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Cancer Survivors' Responses to Daily Stressors: Implications for Quality of Life

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Objective: This study examined cancer survivors' experience of and responses to challenges and stressors associated with everyday living. The impact of daily stressors on quality of life concerns and cortisol patterns was also investigated. *Method:* Participants included 111 cancer survivors who participated in a national telephone diary study of daily experiences (National Study of Daily Experiences). Their responses were compared with those of 111 sociodemographically matched participants with no cancer history using a multilevel modeling approach. Over an 8-day period, participants completed a daily inventory of the occurrence and impact of stressful events, affect, and physical symptoms. Salivary cortisol was sampled four times per day, and indices of awakening response (cortisol awakening response), diurnal slope, and overall output (area under the curve) were examined. *Results:* Cancer survivors experienced similar numbers and types of stressful events as the comparison group. Although appraisals were largely comparable, cancer survivors showed a modest tendency to perceive stressors as more severe and disruptive, particularly those involving interpersonal tensions. The occurrence of stressors was associated with increased negative affect, decreased positive affect, and increased physical symptoms, but little change in cortisol. Relative to the comparison group, cancer survivors showed less pronounced changes in positive affect and cortisol output when stressors occurred, but a greater increase in negative affect in response to interpersonal conflicts. *Conclusion:* Findings indicate that cancer survivors show a resilient ability to respond to day-to-day stressors and challenges. However, daily stressors can have a significant impact on survivors' mood and physical symptoms and therefore may be an important intervention target.

Keywords: cancer, stress, affect, cortisol, quality of life

Due to advances in detection and treatment, approximately two in three adults diagnosed with cancer today can be expected to survive more than five years (Ries et al., 2006). This improved survival rate, combined with the aging population, has led to a substantial increase in the number of cancer survivors in the United States, now numbering more than 10.5 million individuals (Ries et al., 2006). While the medical concerns of cancer survivors are gaining attention (Hewitt, Greenfield, & Stovall, 2005; President's Cancer Panel, 2005−2006), there is also growing interest in understanding their psychosocial concerns and quality of life (QOL).

Most research has focused on overall emotional well-being or psychological symptoms among cancer survivors. Results are generally encouraging, indicating that cancer survivors show comparable levels of psychological functioning to age-matched comparison groups (Bradley, Rose, Lutgendorf, Costanzo, & Anderson, 2006; Dorval, Maunsell, Deschenes, Brisson, & Masse, 1998; Ganz, Rowland, Desmond, Meyerowitz, & Wyatt, 1998; Helgeson & Tomich, 2005; Wenzel et al., 2002). However, several large population-based studies have found that cancer survivors report greater distress and more mental health symptoms relative to those with no cancer history (Arndt, Merx, Stegmaier, Ziegler, & Brenner, 2004, 2005; Baker, Haffer, & Denniston, 2003; Hewitt, Rowland, & Yancik, 2003; Rabin et al., 2007), but comparable functioning in positive domains such as psychological and social well-being (Costanzo, Ryff, & Singer, 2009).

The measures used in prior studies capture how cancer survivors respond and adjust to the major life challenge of a cancer diagnosis, treatment, and sequelae. However, it is not known how survivors respond to the routine challenges of everyday living, such as

day-to-day stressors and hassles related to work or caring for others. If cancer survivors are thought to be a psychologically vulnerable group, as suggested by the aforementioned population-based studies, perhaps they are also more sensitive than others to the stress associated with daily hassles. For example, it is not uncommon for cancer survivors to report posttraumatic stress symptoms, including heightened responses to stress (Jim & Jacobsen, 2008). An alternative hypothesis stems from the transactional model of coping, which posits that stress occurs when appraisal of the demands of a situation exceeds resources for meeting demands (Lazarus & Folkman, 1984), which has subsequently been applied in the context of cancer (e.g., Heim, Valach, & Schaffner, 1997; Stanton & Snider, 1993; Costanzo, Lutgendorf, Rothrock, & Anderson, 2006). Specifically, after successfully coping with the demands associated with a serious illness and its treatment, cancer survivors may appraise everyday stressors as less severe and bothersome. In the present study, we investigated cancer survivors' well-being at the level of day-to-day experiences to test these hypotheses. Specifically, we examined appraisals of daily stressors as well as the affective, somatic, and physiological sequelae of these experiences.

Although prior research has focused on global emotional functioning or distress related to the cancer experience, we argue that responses to daily stressors may also play a salient role in cancer survivors' QOL. Daily stress processes have been shown to contribute to both psychological and physical symptoms in other populations (Almeida, Neupert, Banks, & Serido, 2005; Almeida, Wethington, & Kessler, 2002; Neupert, Almeida, & Charles, 2007). Among cancer survivors, depressed mood, fatigue, pain, and other somatic and affective symptoms are commonly reported QOL concerns (Arndt et al., 2005; Arndt, Merx, Sturmer, et al., 2004; Baker et al., 2003; Bower et al., 2006; Carlson et al., 2004; Cella, Davis, Breitbart, & Curt, 2001; Hewitt et al., 2003). It may be that daily stressors could exacerbate these already prominent concerns, and if so, responses to day-to-day hassles could be an important intervention target in this population.

