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ORIGINAL ARTICLE

Emotional Suppression Tendencies as Predictors of Symptoms, Mood, and Coping Appraisals During AC Chemotherapy for Breast Cancer Treatment

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Abstract Tendencies to suppress negative emotions have been shown to predict adjustment to cancer and cancer progression. We examined whether emotional suppression, in terms of both general and emotion-specific tendencies, predict symptom reports, mood states, and coping appraisals during adriamycin/doxorubicin, cyclophosphamide/cytoxan chemotherapy for breast cancer. Forty participants completed a measure yielding scores for anxiety suppression, anger suppression, depression suppression, and total emotional suppression. They then reported their experiences of 34 physical symptoms, mood, and coping efficacy on a daily basis for the duration of treatment (84 days). Mixed model analyses revealed that emotional suppression predicted lower reports of symptoms that are vague, well-known, and potentially embarrassing side effects of chemotherapy (e.g., fatigue and constipation). Emotional suppression and particularly anger suppression predicted higher reports of symptoms relating to immune function and cardiovascular arousal (e.g., mouth sores and heart palpitations) and with appraisals of poorer coping. The three suppression tendencies exhibited distinctive patterns of relationships with symptoms, mood, and coping appraisals, suggesting that anxiety suppression, anger suppression, and depression suppression have partially independent relationships with symptomatic and mood processes. The findings highlight the potential importance of emotional suppression for understanding symptom and coping responses during chemotherapy.

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Dispositional tendencies to suppress negative emotions have been associated with poor adjustment to cancer experiences and cancer progression [1–4]. These findings suggest that emotional suppression influences self-regulation efforts to manage cancer experiences in ways that undermine psychological and physiological processes involved in adjustment and cancer control. A particularly challenging aspect of the cancer experience is coping with chemotherapy and its symptomatic side effects. Identifying predictors of chemotherapy symptom experiences is important for developing ways to improve tolerance and well-being during the treatment cycles. Moreover, as some chemotherapy symptoms reflect variations in immunocompetence [5, 6], psychological predictors of these symptoms may be indicative of psychological processes influencing immune responses to chemotherapy. In this study, we assessed the role of emotional suppression tendencies as predictors of symptomatic side effects, mood responses, and perceived coping efficacy among women undergoing chemotherapy treatment for breast cancer.

Emotional Suppression

Emotional suppression, which involves conscious efforts to inhibit expressive elements of emotional experiences, is one of several strategies identified by general theories of emotion regulation as well as by illness-specific theories of self-regulation [7, 8]. According to the process model of emotion regulation [9, 10], suppression and other strategies are utilized at specific stages during the course of an emotional experience. The emotion generation-regulation process begins

with exposure to and evaluations of situational cues. These evaluations trigger emotional response tendencies involving coordinated sets of experiential, physiological, and behavioral processes. Suppression, involving efforts to decrease expressive behavior, is one strategy used to modulate both negative and positive emotions—although suppressing negative and positive emotions may have distinctive effects on emotional and physiological experiences [11, 12]. Although suppression may be useful in many life situations, research suggests that general tendencies to suppress negative emotions such as anxiety, sadness, and anger, can, over time, be maladaptive [1–4, 9–11, 13]. Suppression may modify the behavioral aspects of a negative emotional experience, but it does not target the emotional experience itself and so the experiential and physiological responses may continue unresolved [10].

Theory and research point to several mechanisms through which emotional suppression may influence symptom experiences and well-being during aversive treatments such as chemotherapy. On the one hand, individuals high in suppression tendencies may be motivated to hide their experiences of distress from others and so they may under-report side effects of treatment. Within the context of chemotherapy, women high in suppression tendencies may minimize vague, well-known, or embarrassing side effects of treatment in attempts to be brave, hide these negative experiences, and minimize the distress others may feel over their suffering.

On the other hand, suppression tendencies may exacerbate the experiences of specific symptoms. Unintentional ramifications of suppressing negative emotions may include sustained negative emotion and reductions in positive emotion [13, 14] as well as cardiovascular arousal [15, 16] and immunological changes [17, 18]. Continuous efforts to suppress emotional expression can deplete cognitive and social resources [13, 16], and this depletion may further enhance stress arousal and undermine well-being in ways that exacerbate symptoms and illness distress [19]. These physiological effects suggest that emotional suppression, by enhancing stress-related activation of hypothalamic–pituitary–adrenocortical (HPA) processes and disrupting immune function, may increase the experience of autonomic and immune-related symptoms during chemotherapy (e.g., heart palpitations, fever, urinary or bladder infections, mouth sores, and ulcers).

In cancer research, investigators often construe emotional suppression or control as a dispositional tendency to suppress a composite of negative emotions relating to anxiety, depression, and anger (although there are exceptions; e.g., [20]). Yet given that these three emotions may be linked with distinctive motivational, psychophysiological, and behavioral processes (e.g., between anxiety and depression [20]; between anger and anxiety [21]; see Pankseep [22]), it is likely that anxiety suppression, depression suppression, and anger suppression differentially influence symptom and mood experiences in general and during chemotherapy. To the extent that suppression interferes with the resolution of an emotional experience, it may prolong the arousal of that emotion and its physiological effects.

Research demonstrates that the emotional systems of anxiety, depression, and anger all have associations with physiological processes relating to cancer symptoms, chemotherapy side effects, and immune function. Yet little is known about how these three emotional systems may uniquely influence specific symptoms or physiological processes during cancer treatment, as studies have tended to focus solely on one emotional system. Research on trait anxiety has revealed associations with higher symptom reports among patients undergoing chemotherapy, with analyses suggesting that the effects are due to a proneness to experience more symptomatic side effects (and potentially due to heightened endocrine reactivity) rather than a bias to over-report symptoms [23]. Among women with breast cancer receiving tamoxifen, trait anxiety is associated with heightened sensitivity to symptoms (e.g., hot flashes and vaginal irritation) and greater physiological responses to tamoxifen indicative of heightened endocrine responsiveness [24, 25]. Depression is also associated with higher levels of cancer symptoms and alterations in autonomic regulation, endocrine activity, and immune function [26–30]. Individuals who are prone to anger may experience increased levels of norepinephrine, which in turn may activate both immune responses and the expression of genes responsible for chronic inflammation [31].

Despite evidence that anxiety, depression, and anger are each linked with physiological responses during cancer treatment, few studies have evaluated how efforts to suppress these specific emotions uniquely influence symptom and physiological processes involved in treatments such as chemotherapy. Anger suppression effects have received the most attention to date, with evidence indicating that it may play a role in cardiovascular and immune-related processes. For example, tendencies to suppress anger have been found to predict greater blood pressure reactivity to stressful stimuli [32], higher rates of hypertension in men [33], and reduced immune function in men treated for prostate cancer [17]. These findings suggest that, within the context of chemotherapy, anger suppression may enhance side effects relating to cardiovascular and immune processes. To the extent that anxiety and depression suppression prolong experiences of anxiety and depression, respectively, they may also enhance symptoms related to their associated cardiovascular, endocrine, and immune processes.

