderate for the breast cancer subscale, with Cronbach alphas ranging from 0.55–0.68, and for the colorectal cancer subscale, with Cronbach alphas from 0.48–0.59.

Procedures

Ethical and research governance approval for the study was obtained through East of Scotland Research Ethics Committee A, the local medical research ethics committee for NHS Tayside in Dundee, Scotland. Eligible patients were identified by the clinical team and invited to participate. After providing written consent, study participants in the before phase completed questionnaires at baseline prior to starting chemotherapy and at the start of subsequent chemotherapy cycles for a maximum of six assessments.

Data Analysis

Descriptive statistics and frequency distributions were computed for all tested variables. A preliminary correlational analysis was initially performed to examine relationships between self-efficacy and state anxiety, as well as between self-efficacy and HRQOL. In main analyses, longitudinal multilevel modeling was used (Heck et al., 2013; Raudenbush & Bryk, 2002; Shek & Ma, 2011). This modeling approach conceptualizes repeated measures as being nested within individuals, accounts for correlations in repeated measures within an individual, and allows for an unbalanced dataset to be analyzed (i.e., patients with missing data at some, but not all, time points) under the assumption that data is missing at random (Raudenbush & Bryk, 2002).

First, four models were developed to test changes in total and subscale self-efficacy scores over time. Linear and curvilinear effects of time were considered. Goodness-of-fit criteria (–2 log likelihood) were used to select the final linear or curvilinear models. The variance in individual change parameters estimated by the models was then checked. If substantial interindividual differences in the trajectories of self-efficacy parameters were present, predefined moderator and predictor variables could be entered to explain

TABLE 1. Sample Characteristics

Characteristic	$\bar{X}$	SD	Range
Age (years) (N = 135)	56	10.4	30–76
Characteristic		**n**	**%**
Gender (N = 137)			
Female		108	79
Male		29	21
Primary cancer diagnosis (N = 136)			
Breast		81	60
Colorectal		55	40
Disease stage (N = 126)			
I		14	11
II		51	42
III		57	45
IV		4	3
Number of comorbid illnesses (N = 137)			
0		50	37
1		38	28
2 or greater		49	36
Baseline ECOG performance status (N = 129)			
0		92	71
1		35	27
2		2	2

ECOG—Eastern Cooperative Oncology Group
Note. Tumor staging was based on the Tumour Node Metastasis Union International Contra la Cancrum.
Note. ECOG scores were 0 as fully active, 1 as restricted in physically strenuous activity but able to perform light work, and 2 as capable of self-care but not work activities.
Note. Because of rounding, percentages may not total 100.

TABLE 2. Changes in Self-Efficacy, State Anxiety, and Well-Being Scores at Each Time Point Compared to Baseline

	Baseline (N = 132–137)		CTx 2 (N = 120–127)		CTx 3 (N = 111–117)		CTx 4 (N = 106–109)		CTx 5 (N = 94–97)		CTx 6 (N = 88–91)	
Variable	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
SUPPH												
Stress reduction	33.2	9.8	0.8	8.6	0.8	9	0.55	9.8	0.95	9.3	1.3	9.4
Decision making	10.5	3.4	–0.2	3.3	–0.2	4.1	–0.2	3.8	0.1	3.4	0.4	3.7
Positive attitude	61.4	12.6	–0.2	10.1	–0.5	12.3	–1.5	13.2	1.4	10.5	0.9	11.2
Total score	104.5	24.4	0.2	20.8	0.4	22.2	–1	23.7	1.6	20.6	2.5	20.5
STAI: State anxiety	35.9	12.3	–3.1	9.6	–2.3	11.2	–3.9	11.5	–4	11.1	–4.7	11.1
FACT												
Physical well-being	23.8	4.7	–0.9	4.5	–1.8	5.4	–1.6	5.8	–2.1	5.3	–1.9	5.3
Emotional well-being	18.9	4.1	1.5	2.7	1.3	3.9	1.4	4	2	3	2.2	3.2
Social well-being	24.9	4.8	0.6	4	0.3	5.2	0.1	5.1	0.1	4.4	0.1	4.4
Functional well-being	18.8	6.3	0.4	5.1	0.1	5.5	0.1	5.4	0.3	5.4	0.2	6
Cancer-related concerns	25.6	6.6	–0.2	4.8	0.2	5.2	–0.2	5.7	–0.2	5.9	–0.1	6.4