Daily stress processes have also been linked to neuroendocrine activity, especially the hormones of the hypothalamic−pituitary−adrenal (HPA) axis, including increased cortisol and disruptions in the daily cortisol rhythm (Jacobs et al., 2007; Smyth et al., 1998; Seltzer et al., 2009; van Eck, Berkhof, Nicolson, & Sulon, 1996). These relationships may have particular relevance for cancer patients and survivors given well-documented associations between cortisol, disrupted circadian rhythms, and cancer development, progression, and survival (Filipski et al., 2002; Fu & Lee, 2003; Fu, Pelicano, Liu, Huang, & Lee, 2002; Mormont et al., 2000; Schernhammer et al., 2003; Sephton & Spiegel, 2003; Sephton, Sapolsky, Kraemer, & Spiegel, 2000).

The present study examined affective, somatic, and cortisol responses to daily stressors in a sample of cancer survivors who were participants in the National Survey of Midlife Development in the United States (MIDUS), designed to study health and well-being during midlife. A subset of MIDUS respondents completed the National Study of Daily Experiences (NDSE), a unique 8-day diary study that assessed participants' responses to daily events. The large, population-based sample afforded the opportunity to compare respondents with a history of cancer to those with no cancer history. The overall goal was to understand the day-to-day stressful experiences of cancer survivors and their relation-

ships to important biobehavioral sequelae. Stressors involving interpersonal tensions were of particular interest due to the well-documented relationships between perceptions of social relationships and both QOL and health outcomes among cancer patients (Carpenter, Fowler, Maxwell, & Andersen, 2010; Costanzo et al., 2005; Frick, Motzke, Fischer, Busch, & Bumeder, 2005; Hann et al., 2002; Karnell, Christensen, Rosenthal, Magnuson, & Funk, 2007; Kroenke, Kubzansky, Schernhammer, Holmes, & Kawachi, 2006; Lutgendorf et al., 2005) as well as the ability of social stressors to reliably evoke affective and physiological responses (Birditt, Fingerman, & Almeida, 2005; Dickerson & Kemeny, 2004). The specific objectives were as follows.

The first objective was to describe both the frequency and the perceptions of daily stressors among cancer survivors as compared to those of individuals with no history of cancer. We were interested in determining whether cancer survivors differed with respect to appraisal of the severity and impact of stressors that occurred during the study period, with a special focus on those events involving interpersonal tensions. The second objective was to explore relationships between the experience of daily stressful experiences and both QOL concerns (mood disturbance and physical symptoms) and diurnal cortisol patterns. Specifically, we sought to determine whether affective, somatic, and physiological reactivity to stress differed between cancer survivors and individuals with no cancer history. The goal was to understand whether daily stressors had a disproportionate impact for cancer survivors. We also examined whether the length of time since the initial cancer diagnosis affected cancer survivors' responses to stress.

Method

MIDUS and NSDE

Data were drawn from MIDUS, a national survey of 7,108 adults ages 25−74 years completed in 1995–1996 (Wave 1) and 2004–2006 (Wave 2). MIDUS is comprised of four subsamples: a national random digit dialing (RDD) sample ($n = 3,487$); over-samples from five metropolitan areas ($n = 757$); siblings of individuals from the RDD sample ($n = 950$); and a national RDD sample of twin pairs ($n = 1,914$). The main RDD sample was selected from working telephone banks. For each household contacted, a random respondent between 25 and 74 years of age was selected. Of those contacted, 70% agreed to participate.

The NSDE examined daily stressful experiences in a subsample of Wave 2 MIDUS respondents ($n = 2,022$) who were recruited after participating in Wave 2 of MIDUS. Of those contacted for NSDE, 63% agreed to participate. Participants completed 10–15 minute telephone interviews on eight consecutive evenings at approximately the same time each day (Almeida, McGonagle, & King, 2009a). Of NSDE participants, 72% completed all eight interview days, with 96% completing at least six interview days. Additional details about the NSDE can be found in Almeida et al. (2009a).

The present study focused on participants in the NSDE study, all of whom also participated in the larger MIDUS survey. Although most data reported herein derived specifically from the NSDE, data from Wave 2 of MIDUS were used to determine cancer status, other relevant health history, and demographic information.

Sample

Cancer survivors. Individuals who participated in NSDE and responded affirmatively to the question "Have you ever had cancer?" in Wave 2 of the larger MIDUS study were selected for the analysis. In the present study, we follow the National Cancer Institute's and National Coalition for Cancer Survivorship's definition of a cancer survivor to include individuals diagnosed with cancer from the time of diagnosis through the remainder of life (National Cancer Institute, 2011).

As part of the Wave 2 MIDUS survey, participants were queried about the type of cancer and their age at diagnosis. Those who reported a diagnosis of skin cancer only were excluded from the present analyses. Overall, 111 individuals met eligibility criteria. These cancer survivors were a median of 11 years postdiagnosis (range: 1–59 years). Cancer sites included breast (29.7%), prostate (20.7%), colon (14.4%), cervical (9.0%), leukemia or lymphoma (9.0%), uterine (2.7%), ovarian (2.7%), lung (1.8%), other (15.3%), and unknown (0.9%).

Comparison group. A computerized algorithm was used to select a comparison group of NSDE participants matched on age (within 3 years), sex, and education level. Matches were randomly selected for each cancer survivor ($n = 111$) from the pool of all individuals with no cancer history meeting matching criteria. Participants with other health conditions were not excluded; the comparison group was intended to be a sample of peers with no cancer history.