On the other hand, symptoms can have unique psychological meanings such that efforts to suppress or minimize reports of their occurrence may be linked with tendencies to suppress specific emotions. For example, anxiety suppres-

sion may be associated with tendencies to under-report symptoms that may elicit social anxiety (e.g., constipation, cold sweats, nausea, and deformed nails), depression suppression may be associated with the under-reporting of depression-related symptoms (e.g., fatigue or sleep difficulties), and anger suppression may be associated with efforts to minimize the reporting of symptoms exacerbated by anger (e.g., headache or muscle tension).

In evaluating the associations of suppression tendencies with symptom experiences, it is important to determine whether these relationships are independent of other personality traits. Research has established that traits relating to negative affect arousal, particularly neuroticism and trait anxiety, are associated with enhanced attention to and reporting of symptoms [21, 34, 35], yet these traits have been found to be unrelated to suppression tendencies [13, 36, 37]. Nevertheless, it may be that both symptom experiences and emotional suppression are linked with other traits associated with vulnerability to negative affect and somatic experiences. One potential trait is sensitivity of the behavioral inhibition system (BIS), a neural system that responds to threatening stimuli and motivates avoidance behavior [38]. BIS sensitivity may predispose individuals to arousal of the physiological and mood concomitants of anxiety as well as avoidance-related modulation strategies such as expressive suppression (which may enable one to avoid distressing interactions).

Private body consciousness, involving tendencies to focus on internal sensations, is another trait that may be associated with both suppression tendencies and symptom reports [39]. Consistent with self-regulation theory that attentional self-focus can increase sensitivity to illness-related symptoms, this trait has been linked with heightened reports of symptom frequency and intensity in individuals with chronic conditions [40] and individuals undergoing chemotherapy [41]. Low levels of this trait may be linked with both lower suppression tendencies (which involve diverting attention away from emotional sensations when interacting with others) and lower symptom reports during chemotherapy. Establishing that associations of emotional suppression with symptom experiences are independent of BIS sensitivity and private body consciousness would add support that the associations are due to suppression tendencies rather than affective or attentional styles.

AC Chemotherapy

Adriamycin/doxorubicin, cyclophosphamide/cytoxan (AC) is a common chemotherapy administered to breast cancer patients worldwide. Many symptomatic side effects of AC chemotherapy have been identified [42], and it is well established that patients endure psychological distress along with physical symptoms [43–45]. Studies assessing predictors of chemotherapy side effects have tended to focus on limited sets of symptoms, such as fatigue [46, 47] and nausea or vomiting [48, 49]. Moreover, most studies have used retrospective measures requiring participants to recall their symptoms over time periods of several days, weeks, and even months. Such reports are subject to inaccuracies due to errors and biases in recall; moreover, they fail to take into account day-to-day fluctuations in symptoms over the chemotherapy cycles. Some studies have used daily assessments, but they have tended to focus on only one or a few symptoms [26, 50]. Daily diaries used in cancer pain management [51, 52] and clinical trials [53, 54] have been found to be acceptable to participants and provide evidence of daily variability in responses.

Present Study Design and Predictions

The primary aim of this prospective study was to assess whether suppression tendencies predict daily reports of a comprehensive set of symptoms, mood, and coping appraisals over the duration of AC chemotherapy for breast cancer. Prior to the initiation of chemotherapy, women completed an emotional suppression measure with subscales for anxiety suppression, anger suppression, and depression suppression. They then completed daily assessments of symptoms, mood, and coping for the four cycles of chemotherapy.

Based on theory and evidence that emotional suppression may exacerbate cardiovascular, endocrine, or immune alterations responsible for some symptom experiences and yet inhibit the reporting of other symptoms, we predicted that the associations of suppression with symptom reports would vary across the symptoms. Although it was recognized that reports of some symptoms may be affected by both of these competing influences of emotional suppression, several predictions regarding potentially dominant influences were made. It was predicted that emotional suppression (both total and subscale scores) would be associated with lower reports of symptoms that are vague (not directly observable), embarrassing, or well-known chemotherapy symptoms as women attempt to "put on a brave face" and minimize the chemotherapy effects. These symptoms include fatigue, weakness, appetite disturbances, dizziness, nausea, headache, constipation, diarrhea, bloating, deformed nails, cold sweats, and hot flashes. In contrast, it was predicted that suppression would be associated with higher levels of (a) immune-related symptoms indicative of infections (e.g., fever, urinary and bladder infections, mouth sores and ulcers, swelling) and (b) symptoms indicative of cardiovascular arousal (e.g., heart palpitations). Associations of emotional suppression

with reports of other symptoms (e.g., breathlessness, skin changes, aches/pain, vaginal irritation, dizziness, and sore eyes) were explored, as these symptoms could either be construed as vague or embarrassing symptoms or as indicative of immune-related changes (e.g., skin changes, aches/pain, vaginal irritation, or sore eyes) or cardiovascular arousal (e.g., breathlessness).

The analyses assessed associations of symptoms with each of the suppression subscales to evaluate the potentially distinctive patterns of symptom responses associated with anxiety suppression, anger suppression, and depression suppression. We predicted that anxiety suppression would be associated with lower reports of symptoms that are potentially embarrassing or indicative of anxiety arousal (constipation, deformed nails, cold sweats, and appetite disturbances), anger suppression would be associated with lower reports of headache as it is a common consequence of angry mood, and depression would be associated with lower reports of depression-related symptoms (fatigue and constipation). Given evidence that anger suppression predicts symptoms related to cardiovascular, immune-related processes, we predicted that anger suppression would be associated with higher reported levels of heart palpitations, fever, urinary and bladder infections, mouth sores and ulcers, and swelling. Whether anxiety and depression suppression also predict these symptom reports was explored.

Because emotional suppression may exacerbate distress over time, we hypothesized that suppression tendencies would predict higher levels of anxious, angry, and depressed mood over the course of chemotherapy. Finally, we predicted that emotional suppression would be associated with lower ratings of ability to cope with treatment due to heightened symptoms and poorer regulation of symptoms and emotions over time. BIS sensitivity and private body consciousness were assessed to evaluate whether they are correlated with emotional suppression tendencies and, if so, whether associations of emotional suppression with symptoms, moods, and coping appraisals are independent of these personality traits.

Method

Participants

Women were recruited from four breast cancer clinics in Auckland, New Zealand. The inclusion criteria, as assessed by clinic doctors and verified through evaluations of medical records, were surgical intervention for breast cancer within the past 12 weeks (M=5.3, SD=2.12), no other major concurrent disease or psychopathology, no previous cancer diagnosis, and receipt of the standard, four-cycle protocol of AC chemotherapy without concurrent radiotherapy or hormonal therapy. The clinic oncologists and breast care nurses referred eligible and interested patients to the researchers. All 40 women referred to the researchers agreed to participate. Cycle 1 diaries were completed by 40 (100%) of the women. Of these women, 38 (95%) completed the cycle 2 diaries, 37 (93%) completed the cycle 3 diaries, and 34 (85%) completed the cycle 4 diaries. Of those who did not finish cycle 4, one woman did not do so because her chemotherapy had been suspended.