CTx—chemotherapy cycle; FACT—Functional Assessment of Cancer Therapy–Breast and –Colorectal; STAI—State-Trait Anxiety Inventory; SUPPH—Strategies Used by People to Promote Health

Note. Higher SUPPH scores indicate more positive perceptions of self-efficacy (range = 29–145), higher STAI scores indicate more anxiety (range = 20–80), and higher FACT scores indicate greater health-related quality of life (range = 0–148).

Note. N values vary because of missing data.

variation. Moderators included age, gender, marital status, employment status, stage of cancer, type of treatment, chemotherapy cycle length, comorbidities, and ECOG performance status. Inclusion of moderator variables was informed by clinical expertise and existing research evidence (Harrell, 2001). A Bonferroni adjusted significance level of $\alpha = 0.05/4 = 0.013$ was used for these analyses to control for inflated type I error.

Second, four models were developed to explore the longitudinal relationship between state anxiety (outcome) and total and subscale self-efficacy scores (predictors), adjusted with the same moderator variables. A Bonferroni adjusted significance level of $\alpha = 0.05/4 = 0.013$ was also used.

Finally, a similar set of models explored the longitudinal relationship between HRQOL parameters (outcome) and total and subscale self-efficacy scores (predictors), adjusted for the effects of state anxiety and moderator variables. A Bonferroni adjusted significance level of $\alpha = 0.05/20 = 0.003$ was used. All analyses were performed using MIXED in SPSS®, version 20.0, based on restricted maximum likelihood estimation (Heck et al., 2013).

Findings

Data from 137 patients, who participated in at least one assessment point, were analyzed. Summaries of the sample's demographic and clinical information are shown in Table 1. The typical participant was a 56-year-old woman diagnosed with stage II/III breast cancer with good performance status and with at least one comorbid illness. Descriptive statistics of prechemotherapy (baseline) scores and changes in self-efficacy, state anxiety, and HRQOL scores from baseline at each time point are listed in Table 2. Prechemotherapy total and subscale SUPPH scores indicated moderate to high levels of self-efficacy in this sample.

Changes in Self-Efficacy and Predictors of Change During Chemotherapy

Based on goodness-of-fit criteria, a linear model was found to fit the data for all total and subscale self-efficacy scores. However, no significant overall time effects were found (stress reduction: $\beta = 0.21$, standard error [SE] = 0.17, $p = 0.2$, 95% confidence interval [CI] [–0.12, 0.55]; making decisions: $\beta = 0.06$, SE = 0.06, $p = 0.4$, 95% CI [–0.07, 0.18]; positive attitude: $\beta = 0.2$, SE = 0.2, $p = 0.31$, 95% CI [–0.19, 0.6]; total SUPPH score: $\beta = 0.46$, SE = 0.37, $p = 0.22$, 95% CI [–0.28, 1.2]). A general, but not statistically significant, upward trend was seen in total and subscale SUPPH scores, indicating increases from prechemotherapy to end of treatment. No significant effects of moderator variables on total and subscale self-efficacy scores were found (all $p \geq 0.013$). A trend toward higher self-efficacy in making decisions was found among fully ambulatory patients compared to those with deficits in performance status ($p = 0.013$).

Longitudinal Relationship Between Self-Efficacy and State Anxiety

Preliminary correlational analyses indicated significant ($p < 0.05$) relationships between self-efficacy

parameters and state anxiety at all time points (see Table 3). Increases in total and subscale self-efficacy scores were consistently and significantly ($p < 0.013$) associated with decreases in state anxiety throughout chemotherapy (see Table 4). Of note, adjusted β values of all three self-efficacy subscales were greater than that of the total SUPPH. Decision making was found to be associated with the greatest change in state anxiety, with every increase of 10 points in SUPPH decision making corresponding to a decrease of 6.5 points in the state anxiety score on the STAI.