Participants' ages ranged from 35−83 years with a mean age of 65 years for both groups. Full demographic data were drawn from the larger MIDUS survey and are provided in Table 1. Chi-square analyses indicated that the comparison group did not differ significantly from the cancer survivors on any demographic variables, including ethnicity, region of residence, or employment status (ps > .10). There was also no difference in income ($p = .50$).

NSDE interviewers were not provided with participants' health history information from the MIDUS survey and thus were blind to the participants' cancer status.

Measures

Daily Inventory of Stressful Events. The Daily Inventory of Stressful Events (DISE) is a semistructured telephone interview that documents the occurrence of stressful events, as well as descriptive information related to their duration, timing, and the impact on the participant (Almeida et al., 2002). The DISE was administered daily across the 8-day study period at approximately the same time each day. All questions were administered by telephone.

Participants were asked about the occurrence of stressful events during the past day, including interpersonal tensions (having an argument or disagreement and situations in which the participant let something pass in order to avoided a disagreement), overload events (other stressful events occurring at home or at work or school), and network stressors (events that happened to close friends or relatives). In the present study, analyses examined overall occurrence of stressful events but also focused specifically on interpersonal tensions.

For any events reported, participants were asked to rate how stressful the experience was from *not at all* to *very*. They were also asked to rate their perception of control on a 4-point scale, from

Table 1

Demographic Characteristics of Cancer Survivors and the Comparison Group

Characteristics	Cancer survivors ($n = 111$)	Comparison group ($n = 111$)
Sex		
Female	63.1	63.1
Male	36.9	36.9
Ethnicity		
White	92.8	95.5
African American	1.8	0.9
Native American	1.8	0.9
Asian	0.0	0.9
Other	3.6	1.8
Relationship status		
Married	68.5	76.6
Divorced or separated	14.4	9.9
Widowed	13.5	9.9
Never married	3.6	3.6
Education		
Less than 12 years	5.4	5.4
High school graduate	27.0	27.0
Some college or trade school	25.2	25.2
College graduate/advanced degree	42.3	42.3
Employment status		
Employed	32.4	34.2
Retired	57.7	54.1
Homemaker	8.1	8.1
Disabled	1.9	0.9
Other	0.0	2.7
Income		
Mean (*SD*)	$52,177 ($46,013)	$56,660 ($52,305)

Note. Values are percent unless otherwise indicated.

none to *a lot*. Finally, participants were asked to appraise the extent to which the stressor disrupted their daily routine on a 4-point scale, from *none at all* to *a lot*.

Positive and negative affect. During the same telephone interview, participants completed a daily inventory assessing negative and positive affect. Participants were asked to rate how often they experienced 14 negative mood states (e.g., nervous, hopeless, irritable) and 13 positive mood states (e.g., cheerful, full of life, confident) on a 5-point scale, from *none of the time* to *all of the time*, from the time of awakening to the time of the telephone interview. The scale demonstrated excellent reliability in the NSDE sample; Cronbach's alpha was .91 for negative affect and .96 for positive affect.

Physical symptoms. Each day, participants were asked how often they experienced 26 symptoms, including fatigue, aches or pains, muscle weakness, gastrointestinal symptoms, chest pain, dizziness, menstrual and menopausal symptoms, and cold and flu symptoms. They were asked to rate the severity of any symptoms experienced on a 10-point scale. This information was also reported as part of the daily telephone interview.

Cortisol. Salivary cortisol samples were collected on Days 2−5 of the 8-day interview period using salivette collection containers (Sarstedt). Day 1 served as an "instruction day" regarding the salivary collection method, and Days 6–8 were used to assist the participants with sending the samples back to the laboratory.

On each of the four collection days, participants were asked to provide saliva samples at four times: on awakening (before getting

out of bed), 30 minutes later, just before lunch, and just before bed. Participants were instructed to wait at least 1 hour after a major meal to provide samples. The timing of the "before lunch" sample was selected to allow for assessment of the cortisol awakening response (CAR) recovery in the larger NSDE study and to avoid potential contamination of food or beverages. Although participants were asked to provide samples based on their personal schedule rather than specific clock times, 90% of the "before lunch" samples were taken between 11 a.m. and 3 p.m. ($SD = 79$ min), and 90% of the "before bed" samples were taken between 9 p.m. and 12:30 a.m. ($SD = 75$ min).

Cortisol concentrations were determined by luminescence immunobioassay (IBL International). Cortisol slopes were calculated by regressing log-transformed cortisol values on the time that elapsed between samples for each individual. The CAR reflects the change in cortisol between the waking and 30-min postwaking samples, and the diurnal slope reflects the linear change across the 30-min postwaking, before lunch, and before bed samples. Flatter slopes are thought to be indicative of greater dysregulation and less deactivation of the HPA response toward the end of the day. We also examined area under the curve (AUC; Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003) as an estimate of total cortisol output.

More detailed descriptions of cortisol collection and analysis procedures can be found in Almeida et al. (2009a) and Almeida, Piazza, and Stawski (2009b).

Health conditions and medication use. On a self-administered questionnaire that was given to all respondents at Wave 2 of the larger MIDUS study, participants were asked to report whether they had experienced any of 30 different sets of chronic health conditions over the past 12 months (e.g., "asthma, bronchitis, or emphysema," "arthritis, rheumatism, or other bone or joint diseases," "high blood pressure or hypertension"). Excluding cancer, cancer survivors reported significantly more chronic conditions ($M = 3.6$, $SD = 2.9$) than did the comparison group ($M = 2.6$, $SD = 2.3$; $p < .01$).