The sample was predominately New Zealand European (85%; Maori 7.5%, other ethnicity 7.5%); ages ranged from 34 to 69 years old (M=48.6, SD=8.67). Most were married or in a de facto relationship (80%), had children (76%), and held secondary (85%) and tertiary (68%) educational qualifications; 67% were employed. Data from medical records revealed that nearly equal numbers of women had either a left (52.5%) or right (45%) carcinoma; 2.5% had bilateral carcinoma. The majority had a total mastectomy (55%), 35% had a partial mastectomy, 5% had a lumpectomy, and 5% had bilateral surgery. Based on the Nottingham Prognostic Index [55], nearly two thirds of the women had "poor" (37.5%) or "very poor" (27.5%) prognoses; the rest had "average" (32.5%) or "good" (2.5%) prognoses. The average time from surgery to the start of AC chemotherapy was 42.70 days (SD=16.80). Most women (90%) had publicly funded medical care; four women (10%) had care provided through private insurance.

Design

The study utilized a prospective design with repeated measures. Independent variables were baseline scores of emotional suppression (total), anxiety suppression, depression suppression, and anger suppression. Within-subjects dependent variables were symptoms, moods, and coping appraisals assessed on each of the 84 days of AC chemotherapy.

Measures

Emotional Suppression

The Courtauld Emotional Control Scale [56] was used to assess dispositional tendencies to suppress negative emotions. It includes seven-item subscales assessing tendencies to suppress anxiety (e.g., "When I feel afraid [worried], I bottle it up"), anger (e.g., "When I feel angry [very annoyed], I hide my annoyance"), and depression (e.g., "When I feel unhappy [miserable], I keep quiet"). Ratings range from 1 (*almost never*) to 4 (*almost always*) and are summed to generate scores. Originally developed for use in studies of women with breast cancer, the measure has been used with other populations as well [56, 57]. Test–retest reliability has been found to be high; for total scores, r=0.95

over a 3- to 4-week period [56]. Scores are independent of social desirability [56] and negatively related to adjustment scores in cancer patients [1, 4, 58]. Internal consistency has been found to be high in a variety of samples [1, 4, 56, 59, 60]; in this study, Cronbach's α's were 0.84 (anxiety), 0.84 (anger), 0.87 (depression), and 0.91 (total). The degree of correlation among the subscales indicated that they assessed distinctive, although related tendencies to suppress specific negative emotions; for anger and depression, r=0.47; for anger and anxiety, r=0.51; for depression and anxiety, r=0.46.

Symptoms

The symptom measure was adapted from the 24-item Chemotherapy Symptom Assessment Scale [61]. The response format and instructions were revised to be applicable to daily assessment, and additional symptoms identified as potential side effects of AC chemotherapy were added [62–66]. The symptoms were headache, vomiting, taste changes, appetite changes, nausea, cold sweats, hot flushes, fatigue, weakness, sleep disturbances, constipation, bloating, swelling, fever, heart palpitations, sore mouth, ulcers in mouth, trouble swallowing, urinary or bladder infection, dizziness, skin discoloration, skin bruising, skin changes such as dryness, soreness or itchiness, vaginal irritation, aches or pain, breathlessness, nail changes, sore eyes, infections, diarrhea, tingling in fingers/toes, and breast sensitivity. All 32 symptoms were rated from 1 (*not at all*), to 5 (*very much*). Menstrual irregularities, hair loss, and weight change were also assessed at the end of each of the four cycles.

Anxiety

Anxious mood was assessed with the Spielberger State-Trait Anxiety Inventory short form [67], which includes six items (e.g., "I feel tense"). Ratings of how one feels "today", from 0 (*not at all*) to 4 (*extremely*), are summed; α=0.85 at baseline.

Anger

The measure of angry mood [68] consists of three items: "I am angry", "I am resentful", and "I am grouchy" (α=0.85 at baseline). Indications of how one feels "today" are rated from 0 (*not at all*) to 4 (*extremely*); ratings were summed.

Depression

The four-item version of the Centre for Epidemiological Studies Depression Scale [69] was used to assess depressed mood. The items (e.g., "I feel depressed", "I feel sad") were rated from 0 (*rarely or none of the time*) to 3 (*most or all of the time*), and ratings were summed; α=0.60 at baseline.

Coping Appraisals

Daily appraisals of coping with chemotherapy were assessed with the item: "To what extent do you feel you are successfully dealing with your chemotherapy treatment?" Ratings ranged from 1 (*not very well*) to 5 (*extremely well*).

Personality Measures

The seven-item BIS subscale of the BIS/BAS measure [38] was used to assess sensitivity to anxiety during unpleasant situations. Items (e.g., "I feel worried when I think I have done poorly at something important") are rated on four-point scales; α=0.74. The Private Body Consciousness Scale [39] has five items assessing general awareness of sensations (e.g., "I am very aware of changes in my body temperature") with ratings from 0 (*extremely uncharacteristic*) to 4 (*extremely characteristic*); α=0.64.

Procedure

The Auckland Ethics Committee approved the study. To ensure acceptability, clarity, comprehensiveness of symptoms, and ease of completion, the questionnaire was reviewed by three breast cancer researchers, an oncologist, and two AC chemotherapy patients, and it was pilot-tested with two women for three chemotherapy cycles.

When an eligible patient attended her first clinic appointment post-surgery, the oncologist or breast care nurse gave her verbal and written descriptions of the research. Patients expressing interest were then contacted by the researchers and, upon providing informed consent, received the baseline questionnaire prior to the onset of chemotherapy. This questionnaire included the measures of demographic characteristics, emotional suppression, private body consciousness, BIS sensitivity, and mood states. Participants received a daily diary prior to the onset of each chemotherapy cycle, which included the measures of symptoms, mood, and coping appraisals. Chemotherapy involved the injection of the AC drugs and anti-emetic drugs during a hospital session on the first day of the cycle, followed by a rest period of 20 days. Participants were telephoned on day2 and then weekly to monitor daily completions of the diaries and address any questions.

Analytical Strategy

Pearson correlational analyses were used to assess zero-order relationships of the emotional suppression measures

(total and subscale scores) with age, prognostic status, BIS sensitivity, and private body consciousness, as well as the correlations among anxiety suppression, anger suppression, and depression suppression. Associations of emotional suppression with daily symptoms, mood, and coping appraisals were assessed using the SAS statistical program's mixed model analysis of repeated measures data (PROC MIXED) [70]. Analyses included up to 84 observations (i.e., 84 daily ratings for individual symptoms and coping appraisal, 84 mean daily ratings for symptom clusters, and 84 daily scores for mood measures) for each of the 40 participants. Of the possible 3,360 observations, 231 (7%) were missing due to the six women dropping out of the study, and ten to 11 (<1%) were missing due to one to four missed days by four women and missing values by two women. The models were designed to assess the associations of emotional suppression with symptom levels (or moods or coping appraisals) after controlling for the chemotherapy treatment effects associated with each of the 84 days on symptoms (or moods or coping appraisals). The models included 83 dummy variables to account for the effects of each of the treatment days. The modeling of the time-specific effects assumed a first-order autoregressive process, AR(1), because it is expected that daily ratings obtained closer in time were more highly correlated than those obtained at more distal points in time. The analyses utilized a "repeated" statement with "subject" treated as a random effect. The models included the intercept, with degrees of freedom calculated using the Kenward–Roger method [71].