Longitudinal Relationship Between Self-Efficacy and Health-Related Quality of Life

Significant ($p < 0.05$) relationships between self-efficacy and HRQOL measures were found at all time points. Increases in total self-efficacy and in self-competence in keeping a positive attitude were independently and significantly associated with increases in physical, emotional, and functional well-being, as well as with fewer cancer-related concerns ($p < 0.003$) (see Table 5). In addition, increases in perceived self-efficacy related to stress-reduction strategies were independently associated with fewer cancer-related concerns throughout chemotherapy ($p = 0.001$).

Discussion

In this secondary analysis, the authors explored trajectories of self-efficacy and the longitudinal relationship between perceived self-efficacy, anxiety levels, and HRQOL during chemotherapy. The findings provide a novel insight on fluctuations in perceived self-efficacy during chemotherapy. They also support and substantiate previous evidence suggesting that self-efficacy can have a positive impact on psychological outcomes (Lev et al., 2001; Mystakidou et al., 2010).

Previous studies in patients with breast (Chang et al., 2014; Cheng et al., 2012; Gaston-Johansson et al., 2013; Zhang, Kwekkeboom, & Petrini, 2015) and colorectal (Zhang, Zheng, et al., 2015) cancers have suggested increases in overall self-efficacy during treatment. Despite a similar trend in the current study, levels of self-efficacy did not change significantly. This finding is worth further investigation. It may reflect well-supported participants, with high self-efficacy levels prior to starting chemotherapy. Alternatively, it may suggest a sample that systematically accessed information and engaged sufficiently and successfully with available services on an ongoing basis (Foster et al., 2015). In Zhang et al.'s (2014) study, patients' self-efficacy scores were low at baseline and increased significantly during

TABLE 3. Pearson Correlational Analyses Between Main Study Variables by Chemotherapy Cycle (CTx)

	Strategies Used by People to Promote Health			
Variable	Stress Reduction	Decision Making	Positive Attitude	Total Score
State-Trait Anxiety Inventory				
State anxiety				
CTx 1	−0.25**	−0.15	−0.45**	−0.38**
CTx 2	−0.44**	−0.44**	−0.53**	−0.49**
CTx 3	−0.45**	−0.32**	−0.61**	−0.53**
CTx 4	−0.52**	−0.42**	−0.67**	−0.62**
CTx 5	−0.49**	−0.27*	−0.58**	−0.6**
CTx 6	−0.57**	−0.31**	−0.68**	−0.65**
Functional Assessment of Cancer Therapy–Breast and –Colorectal				
Physical well-being				
CTx 1	0.11	0.11	0.3**	0.2*
CTx 2	0.24**	0.22**	0.3**	0.28**
CTx 3	0.26**	0.27**	0.46**	0.37**
CTx 4	0.3**	0.38**	0.39**	0.39**
CTx 5	0.32**	0.28**	0.26**	0.4**
CTx 6	0.28**	0.19	0.43**	0.38**
Emotional well-being				
CTx 1	0.28**	0.14	0.44**	0.39**
CTx 2	0.37**	0.27**	0.46**	0.41**
CTx 3	0.34**	0.08	0.42**	0.34**
CTx 4	0.44**	0.25*	0.54**	0.5**
CTx 5	0.44**	0.28**	0.56**	0.57**
CTx 6	0.47**	0.21*	0.56**	0.52**
Social well-being				
CTx 1	0.04	0.13	0.1	0.07
CTx 2	0.23*	0.25**	0.34**	0.27**
CTx 3	0.26**	0.11	0.29*	0.31**
CTx 4	0.36**	0.37**	0.4**	0.4**
CTx 5	0.32**	0.25*	0.44**	0.42**
CTx 6	0.23*	0.16	0.36**	0.32**
Functional well-being				
CTx 1	0.29**	0.16	0.44**	0.38**
CTx 2	0.46**	0.33**	0.5**	0.48**
CTx 3	0.35**	0.32**	0.56**	0.46**
CTx 4	0.51**	0.45**	0.6**	0.59**
CTx 5	0.45**	0.31**	0.52**	0.55**
CTx 6	0.41**	0.18	0.52**	0.48**
Cancer-related concerns				
CTx 1	0.15	0.02	0.27**	0.19*
CTx 2	0.32**	0.31**	0.38**	0.37**
CTx 3	0.32**	0.19	0.49**	0.4**
CTx 4	0.4**	0.33**	0.43**	0.44**
CTx 5	0.26*	0.19	0.37**	0.35**
CTx 6	0.41**	0.23*	0.31**	0.39**