Participants were also queried about current use of medications. A composite variable was created of medications known to influence cortisol, including allergy medication, steroid inhalers, other steroid medications (e.g., prednisone), medications containing cortisone, oral contraceptives, other hormonal medications, and psychotropic medications. There were no significant differences between groups in the use of classes of medications with the potential to affect cortisol values. The most frequently endorsed classes included allergy (18% of cancer survivors, 15% of the comparison group), psychotropic (17% of cancer survivors, 15% of the comparison group), and hormonal medications (8% of cancer survivors, 12% of the comparison group).

Analyses

All variables were examined for outliers. Cancer survivors were compared to the matched comparison group on the occurrence and appraisal (severity, disruption, and perceived control) of daily stressors using two-tailed t tests.

To examine group differences in affective, somatic, and physiological responses to stressors, we used multilevel modeling (Snidjers & Bosker, 1999), following models described by Stawski, Sliwinski, Almeida, and Smyth (2008) and Hoffman and Stawski

(2009). Because positive and negative affect, physical symptoms, cortisol, and information on daily stressors were collected across multiple days, we used linear multilevel models to model each of these indices as a function of (a) whether a stressor was reported on that day, (b) group (cancer survivors vs. comparison group), and (c) their interaction. We opted to use a simple dichotomization for daily stressors ("stressor day" if one or more stressors occurred vs. "nonstressor day" if no stressors occurred) because this provides a clear test of how affect, physical symptoms, and cortisol vary as a function of the presence or absence of stressors. Furthermore, multiple stressor days were very rare (approximately 8% of all days across all participants), and preliminary analyses indicated that the influence of multiple stressors over and above the dichotomization of stressor days was negligible. Occurrence of daily stressors was treated as a time-varying covariate using grand-mean centering, such that the resulting estimate for this time-varying effect reflected the change in each dependent variable (affect, physical symptoms, cortisol) associated with the experience of a stressor (i.e., level of the dependent variable on a day when no stressors were reported compared to a day during which stressors were reported). The changes in each dependent variable served as indices of stress reactivity (i.e., changes in the dependent variable associated with the reported experience of a stressor). The interaction between group and the daily stressor effect was the critical test of whether cancer survivors differed from the comparison group in their affective, somatic, and physiological reactivity to daily stressors. Given the potential influence of medications on cortisol (Granger, Hibel, Fortunato, & Kapelewski, 2009), the composite index of medication use was included as a covariate in all analyses involving cortisol parameters.

We conducted additional analyses considering whether, among cancer survivors, time since diagnosis moderated occurrence and appraisal of daily stressors, as well as affective, somatic, and physiological responses to daily stressors. These analyses were restricted to cancer survivors, and time since diagnosis was included as an additional predictor in the models examining occurrence and appraisal of daily stressors. For models examining responses to daily stressors, both main effects of time since diagnosis as well as its interaction with the daily stressor effect were tested to determine variation in response as a function of time since diagnosis. Additional follow-up analyses examined the effects of chronic health conditions and current or recent cancer treatment on the study results.

Results

Experience and Appraisal of Daily Stressors

Differences between cancer survivors and the comparison group with respect to occurrence and perceived impact of daily stressors are reported in Table 2. There were no significant differences in the number of stressful life events experienced; both groups reported an average of four events over the 8-day interview period. There were also no significant differences between groups in the number of different types of stressors occurring, including interpersonal tensions, overload stressors, or network stressors ($ps > .05$). Interpersonal tensions (arguments or disagreements or avoided arguments or disagreements) were the most common type of stressful occurrence in both groups.

Table 2

Daily Stressor Profile of Cancer Survivors Relative to the Comparison Group

Variables	Cancer survivors (*n* = 111)	Comparison group (*n* = 111)
Number of stressors		
Total	3.81 (2.96)	4.02 (3.34)
Arguments	0.67 (1.18)	0.76 (1.07)
Avoided arguments	0.96 (1.00)	1.12 (1.20)
Home overload	0.83 (1.09)	0.67 (1.08)
Work overload	0.32 (0.80)	0.42 (1.07)
Network	0.43 (0.72)	0.43 (0.86)
Appraisal: any stressor		
Severity	1.74 (0.76)	1.76 (0.67)
Perceived control	1.36 (0.95)	1.39 (0.95)
Disruption to daily routine*	0.99 (0.74)	0.77 (0.67)
Appraisal: arguments		
Severity*	2.16 (0.71)	1.84 (0.80)
Perceived control	1.78 (1.10)	1.59 (1.11)
Disruption to daily routine	0.97 (0.95)	0.74 (0.87)
Appraisal: avoided arguments		
Severity	1.31 (0.86)	1.49 (0.77)
Perceived control	1.69 (1.16)	1.70 (1.14)
Disruption to daily routine*	0.76 (0.82)	0.48 (0.70)

Note. Values are mean and standard deviation in parentheses. Appraisal domains rated on a scale of 0–3.
* Cancer survivors differ from the comparison group at $p < .05$.

Cancer survivors showed a modest tendency to appraise stressors as more severe or disruptive. Specifically, cancer survivors rated arguments and disagreements as more stressful than did the comparison group ($p = .045$); however, there were no differences in severity ratings for avoided arguments or overall stressors. Cancer survivors also perceived stressors to be more disruptive to their daily routine ($p = .033$), and this difference also held specifically for avoided arguments ($p = .049$). However, there were no differences between groups in perceptions of control over stressors. Moreover, the number of years since cancer diagnosis was not related to the experience or appraisal of daily stressors.