Because some symptom variables were skewed, logarithmic transformations were conducted to correct the skew and preliminary mixed model analyses were conducted on these transformed variables. The patterns of findings were equivalent to those obtained for the untransformed variables, and so the final analyses reported here are those using the untransformed variables. Preliminary mixed model analyses assessed the significance of the following covariates: age, prognostic status, BIS sensitivity, and private body consciousness. Because of the multiple analyses, a significance level of $p<0.01$ was used in order to maintain a balance between the relative risks of type I error and type II error.

Results

Emotional Suppression: Associations with Personal Characteristics

In general, participants reported suppression levels comparable to those observed for women with breast cancer in previous studies [4, 59]. For total scores, $M=46.35$, SD=9.97, range=25–65; for anxiety suppression, $M=15.77$, SD=4.17, range=7–28; for anger suppression, $M=14.65$, SD=3.86, range=7–21; for depression suppression, $M=15.93$, SD=4.35, range=7–26. The total, anxiety, anger, and depression suppression measures were not correlated with prognostic status (r's=−0.07, −0.18, 0.13, and 0.21, respectively; p's>0.28), age (r's=−0.10, −0.34, 0.12, and 0.00; p's>0.08), BIS sensitivity (r's=−0.05, −0.14, −0.17, and 0.18; p's>0.37), or private body consciousness (r's=−0.27, −0.29, −0.05, and −0.13; p's>0.16), nor did the inclusion of these variables as covariates in the mixed linear model analyses alter the patterns of findings. These variables were therefore not included as covariates in the final analyses.

Reports of Symptoms, Moods, and Coping

Ratings for four symptoms—infections, diarrhea, tingling in fingers/toes, and breast sensitivity—did not change significantly across the 84 days, indicating that they were not affected by chemotherapy. These symptoms were therefore not included in the analyses. For the end-cycle assessments of menstrual irregularities, hair loss, and weight change, ceiling effects (e.g., 100% reported extreme hair loss by cycle 2) precluded analyses of emotional suppression influences on their occurrence.

To reduce the number of analyses, we combined symptoms reflecting common physiological activities. The criteria for grouping symptoms were (1) covariation during the cycles (i.e., peaking at the same times, such as on days 2–5) and (2) physiological correspondence (i.e., involving the same physiological system, such as the gastrointestinal system). Using these criteria, 13 of the 28 symptoms were combined into clusters: constipation (constipation and bloating), fatigue (fatigue, weakness, and sleep difficulties), appetite disturbances (changes in taste, appetite changes, and nausea), skin changes (bruising and changes involving dryness, soreness, or itchiness), and mouth/throat sores (sore mouth, mouth ulcers, and difficulty swallowing). For each cluster, the mean rating was calculated for each of the 84 days. The other 15 symptoms were treated individually.

Alternative strategies for creating larger symptom clusters proved problematic. Using factor-analytic techniques or reliability analyses to determine symptom clusters based on internal consistency is not appropriate because even symptoms involving common physiological processes do not necessarily covary. In the context of chemotherapy, for example, one may experience fatigue without having sleep disturbances. Chemotherapy effects on appetitive processes may induce changes in taste or hunger patterns without inducing nausea. Alternatively, one may describe a particular physiological state as one symptom rather than another (e.g., as bloating rather than constipation, as sore mouth

rather than ulcers in mouth, etc.). It was also necessary to group only symptoms with common patterns of fluctuation (i.e., common peak days), as combining symptoms with different fluctuation patterns would yield scores with substantially less variation over the days, thereby obscuring their relationships with the emotional suppression. The approach to generate a small set of symptom clusters according to criteria of physiological correspondence and treat other symptoms separately provided a balance between reducing the number of analyses and maintaining appropriate distinctiveness of specific symptoms.

Table 1 presents the means for the symptoms, as well as the peak days of severity during a cycle and the proportions of women reporting the symptoms (as indicated by a rating of 2 or higher) during the treatment period. Symptoms are listed in order of their peak days of severity during the 21 days of the cycle and, secondarily, by the proportions of women reporting the symptoms. All symptoms were experienced by the majority of the women with the exceptions of heart palpitations and cold sweats. Daily symptom reports varied considerably over the four 21-day cycles; those with peak days on day 1, days 2–5, and days 6–12 exhibited cyclical patterns similar to those illustrated in Fig. 1. The panels in this figure illustrate the mean ratings for headache, a symptom that tended to spike on day 1; appetite disturbance, an example of symptoms that tended to peak during days 2–5; and constipation, an example of symptoms that tended to peak during days 6–12 of each cycle. Nail changes and sore eyes both showed a steady increase over the 84 days.

Ratings of mood states and coping appraisals also exhibited cyclical patterns of change over the cycles (see Table 1; Figs. 2 and 3). Anxious mood tended to be elevated at the onset of a cycle and decrease over the course of the cycle. Angry moods, although generally low, tended to peak 6–9 days into a cycle. Depressed mood tended to peak at days 6–7, whereas coping appraisals tended to be the lowest at days 5–7 of a cycle.

Mixed Model Analyses of Symptoms, Mood States, and Coping Appraisals

Analyses revealed that suppression variables were negatively associated with seven symptom sets (see Table 2). Emotional suppression (total) was negatively associated with headache, constipation, cold sweats, fatigue, and nail changes. Anxiety suppression was associated with lower reports of constipation, cold sweats, fatigue, and appetite disturbances. Anger suppression was negatively associated with headache, constipation, and nail changes, whereas

Table 1 Symptoms and moods assessed daily during AC chemotherapy treatment

Symptoms/mood/coping	Mean (SD)	Peak days during cycle	% Reporting symptom
Headache	1.52 (0.88)	1	100
Vomiting	1.08 (0.46)	1	60
Constipation	1.36 (0.66)	2–5	98
Dizziness	1.24 (0.64)	2–5	90
Hot flushes	1.37 (0.77)	2–5	80
Skin discoloration	1.16 (0.50)	2–5	77
Swelling	1.12 (0.43)	2–5	75
Fever	1.04 (0.25)	2–5	60
Heart palpitations	1.12 (0.45)	2–5	37
Cold sweats	1.13 (0.52)	2–5	37
Fatigue	1.92 (0.92)	6–12	100
Appetite disturbances	1.74 (0.93)	6–12	100
Sore mouth	1.32 (0.47)	6–12	100
Skin changes	1.20 (0.37)	6–12	88
Aches/pain	1.33 (0.78)	6–12	72
Breathlessness	1.21 (0.57)	6–12	67
Vaginal irritation	1.10 (0.38)	6–12	63
Bladder problems	1.27 (0.45)	6–12	60
Sore eyes	1.44 (0.82)	Steady increase	92
Nail changes	1.27 (0.58)	Steady increase	75
Anxious mood	4.98 (4.74)	1–7	100
Depressed mood	2.14 (2.45)	2–9	100
Angry mood	0.79 (1.85)	6–9	100
Coping appraisal	4.03 (0.93)	1–9 (lowest)	–

For peak days during cycle, numbers reflect days during the four 21-day cycles when symptom or negative mood reports were the highest; for coping appraisals, numbers reflect days when appraisals of coping efficacy were the lowest. Steady increase refers to consistent increases over the total 84 days of treatment