* $p < 0.05$; ** $p < 0.001$

TABLE 4. Mixed-Model Results for the Longitudinal Relationship Between Self-Efficacy Parameters (Predictor Variables) and State Anxiety (Response Variable)

Self-Efficacy Parameter	Adjusted β Value	SE	t	p	95% CI
Stress reduction	−0.37	0.06	−5.97	< 0.001	[−0.5, −0.25]
Decision making	−0.71	0.18	−3.95	< 0.001	[−1.07, −0.35]
Positive attitude	−0.29	0.05	−6.43	< 0.001	[−0.38, −0.2]
Total score	−0.19	0.24	−7.61	< 0.001	[−0.23, −0.14]

CI—confidence interval; SE—standard error

Note. All self-efficacy parameters were measured by the Strategies Used by People to Promote Health. State anxiety was measured using the 20-item state anxiety portion of the State-Trait Anxiety Inventory.

Note. All models were adjusted for gender, age, type of cancer, disease staging, number of comorbidities, and Eastern Cooperative Oncology Group performance status. In all models, time (chemotherapy cycle) and self-efficacy parameter were allowed to vary (added as random effects) based on −2 log likelihood information criteria. Analyses were adjusted for multiple comparisons ($\alpha = 0.013$).

chemotherapy. This may be explained through sociocultural and clinico-cultural factors that have suppressed patients' baseline perceptions of self-competency and allowed any postbaseline changes to become more prominent.

None of the selected moderator variables showed significant impact on over-time changes in self-efficacy. Similar findings were reported in a mixed-diagnosis sample of cancer survivors in the year following primary treatment (Foster et al., 2015). Type of cancer was not found to affect the way that self-efficacy was perceived and changed during chemotherapy despite potentially different chemotherapy toxicity profiles. Future comparative analyses could further clarify the role of specific cancers in trends of self-efficacy and explore whether self-efficacy is alternatively influenced by chemotherapy frequency (e.g., weekly versus twice weekly), chemotherapy regimen, or treatment modality (e.g., surgery versus chemotherapy).

Consistent with previous studies (Hirai et al., 2009; Melchior et al., 2013; Zhang et al., 2014; Zhang, Kwekkeboom, & Petrini, 2015; Zhang, Zheng, et al., 2015), self-efficacy was negatively associated with state anxiety levels. As indicated by adjusted β values, all three self-efficacy parameters (decision making, stress reduction, positive attitude) were more strongly related to changes in anxiety compared to the total SUPPH score. This finding suggests that it is important to examine the subscales of the SUPPH because each of them makes a stronger unique contribution to explaining anxiety levels. In addition, decision making was the self-efficacy component that showed the greatest influence on state anxiety in this study. This result adds to the existing body of evidence that favors participation in decision making as a means to reduce stress through regaining control, reducing decisional conflict, and preserving autonomy (Brown et al., 2012). However, overall existing evidence is still ambiguous. Studies suggest no significant differences between patients who are more actively involved in the treatment decision–making process and those who are not in terms of anxiety levels (Chawla & Arora, 2013; Livaudais, Franco, Fei, & Bickell, 2013). If decision making is related to treatment options, some patients may be willing to consciously decide not to attend to this information, perceiving it to provoke anxiety (Swainston, Campbell, van Wersch, & Durning, 2012). Other factors, such as health literacy and marital satisfaction, that have been postulated as influencing this relationship are yet to be fully explored (Forsythe et al., 2014; Livaudais et al., 2013).