Affective, Somatic, and Physiological Responses to Daily Stressors

Average scores on mood, physical symptoms, and cortisol parameters across the 8-day study period are summarized in Table 3. Cancer survivors reported slightly lower positive affect than did the comparison group ($p = .049$). Survivors experienced an average of 16 symptoms during the 8-day study period—a similar number and severity compared to their peers with no cancer history. There were also no group differences in cortisol patterns. Within the sample of cancer survivors, a longer time since initial diagnosis was associated with greater positive affect ($p = .029$) and lower cortisol output, as measured by AUC ($p = .044$).

As anticipated, both the cancer survivors and the comparison group experienced increased negative affect, decreased positive affect, and an increased number of physical symptoms on stressor days. Coefficients from these models representing the relationship between occurrence of a stressor and responses for each group (i.e., stress reactivity slopes) are provided in Table 4.

Among the cancer survivors, we investigated whether length of time since diagnosis moderated any of these effects. Time since diagnosis was not associated with the magnitude of the daily stressor effect on positive or negative affect, physical symptoms, or cortisol parameters ($ps > .15$).

Finally, we examined whether cancer survivors differed from the comparison group in their affective, somatic, and cortisol reactivity to daily stressors (see Tables 4–5). With respect to affective responses, cancer survivors showed a less pronounced decline in positive affect on stressor days relative to the comparison group ($p = .022$; see Figure 1a). An examination of events involving interpersonal tensions suggested that this difference was stronger for avoided arguments, although it was not significant ($p = .091$), with both groups showing comparable declines in positive affect in response to arguments or disagreements. Both groups showed a similar increase in negative affect on stressor days. When considering stressors involving interpersonal tensions, cancer survivors were more reactive to arguments or disagreements but less reactive to avoided disagreements. Specifically, on days during which an argument or disagreement occurred, cancer survivors showed a larger increase in negative affect than did the comparison group ($p = .046$; see Figure 1b). However, on days during which arguments or disagreements were deliberately avoided, cancer survivors reported a smaller increase in negative affect than did those with no cancer history ($p = .030$; see Figure 1c).

Although both cancer survivors and the comparison group reported increased physical symptoms on stressor days, there were no differences between groups on symptom occurrence or severity in response to daily stress.

With respect to cortisol responses, neither group exhibited a significant change in either CAR or diurnal slope on stressor days compared to nonstressor days (see Table 5). Those with no cancer history showed the expected increase in cortisol output (AUC) on stressor days, but cancer survivors did not show a significant change ($p = .003$; see Figure 2a). This was true when all stressors were considered as well as on days during which an argument or disagreement occurred ($p = .006$; see Figure 2b).

Effects of Health-Related Variables

Because cancer survivors reported significantly more chronic conditions ($M = 3.6$, $SD = 2.9$) than did the comparison group

Table 3

Mood, Physical Symptoms, and Cortisol Patterns of Across the 8-Day Study Period

Variables	Cancer survivors (*n* = 111)	Comparison group (*n* = 111)
Mood		
Negative affect	2.70 (3.25)	2.29 (2.93)
Positive affect*	34.47 (10.12)	36.85 (7.63)
Physical symptoms		
Occurrence (number of symptoms)	15.62 (12.42)	17.53 (15.90)
Severity	3.72 (1.58)	3.41 (1.40)
Cortisol (nmol/L)		
Cortisol awakening response	0.44 (0.81)	0.21 (0.90)
Daily decline	−0.14 (0.06)	−0.13 (0.06)
Area under curve	79.96 (19.41)	84.59 (19.15)

Note. Values are mean and standard deviation in parentheses.
* Cancer survivors differ from the comparison group at $p < .05$.

Table 4
Multilevel Model Estimates of Reactivity Slopes: Mood and Physical Symptoms

Stressors	Group	Negative affect	Positive affect	Number of symptoms	Symptom severity
All stressors	Cancer survivors	.15 (.02)**	−.09 (.03)**	.30 (.12)**	.08 (.11)
	Comparison group	.15 (.02)**	−.18 (.03)**	.31 (.11)**	.20 (.11)
	Difference	.00 (.02)	.10 (.05)*	−.01 (.16)	−.13 (.15)
Arguments	Cancer survivors	.28 (.03)**	−.23 (.05)**	.59 (.10)**	.07 (.19)
	Comparison group	.20 (.03)**	−.22 (.05)**	.58 (.21)**	.24 (.17)
	Difference	.08 (.04)*	−.01 (.08)	−.01 (.28)	−.16 (.26)
Avoided arguments	Cancer survivors	.06 (.02)**	.02 (.05)	.26 (.16)	.15 (.16)
	Comparison group	.13 (.02)**	−.09 (.04)*	.02 (.16)	−.01 (.14)
	Difference	−.07 (.03)*	.11 (.06)	−.24 (.23)	.17 (.21)

Note. Standard errors are in parentheses. Estimates reflect the change in outcome from a nonstressor day to a stressor day. Positive slopes indicate levels were higher on stressor days compared to nonstressor days, and negative slopes indicate levels were lower on stressor days compared to nonstressor days. *Difference* reflects the difference in reactivity slopes between groups.
* $p < .05$.   ** $p < .01$.