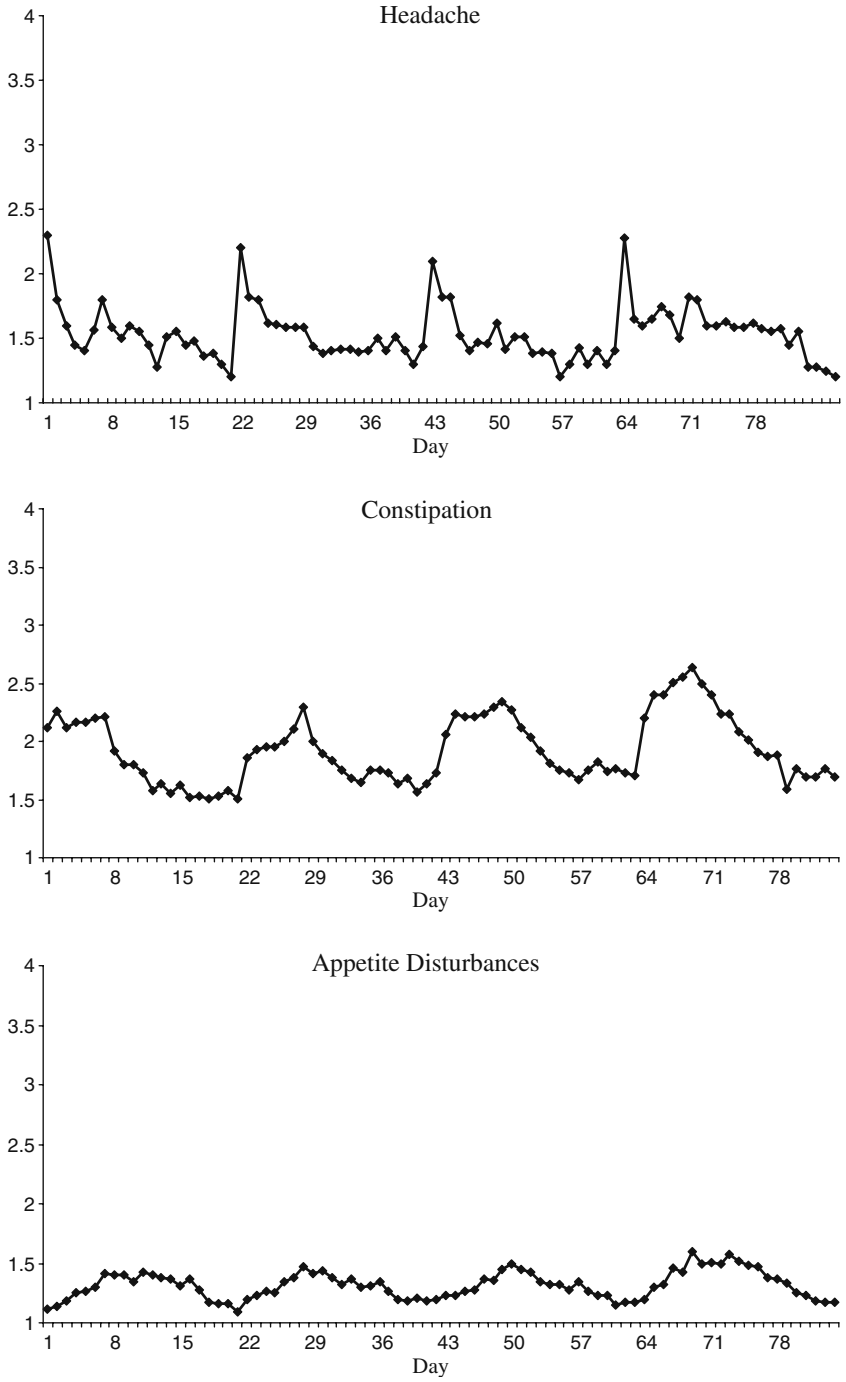

Fig. 1 Examples of differences in the patterns of daily fluctuations in symptom severity over the course of the four 21-day cycles of AC chemotherapy. Cycles commenced on days 1, 22, 43, and 64. The pattern of mean severity ratings for headache is characteristic of the patterns for symptoms spiking on the first day of the cycles. The pattern of mean ratings for constipation is illustrative of the patterns for symptoms peaking during the first week of the cycles. The graph of mean ratings for appetite disturbances exemplifies the patterns for symptoms peaking during the second week of the cycles

depression suppression was negatively associated with constipation, cold sweats, fatigue, and breathlessness.

Suppression tendencies were positively associated with eight symptom sets: swelling, fever, heart palpitations, sore mouth, skin changes, aches and pain, vaginal irritation, and bladder problems (see Table 3). Emotional suppression (total) was positively associated with fever, skin changes, aches and pain, and vaginal irritation. Anger suppression was positively associated with all eight symptoms except fever, whereas both anxiety suppression and depression suppression were positively associated with fever and not significantly related to the other seven symptoms. Suppression tendencies did not predict reports of five symptoms: vomiting, skin discoloration, hot flushes, dizziness, or sore eyes.

Emotional suppression (total) was not associated with mood states. Anxiety suppression was associated with lower reports of anxiety (Est.=−0.19; SE=0.05; CI=−0.291, −0.090; t=−3.82; p<0.001). Anger suppression was associated with higher depression (Est.=0.083; SE=