The current analysis provides new evidence on the longitudinal effects of self-efficacy on patients' HRQOL. Patients' increases in overall levels of self-efficacy were found to be positively associated with gains in emotional and functional well-being and with fewer cancer-related concerns. Empirical evidence supports the idea that a positive attitude to illness affects the psychological aspects of HRQOL (Shelby et al., 2014; Yeung & Lu, 2014). According to the social cognitive theory, self-efficacy can have an indirect impact on coping with stress by enhancing positive affective states and reducing negative affect states (Bandura, 2001). Perceived self-competence may have led to engagement in self-management activities that, in turn, may have led to better management of chemotherapy toxicity, lower symptom distress, and greater perceived HRQOL. In addition, the idea that the positive relationship between self-efficacy and HRQOL could be mediated through reduced levels of state anxiety is compelling. Limited evidence supports the mediating effect of anxiety on the relationship between self-efficacy and HRQOL, but previous research has explored other possible mediating variables, including expectancy-outcome incongruence (Lam & Fielding, 2007), positive social comparisons (Schulz & Mohamed, 2004), affect (Yeung & Lu, 2014), and physical activity (Phillips & McAuley, 2014). Future research is warranted to map factors, such as symptom and patient characteristics, and their interplay in the relationship between self-efficacy and HRQOL.

Contrary to previous research findings (Heckman et al., 2011; Zhang et al., 2014; Zhang, Zheng, et al., 2015), no significant relationship was found between self-efficacy and physical and social well-being in

this study. A reason for this may be that the SUPPH focuses more on the psycho-emotional aspects of self-care than the physical aspects, and this might have prevented significant relationships from emerging.

Strengths and Limitations

To the authors' knowledge, this is the first study that has investigated effects of self-efficacy over time on patients' levels of anxiety and perceived HRQOL during chemotherapy. In addition, the mixed-model analyses optimized the evaluation of the study's longitudinal data and allowed for effective control of attrition rates and associated missing data. However, the study has limitations. The results reported represent a secondary analysis, which limits examination of relationships and generalizability to a patient population with certain characteristics (e.g., patients with breast or colorectal cancer, patients undergoing adjuvant chemotherapy, female patients) and in relation to the sample size at hand. Patients in this study exhibited high levels of self-efficacy at baseline, but it remains unclear what the trajectories prior to chemotherapy initiation may have been because data were not collected in the period immediately after diagnosis or before surgery.

Implications for Nursing

The current findings suggest that, by supporting patients' perceived self-competence from as early as possible after a cancer diagnosis, clinicians can help ease patients' stress levels and empower them during the challenging period of treatment that follows. One important factor for participants in this study was decision making. Educational interventions using audiovisual material (Carey et al., 2006) have the potential to help patients through their decision-making process, as well as enhance self-management strategies. The use of patient-reported outcome measures has also been shown to increase patients' perceived level of control over their illness by actively engaging in decision making, increase patients' satisfaction with care, and promote self-care by improving communication with health professionals (Donaldson, 2008; Valderas & Alonso, 2008). In addition, the authors showed that increased self-efficacy can be predictive of lower anxiety throughout chemotherapy. Developing new and delivering existing clinical interventions aimed at empowering patients through information provision and skills development is expected to reduce anxiety levels and the associated distress. The importance of having and promoting a positive attitude toward

TABLE 5. Mixed-Model Results for the Longitudinal Relationship Between Self-Efficacy Parameters (Predictor Variables) and Well-Being Parameters (Response Variables)