($M = 2.6$, $SD = 2.3$; $p < .01$), all analyses comparing groups were rerun covarying for number of chronic conditions. Adjusting for chronic conditions did not affect the significance of any of the study results.

Three cancer survivors reported undergoing chemotherapy or radiation therapy at the time of, or during the months prior to, participation in the study. All analyses were rerun excluding these participants and the matched comparison respondents. Eliminating these participants did not affect the significance of any of the study results.

Discussion

Findings from the present study suggest that cancer survivors experienced similar numbers and types of daily stressful events as those with no cancer history. Further, the results largely paint a picture of resilience among cancer survivors at the level of responses to daily experiences. There was not a robust pattern of group differences suggesting that cancer survivors are more vulnerable to the effects of daily stressors. Specifically, results indicated that survivors generally make similar appraisals of day-to-day-hassles as their same-age peers and show comparable affective, somatic, and physiological responses to stress. The findings are consistent with literature on global emotional functioning, which indicate that cancer survivors demonstrate comparable levels of psychological functioning to their peers (Bradley et al., 2006; Dorval et al., 1998; Ganz et al., 1998; Helgeson & Tomich, 2005; Wenzel et al., 2002). Results also did not support the hypothesis that the experience of contending with the significant stress associated with cancer diagnosis and treatment would inoculate cancer survivors against minor, everyday stressors by altering their appraisals. However, this phenomenon cannot be discounted. Members of the comparison group may have also experienced significant life stressors, particularly given the relatively older ages of participants, which in turn could have affected their appraisals of everyday stress. For the most part, both groups perceived stressful events occurring during the study period to be controllable and mild in severity.

Alongside the overall portrait of resilience, there were group differences that bear further discussion. First, there was a modest tendency for cancer survivors to appraise daily stressors involving interpersonal tensions or disagreements as more severe and disruptive. It may be that cancer survivors are more sensitive to relationship stresses. Many cancer survivors report closer interpersonal relationships and an increased sense of importance of their relationships as a result of their experience with cancer (Bishop & Wingard, 2004; Cordova & Andrykowski, 2003; Manne et al., 2004; Sears, Stanton, & Danoff-Burg, 2003; Stanton, Bower, & Low, 2006). The enhanced importance of relationships may make even routine tensions more stressful. Alternately, it may be that cancer survivors experience objectively more severe and disruptive interpersonal stressors. The difficulties associated with cancer can certainly cause strain in relationships and stress for family caregivers, increasing day-to-day relationship stress.

Consistent with their appraisals, cancer survivors also experienced a more substantial increase in negative affect on the days during which they had an argument or disagreement with someone. This is also consistent with prior work from the NSDE sample, suggesting that individuals with chronic health conditions experience greater emotional reactivity to daily stressors, particularly among older participants (Piazza, Charles, & Almeida, 2007). In contrast, deliberately avoiding an argument or disagreement was associated with a very modest increase in negative affect for the cancer survivors compared to a more substantial increase in negative affect for the comparison group participants. The pattern of results suggests that cancer survivors may be most sensitive to overt disagreements but are less reactive to more covert tensions.

Another notable finding was that cancer survivors displayed a less pronounced decline in positive affect than did the comparison group in response to stressors when all types of stressors were included. This may have been due in part to the finding that cancer survivors reported lower positive affect overall than the comparison group, leaving less room for a decline. An examination of events involving interpersonal tensions clarified that this pattern emerged for avoided arguments, but not overt arguments or disagreements. Consistent with the findings for negative affect, the pattern of findings suggests a less marked affective response to avoided arguments or disagreements. These findings stand in contrast to the aforementioned research, which shows greater affective responses to stressors among individuals with chronic health conditions (Piazza et al., 2007). The reason for this difference is not
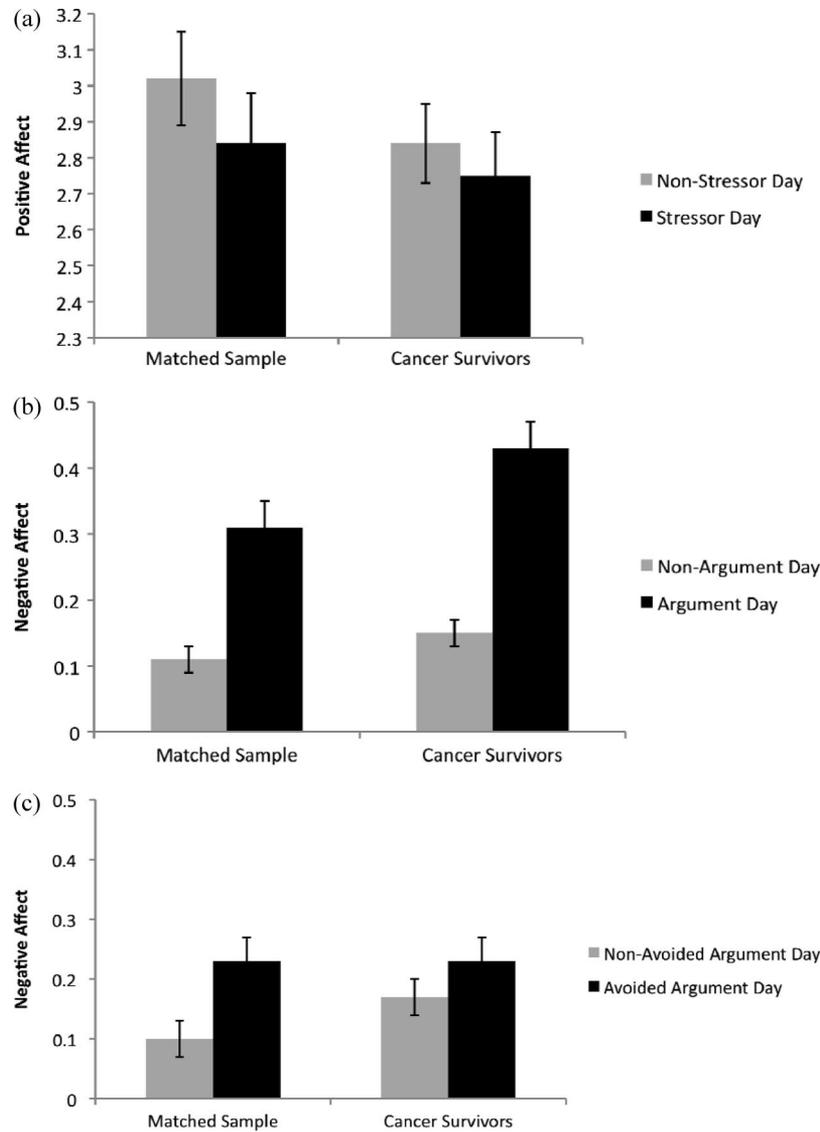
Figure 1. Group differences in affective responses to daily stressors. Compared to those with no cancer history, cancer survivors showed a smaller decline in positive affect on stressor days ($p = .022$) (a); a larger increase in negative affect on days during which an argument or disagreement occurred ($p = .05$) (b); and a smaller decline in negative affect on days during which an argument was avoided ($p = .030$) (c).