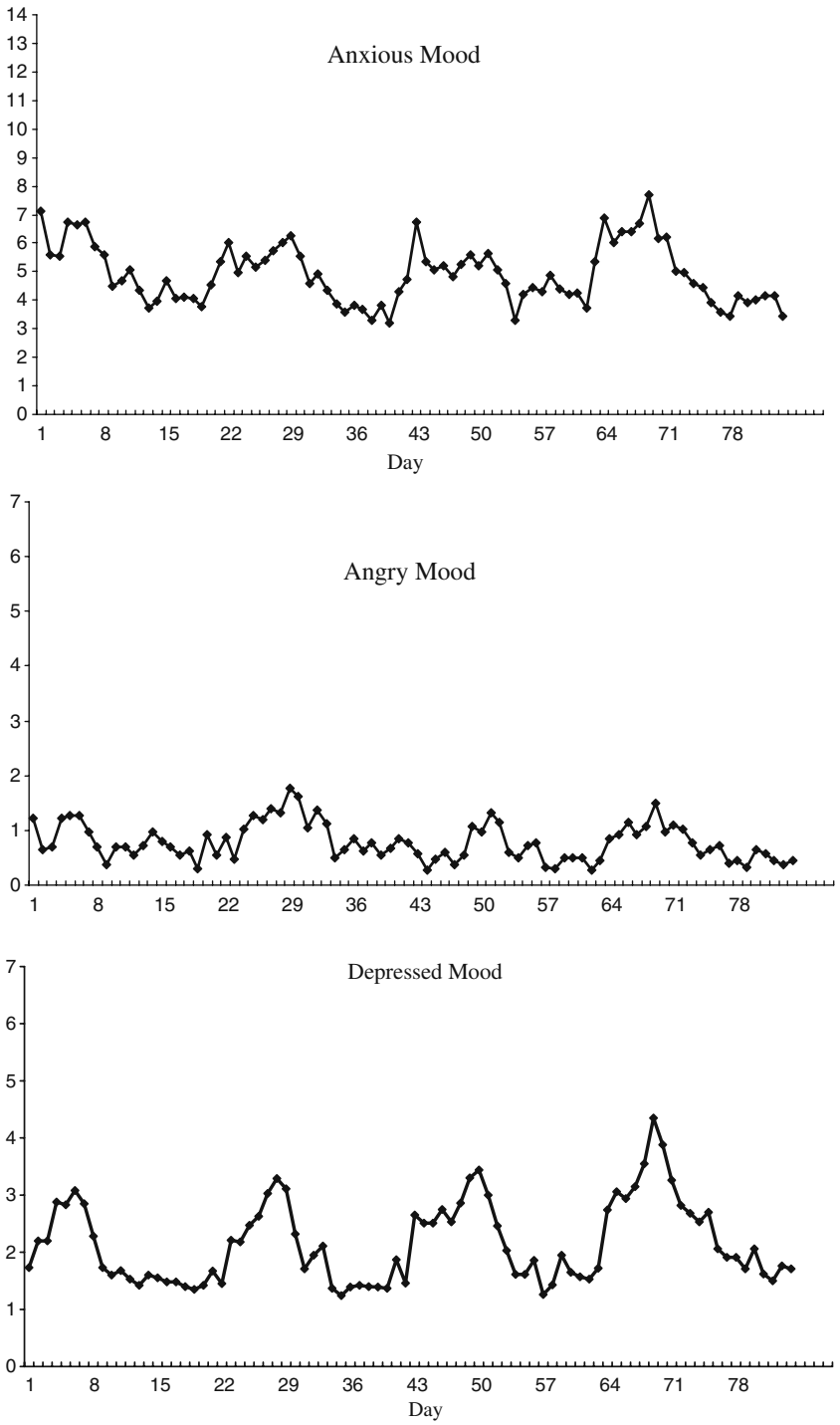

Fig. 2 Mean scores for anxious mood, angry mood, and depressed mood over the course of the 84 days of the four 21-day cycles of AC chemotherapy. Cycles commenced on days 1, 22, 43, and 64

0.026; CI=0.030, 0.137; t=3.14; p<0.01), and depression suppression was associated with higher anxiety (Est.= 0.115; SE=0.047; CI=0.019, 0.210; t=2.44; p<0.01). For coping appraisals, suppression tendencies predicted poorer perceived coping. Significant associations were found for emotional suppression (total; Est=−0.014; SE= 0.003; CI= −0.021, −0.007; t=−3.84; p<0.001), anger suppression (Est =−0.051; SE=0.009; CI=−0.069, −0.033; t=−5.72; p< 0.001), and depression suppression (Est=−0.030; SE= 0.009; CI=−0.047, −0.014; t=−3.71; p<0.001), but not anxiety suppression.

Given the correlations among the suppression subscales, the question arises as to whether the unique relationships between the subscales and symptoms, mood, and coping appraisals remain significant when the shared variance of the other subscales is removed. To assess this issue, we ran the mixed model analyses with all three subscales included as independent variables. For most dependent variables, the

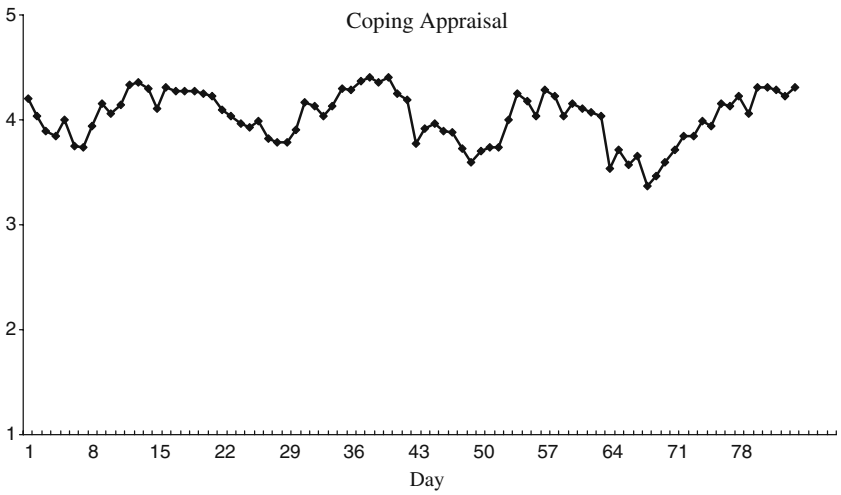

Fig. 3 Mean rating of coping appraisal over the course of the 84 days of the four 21-day cycles of AC chemotherapy. Cycles commenced on days 1, 22, 43, and 64

subscales found to be significant predictors in the original analyses remained significant. Different patterns appeared for the following symptoms: For constipation, only depression suppression was significant ($t=-2.86$, $p<0.01$); for nail changes and vaginal irritation, none of the three subscales was significant. These three symptoms may be associated with general suppression tendencies rather than tendencies to suppress specific emotions; however, the majority of the symptoms have unique associations with the specific suppression tendencies.

Discussion

To our knowledge, this is the first study to show that emotional suppression tendencies predict symptomatic side effects, mood states, and coping appraisals during chemotherapy. That suppression tendencies predicted the majority of symptoms assessed underscores the potential importance of their roles in symptom experiences during chemotherapy. Suppression tendencies were not associated with measures of BIS sensitivity and private body consciousness, suggesting that these personality traits are not responsible for the observed associations of suppression with symptom reports. The findings also demonstrated the differential patterns in symptom fluctuations over the cycles, with the severity of some symptoms peaking on the first day and the severity of other symptoms peaking during other phases of the first 2 weeks; two symptoms showed steady increases in severity over the 84 days. Moreover, symptoms differed in terms of whether they were positively or negatively associated with emotional suppression. These findings highlight the need to focus on individual symptoms or clusters rather than total symptom loads when examining emotional suppression and other psychological factors as predictors of fluctuations in chemotherapy side effects.

As predicted, suppression was negatively associated with reports of symptoms that were vague, socially embarrassing, or well-known side effects of chemotherapy. These symptoms included fatigue, headache, appetite disturbances, constipation, cold sweats, and nail changes. Suppression tendencies did not predict lower reports of diarrhea and hot flashes as expected, although depression suppression did predict lower reports of breathlessness. We cannot determine whether these lower symptom reports reflect veridical experiences, such that they indicate less intensity at a physiological level or lower sensitivity to their occurrence, or whether they are due to tendencies to under-report symptoms in attempts to be brave or strong, divert attention away from them, or minimize their incidence or severity for other reasons. Yet given the highly aversive nature of AC chemotherapy and that suppression was associated with poorer coping appraisals over the full course of the chemotherapy, there is reason to believe that these negative associations may well be due to under-reporting of these symptoms. If women high in suppression are not acknowledging the true severity of these symptoms to medical staff and support people, then they may not be receiving sufficient advice or assistance in using symptom control measures (e.g., medications, analgesics and other pharmaceutical products, rest, and dietary changes). Failure to control symptoms such as appetite disturbances, headache, and fatigue may enhance suffering and undermine daily functioning and health. On the other hand, women high in suppression who under-report these symptoms may rely more heavily on some measures such as self-medication and rest as a means of coping privately with the experiences. Further research should examine the relationships among suppression tendencies, symptom reports, and the use and consequences of symptom control efforts.