Self-Efficacy Parameter (SUPPH)	Adjusted β Value	SE	t	p	95% CI
FACT: Physical well-being					
Stress reduction	0.04	0.02	1.78	0.079	[–0.01, 0.09]
Decision making	0.17	0.07	2.51	0.014	[–0.04, 0.3]
Positive attitude[a]	0.08	0.02	4.15	< 0.001	[0.04, 0.11]
Total score[a]	0.03	0.01	3.21	0.002	[0.01, 0.05]
FACT: Emotional well-being					
Stress reduction[a]	0.04	0.02	1.92	0.055	[–0.001, 0.07]
Decision making	0.001	0.04	0.36	0.972	[–0.08, 0.08]
Positive attitude[a]	0.04	0.01	3.43	0.001	[0.02, 0.06]
Total score[a]	0.02	0.01	3.09	0.002	[0.01, 0.03]
FACT: Social well-being					
Stress reduction	0.03	0.02	1.54	0.132	[–0.01, 0.07]
Decision making	0.07	0.05	1.35	0.182	[–0.04, 0.18]
Positive attitude	0.03	0.02	1.62	0.108	[–0.01, 0.06]
Total score	0.01	0.01	1.40	0.163	[–0.01, 0.04]
FACT: Functional well-being					
Stress reduction[a]	0.08	0.04	2.26	0.024	[0.01, 0.15]
Decision making	0.14	0.08	1.94	0.053	[–0.002, 0.3]
Positive attitude[a]	0.11	0.02	6.15	< 0.001	[0.07, 0.14]
Total score[a]	0.05	0.01	4.59	< 0.001	[0.03, 0.07]
FACT: Cancer-related concerns					
Stress reduction[a]	0.08	0.02	3.47	0.001	[0.03, 0.13]
Decision making[a]	0.12	0.07	1.84	0.07	[–0.01, 0.26]
Positive attitude[a]	0.08	0.02	4.38	<0.001	[0.05, 0.12]
Total score[a]	0.05	0.01	4.30	0.001	[0.025, 0.07]

[a] Time (chemotherapy cycle) and self-efficacy parameter were allowed to vary (added as random effects) based on –2 log likelihood information criteria; in all other models, only time was allowed to vary.

CI—confidence interval; FACT—Functional Assessment of Cancer Therapy–Breast and –Colorectal; SE—standard error; SUPPH—Strategies Used by People to Promote Health

Note. All models were adjusted for State-Trait Anxiety Inventory state anxiety, as well as gender, age, type of cancer, disease staging, number of comorbidities, and Eastern Cooperative Oncology Group performance status. Analyses were adjusted for multiple comparisons ($\alpha = 0.003$).

Knowledge Translation

- Self-efficacy did not change significantly throughout the treatment period, and decision making was the self-efficacy component that correlated with lower state anxiety during chemotherapy.
- A significant relationship over time was found between higher self-efficacy and greater gains in emotional and functional well-being, as well as fewer cancer-related concerns.
- Delivering clinical interventions that aim to empower patients through information provision and skills development is expected to reduce anxiety levels and associated distress.

illness cannot be underestimated because it has been shown to affect patients' experiences of well-being (Yeung & Lu, 2014). Clinicians should recognize that engagement in this process may be particularly difficult for some patients. Clinicians can educate and train patients on how to self-manage by using a number of different techniques, such as goal setting, problem solving, positive feedback, and peer modeling (Davies & Batehup, 2010). Examining ways to identify patients who are particularly struggling with identifying and relying on personal strengths could have a positive clinical impact. This points to the importance of employing longitudinal assessments of perceived self-efficacy to allow clinicians to identify changes in patients' individual circumstances and experiences, particularly because enhancing self-efficacy seems to be related to ongoing gains in psychosocial well-being and quality of life. Such continued assessment could also allow for tailored care appropriate to one's situation at specific times throughout the treatment trajectory.

Conclusion

Results of this secondary analysis among patients receiving adjuvant chemotherapy for breast or colorectal cancer suggested no significant changes in already high self-efficacy levels throughout the treatment period and no deterioration in self-efficacy at any time point, but it did show a significant relationship over time between higher self-efficacy and lower anxiety and between higher self-efficacy and greater physical, emotional, and functional well-being. The current study supports self-efficacy in patients undergoing chemotherapy as a concept that is a suitable focus for educational and behavioral interventions and one that should be identified as influencing patient-reported outcomes.

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