clear. Perhaps survivors who find they prioritize their relationships with friends and family to a greater extent after a cancer diagnosis similarly value maintaining harmonious relationships or "keeping the peace" and are more easily able to let go of interpersonal frustrations.

An additional important finding was that cancer survivors in this study showed no significant change in cortisol output on days during which stressors occurred. In contrast, the comparison group showed the expected increase in cortisol, consistent with prior research showing links between daily stress and cortisol output (Jacobs et al., 2007; Smyth et al., 1998; Seltzer et al., 2009; van Eck et al., 1996). The findings suggest that cancer survivors may have a somewhat blunted physiological response to daily stressors. Prior research has documented cortisol hyporesponsiveness to

acute stressors among metastatic breast cancer patients (Giese-Davis et al., 2006; van der Pompe, Antoni, & Heijnen, 1996). Of greater relevance to the present sample, our results align with those from a prior study that indicated breast cancer survivors showed blunted cortisol responses to the stress associated with undergoing mammography as compared to a sample of women with no cancer history (Porter et al., 2003).

While dysregulation in circadian rhythms and cortisol patterns are thought to play a role in tumor development and progression and have been linked with mortality (Filipski et al., 2002; Fu & Lee, 2003; Fu et al., 2002; Mormont et al., 2000; Schernhammer et al., 2003; Sephton & Spiegel, 2003; Sephton et al., 2000), the clinical significance of the cortisol hyporeactivity to day-to-day stressors observed in this study of cancer survivors is not clear.

Table 5
Multilevel Model Estimates of Reactivity Slopes: Cortisol

Stressors	Group	Awakening response	Diurnal slope	Area under the curve
All stressors	Cancer survivors	−.02 (.14)	.01 (.01)	−7.37 (15.97)
	Comparison group	.00 (.12)	.00 (.01)	42.49 (15.04)**
	Difference	−.02 (.18)	.01 (.01)	−49.87 (21.94)*
Arguments	Cancer survivors	.17 (.24)	.01 (.01)	−31.29 (25.59)
	Comparison group	−.11 (.20)	.01 (.01)	65.42 (23.76)**
	Difference	.27 (.32)	.00 (.01)	−96.73 (34.92)**
Avoided arguments	Cancer survivors	.15 (.19)	.01 (.01)	−10.71 (25.02)
	Comparison group	.20 (.18)	.00 (.01)	13.68 (22.98)
	Difference	−.05 (.26)	.01 (.01)	−24.39 (21.23)

Note. Standard errors are in parentheses. Estimates reflect the change in outcome from a nonstressor day to a stressor day. Positive slopes indicate levels were higher on stressor days compared to nonstressor days, and negative slopes indicate levels were lower on stressor days compared to nonstressor days. *Difference* reflects the difference in reactivity slopes between groups.
* $p < .05$.   ** $p < .01$.

The cancer survivors did not show alterations in diurnal patterns relative to the comparison group, including cortisol decline over the day, in contrast to prior findings with metastatic breast cancer patients (e.g., Abercrombie et al., 2004). Moreover, there were no significant changes in cortisol slopes for either group on days during which a stressor occurred.

It should be emphasized that the group differences were modest in magnitude, and the general pattern of findings suggest that

cancer survivors respond similarly to their peers when encountering daily stressors. Moreover, we did not find that those who were closer in time to their cancer diagnosis were any more vulnerable to the effects of daily stressors than those who were many years beyond the initial diagnosis.