As predicted, suppression tendencies (either emotional suppression total, anger suppression, or both) were

Table 2 Mixed model analyses of emotional suppression tendencies as negative predictors of symptoms over the 84 days of AC chemotherapy

Symptoms	Emotional suppression total		Anxiety suppression		Anger suppression		Depression suppression	
	Est. (SE) [CI]	*t*	Est. (SE) [CI]	*t*	Est. (SE) [CI]	*t*	Est. (SE) [CI]	*t*
Headache[a]	−0.008 (0.003) [−0.014, −0.002]	−2.47*	−0.014 (0.008) [−0.030, 0.001]	−1.92	−0.027 (0.008) [−0.042, −0.012]	−3.50**	−0.005 (0.007) [−0.019, 0.009]	−0.73
Constipation[b]	−0.014 (0.003) [−0.020, −0.010]	−4.82**	−0.021 (0.007) [−0.036, −0.007]	−2.91*	−0.030 (0.007) [−0.045, −0.015]	−3.99**	−0.030 (0.006) [−0.043, −0.018]	−4.55**
Cold sweats[a]	−0.009 (0.002) [−0.013, −0.004]	−3.65*	−0.018 (0.006) [−0.030, −0.007]	−3.10*	−0.008 (0.006) [−0.020, 0.004]	1.37	−0.022 (0.005) [−0.033, −0.012]	−4.23**
Fatigue[b]	−0.014 (0.005) [−0.023, −0.004]	−2.85*	−0.044 (0.012) [−0.067, −0.021]	−3.76**	0.008 (0.013) [−0.017, 0.032]	0.62	−0.040 (0.010) [−0.061, −0.019]	−3.71**
Appetite disturbances[b]	−0.010 (0.005) [−0.020, −0.001]	−2.09	−0.047 (0.011) [−0.070, −0.024]	−3.98**	0.001 (0.013) [−0.024, 0.026]	0.08	−0.014 (0.011) [−0.037, 0.008]	−1.26
Breathlessness[a]	−0.007 (0.003) [−0.014, −0.001]	−2.20	−0.013 (0.008) [−0.029, 0.003]	−1.67	−0.003 (0.008) [−0.019, 0.014]	−0.34	−0.023 (0.007) [−0.038, −0.009]	−3.20*
Nail changes[a]	−0.009 (0.003) [−0.015, −0.003]	−2.79*	−0.018 (0.008) [−0.034, −0.002]	−2.21	−0.020 (0.008) [−0.037, −0.004]	−2.45*	−0.016 (0.007) [−0.030, −0.001]	−2.07

Analyses include observations from 40 women over 84 days with 240–241 observations missing. Statistics for the 84 day variables are not reported due to space constraints and their lack of theoretical importance

$*p<0.01$; $**p<0.001$

[a] Observations=3,120

[b] Observations=3,119

associated with higher levels of symptoms associated with cardiovascular and immune function: heart palpitations, swelling, fever, urinary and bladder symptoms, and mouth sores. Although not predicted, total suppression and anger suppression were also associated with higher levels of aches and pain (which are commonly experienced during infectious illnesses), vaginal irritation (some instances of which may have involved yeast infections), and skin changes. Although these symptoms may reflect other physiological states, these symptom patterns are consistent with theory and research indicating that emotional suppression may disrupt immune function and increase cardiovascular arousal. Further research on the nature of these symptoms and their links with underlying immune and cardiovascular processes can elucidate whether emotional suppression reduces resistance to infections and exacerbates cardiovascular problems and pain during chemotherapy.

Tendencies to suppress anxiety, depression, and anger exhibited different patterns of associations with symptom reports, suggesting that they may link with distinctive psychophysiological responses. The high similarity in the patterns for anxiety and depression suppression suggests that, in the context of chemotherapy, there may be considerable overlap in the experiential and physiological processes involving these two suppression tendencies. Both anxiety and depression suppression predicted lower reports of fatigue and cold sweats (which may be common to depression and anxiety experiences) whereas anger suppression did not. In contrast, only anger suppression predicted (lower) reports of headaches (a symptom commonly evoked by anger). Of the eight symptoms that were positively associated with suppression variables, all but fever were associated with anger suppression whereas only fever was associated with anxiety and depression suppression.

The pattern of positive symptom associations suggests that anger suppression may exacerbate the psychophysiological changes that are responsible for these symptom experiences. The results are consistent with theory and research that anger suppression is linked with greater cardiovascular reactivity, greater pain, and poor immune function [17, 72, 73]. It may be that anger regulation is particularly challenging within the context of cancer because it may be more socially undesirable to admit to feeling angry or resentful than to feeling anxious or depressed [74]. If so, then women with anger suppression tendencies may be highly engaged in anger suppression during this time, so that anger suppression has a particularly strong impact on physiological processes. For other situations (e.g., competitive sports, political debates, or public performances), experiences of anxiety and depression may be regarded as relatively more undesirable and so efforts to suppress these emotions have a relatively stronger

Table 3 Mixed model analyses of emotional suppression tendencies as positive predictors of symptoms over the 84 days of AC chemotherapy

Symptoms	Emotional suppression total		Anxiety suppression		Anger suppression		Depression suppression	
	Est. (SE) [CI]	*t*	Est. (SE) [CI]	*t*	Est. (SE) [CI]	*t*	Est. (SE) [CI]	*t*
Swelling[a]	0.001 (0.002) [−0.003, 0.004]	0.42	−0.004 (0.004) [−0.012, 0.003]	−1.10	0.011 (0.004) [0.004, 0.020]	2.82*	−0.002 (0.004) [−0.009, 0.005]	−0.51
Fever[a]	0.002 (0.001) [0.001, 0.007]	3.30*	0.006 (0.001) [0.004, 0.010]	4.72**	−0.001 (0.001) [−0.004, 0.002]	−0.74	0.005 (0.001) [0.003, 0.008]	3.86**
Heart palpitations[b]	0.002 (0.002) [−0.002, 0.006]	1.01	−0.002 (0.005) [−0.001, 0.008]	−0.31	0.018 (0.005) [0.008, 0.028]	3.45**	−0.002 (0.005) [−0.011, 0.007]	−0.42
Sore mouth[a]	0.004 (0.002) [0.001, 0.009]	2.24	0.001 (0.005) [−0.012, 0.010]	0.02	0.017 (0.005) [0.006, 0.028]	3.12*	0.009 (0.015) [−0.001, 0.019]	1.87
Skin changes[a]	0.004 (0.001) [0.001, 0.007]	2.63*	0.008 (0.004) [0.001, 0.016]	2.26	0.015 (0.004) [0.001, 0.023]	4.05**	0.001 (0.003) [−0.006, 0.008]	0.075
Aches/pain[b]	0.010 (0.004) [0.002, 0.017]	2.44*	0.007 (0.010) [−0.012, 0.027]	0.77	0.038 (0.009) [0.019, 0.058]	3.93**	0.013 (0.009) [−0.005, 0.303]	1.40
Vaginal irritation[b]	0.005 (0.002) [0.002, 0.008]	2.99*	0.009 (0.004) [0.001, 0.016]	2.33	0.011 (0.004) [0.004, 0.019]	2.89*	0.007 (0.004) [0.001, 0.014]	2.04
Bladder problems[a]	0.002 (0.002) [−0.084, 0.148]	0.83	−0.004 (0.004) [−0.011, 0.008]	−0.94	0.014 (0.005) [0.005, 0.023]	3.14*	−0.001 (0.004) [−0.011, 0.007]	−0.01

Analyses include observations from 40 women over 84 days with 240–241 observations missing. Statistics for the 84 day variables are not reported due to space constraints and their lack of theoretical importance

*$p<0.01$; **$p<0.001$

[a] Observations=3,119

[b] Observations=3,120

influence on physiological processes. Further evidence that anger suppression may have a particularly strong impact on experiences during chemotherapy is indicated by the finding that anger suppression had a relatively strong, negative association with coping appraisals whereas anxiety suppression did not predict coping appraisals. Anxiety suppression may present less challenge to the extent that anxiety is viewed as an expected response to chemotherapy.

The patterns of associations between the suppression variables and daily mood states also suggest distinctive influences of the three suppression tendencies. Total emotional suppression scores were unrelated to reports of anxious, angry, and depressed moods over the course of chemotherapy, yet the three subscales showed significant and contrasting relationships with these mood states. Within the context of chemotherapy, anxiety suppression predicted lower daily reports of anxiety whereas anger suppression predicted greater depressed mood and depression suppression predicted greater anxious mood.

Yet there were some notable inconsistencies between the observed associations of the suppression measures with the mood measures and expectations that suppression exacerbates negative moods over time. In particular, anxiety suppression was associated with lower reports of anxiety, and anger suppression and depression suppression did not predict higher reports of anger and depression, respectively. Previous research has yielded inconsistent patterns of results, with some studies finding no associations between emotional suppression and negative mood reports [11, 12, 36] and others finding only weak, positive associations (*r*'s <0.14 [4]) or inconsistent associations over the course of cancer diagnosis and treatment [19]. Although these weak and inconsistent patterns of findings cast doubts on the hypothesis that suppression tendencies significantly exacerbate negative moods, several factors should be considered. First, self-reports of moods may be reduced by suppression tendencies since, by definition, individuals high in suppression tendencies may under-report them. If suppression both enhances emotional arousal and motivates efforts to minimize self-reports of these experiences, then the result may be no observed association between suppression and mood reports. Other means of assessing mood (e.g., behavioral measures or implicit measures [75]) may yield clearer patterns of findings. Second, a recent study [12] guided by the circumplex model of emotions [76] found that suppression tendencies predict higher daily reports of negative moods associated with low activation (e.g., sad, sluggish) but not those associated with high activation (e.g., afraid, angry, upset). Further research that discriminates between active and deactive affect may help to discern whether suppression exacerbates primarily deactive negative emotions. Finally, using measures that assess anxiety, anger, and depression specific to chemo-

therapy rather than measures of general mood may be more sensitive to detecting associations of suppression with affect induced by the chemotherapy experience.

Overall, the finding that emotional suppression predicted poorer self-reported tolerance of chemotherapy, as indicated by appraisals of poorer coping as well as heightened levels of key symptoms, suggests that women high in suppression may be in greater need of support and intervention. If further research confirms that suppression tendencies influence symptom reports and lead to appraisals of poorer coping during chemotherapy, then screening women for suppression tendencies may help in identifying women who may need additional assistance and support during treatment. They might benefit from additional screening of physiological side effects through more objective or behavioral measures (e.g., physical examinations, reports of dietary intake, or sleep patterns) which might provide indications of symptomatology and discomfort that are not revealed by self-reports. These individuals may be particularly likely to benefit from information about symptom prevention and control, such as drinking fluids and taking natural laxatives to prevent or reduce constipation, planning a balance of rest periods and activities during the day to reduce fatigue, mouth care strategies for preventing or controlling sore mouth and throat, etc. Finally, suppression tendencies can change in response to psychosocial interventions that provide training in emotional regulation techniques [59, 60], and so these interventions may be beneficial in helping women cope with the side effects of chemotherapy. Further research may evaluate the influence of emotional suppression on daily symptom experiences of individuals undergoing other forms of cancer treatment or treatments for other illness conditions.

The findings must be evaluated in light of several limitations. Because of the descriptive nature of the study, the causal effects of emotional suppression on symptom experiences remain to be determined. The present study can be followed up by research assessing interventions designed to reduce emotional suppression to examine whether they affect symptom reports, distress, and coping appraisals. The study did not include physiological indices of immune or cardiovascular changes to evaluate whether they mediate the relationships between suppression tendencies and symptoms expected to arise from immune and cardiovascular alterations. The findings point to the potential utility and importance of further research examining the links between suppression, immune and HPA activity, and symptoms. Although the use of daily diaries enhanced the potential power and sensitivity in detecting the associations of emotional suppression with responses to chemotherapy, they may have increased focus on symptoms and moods in ways that directly altered reports of their occurrence and intensity. Moreover, it was not possible to verify that participants completed all of the reports on a daily basis and so failure to complete the reports each day may have introduced biases in recall that contributed to error variance. The clear patterns of diurnal changes suggest some validity in the symptom reports; moreover, daily dairies are superior to more traditional measures involving symptom recall over prior weeks or cycles. Further research should take advantage of electronic assessment tools, such as palmtop computers, to verify the times at which reports are completed. The study was limited by the use of one- to four-item measures of mood and coping appraisals; multiple daily assessments made it unfeasible to use lengthier measures.

Due to ethical constraints preventing collection of data on patients who were not interested in receiving the study information, it was not possible to identify either what proportion of patients meeting the study criteria actually participated or how participants differed from non-participants. Recruitment from the four main clinics in Auckland enhanced the representativeness of the sample in relation to chemotherapy patients in the region, although the representativeness remains limited by the relatively small sample of women who were predominantly New Zealand European, married, employed, and with moderately high levels of education. Given that 67% of the women were employed, it is likely the sample was relatively high in physical and social functioning overall.

The use of multiple analyses increases the risk that some of the observed effects were due to type 1 error, although this risk was minimized to some extent through the use of a significance level of $p<0.01$. On the other hand, clear patterns emerged that generally were in line with predictions and, for nine of the 15 symptoms found to be associated with a suppression tendency, one or more associations were significant at $p<0.001$. Given that the model estimates for the suppression variables are generally small, research is needed to determine whether the statistically significant associations represent clinically significant differences in symptomatic discomfort and daily functioning. The primary implication of the findings is that suppression tendencies are reliably associated with at least subtle differences in symptom, mood, and coping appraisals during chemotherapy, thereby supporting further explorations of the influence of suppression tendencies on these experiences.

To conclude, the findings provide new support for emotion regulation theories that suppression of negative emotions has physiological ramifications that may affect physical health. They also extend our understanding of emotional suppression processes within the context of cancer and, in particular, coping with chemotherapy. The findings highlight the potential utility of further investigations into the unique influences of tendencies to suppress

specific emotions on physiological arousal, symptoms, moods, and other psychological and social experiences; using measures that combine indices of tendencies to suppress specific emotions may mask their unique influences and roles.

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