Although cancer survivors appear to be managing daily stressors well, findings indicate that day-to-day stressors can nonetheless have a significant impact on important dimensions of cancer
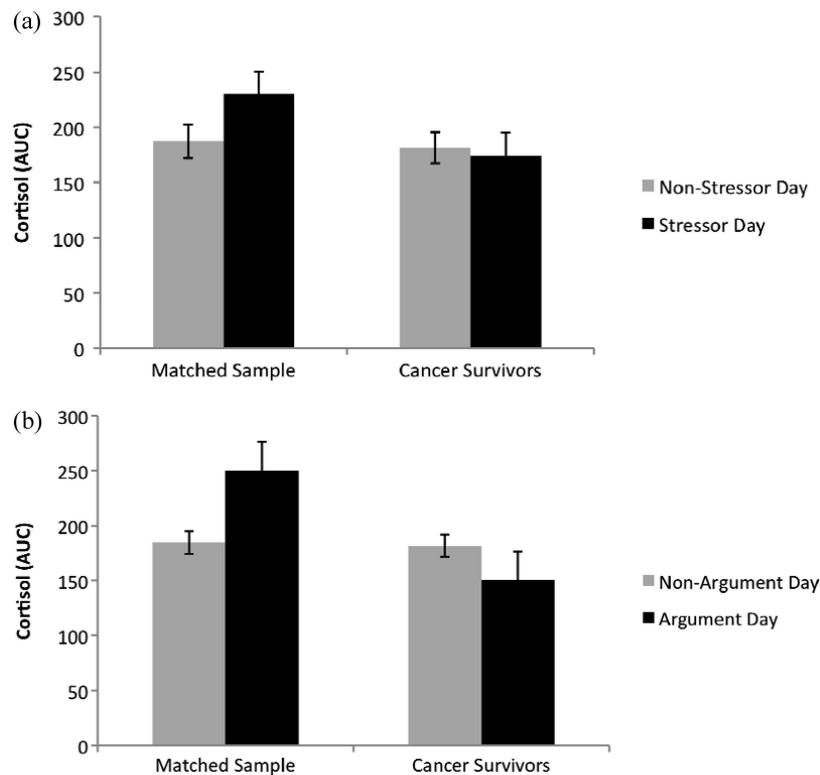
Figure 2. Group differences in cortisol output. Although participants with no cancer history showed the expected increase in cortisol output in response to stress, cancer survivors showed no significant change in cortisol output on stressor days, both when all stressors were considered ($p = .003$) (a), and when only arguments were considered ($p = .006$) (b). AUC = area under the curve.

survivors' QOL, including mood and physical symptoms. On days during which a stressor occurred, particularly an argument or disagreement, cancer survivors experienced increased negative affect, decreased positive affect, and an increased number of physical symptoms. These findings are consistent with the broader body of daily stress literature indicating that daily stressors reliably evoke increased negative affect and decreased positive affect (Stawski et al., 2008; Stawski, Almeida, Lachman, Tun, & Rosnick, 2010) and more physical symptoms (Charles, Piazza, Luong, & Almeida, 2009; Hoffman & Stawski, 2009), particularly when interpersonal stressors are considered (Birditt et al., 2005; Dickerson & Kemeny, 2004). Our results replicate and extend these findings to cancer survivors, suggesting that unfortunately cancer survivors are not immune to the effects of daily stressors even after facing the significant challenges associated with cancer diagnosis and treatment.

With respect to the cancer survivorship literature, most prior work has focused on the impact of the emotional and physical sequelae of cancer on QOL, and our findings highlight the significant role of everyday stressors in affecting cancer survivors' well-being and suggest that daily stress processes can exacerbate QOL concerns. Moreover, the effects of daily stressors on well-being did not differ between cancer survivors who had been more recently diagnosed and those who were long-term survivors, suggesting that daily stressors have a relatively consistent effect on QOL throughout the cancer survivorship continuum.

Study Limitations

Despite the benefits of this unique dataset and value of being able to obtain data from a matched comparison sample, there are a number of limitations that should be acknowledged. Because MIDUS is a national survey of aging, rather than a specific study of cancer survivors, there was a relative paucity of disease- and treatment-related information, such as initial disease stage, treatment history, end date of treatment, current disease status, or ongoing sequelae available in this dataset. These factors likely play an important role in the QOL dimensions examined, and may also affect survivors' responses to daily stressors. Although there was a range in time since diagnosis, a large proportion of participants were many years past their cancer diagnosis—a median of 11 years postdiagnosis. Although we did not find that time since diagnosis moderated any of the relationships examined, results may not generalize to a population of more recently diagnosed cancer survivors or those undergoing active treatment.

Conclusion

This is the first study to our knowledge to examine cancer survivors' well-being at the level of responses to daily experiences. We have previously reported that, after a cancer diagnosis, participants in the larger MIDUS study experienced elevated anxiety and depressive symptomatology relative to their peers. However, cancer survivors also showed resilience in a number of domains, including social well-being, personal growth, and spirituality (Costanzo et al., 2009). Findings from the present study add another dimension, indicating that cancer survivors also show a resilient ability to weather day-to-day stressors and challenges, both emotionally and physiologically. Although the data suggest

that cancer survivors are somewhat more sensitive to arguments or disagreements, they appear to face other interpersonal challenges with greater equanimity.

Results also highlight the importance for researchers and clinicians to focus not only on the distress associated with the experience of cancer, but also to attend to other more modest stressors in understanding the well-being of cancer survivors. Particularly after cancer survivors move beyond active treatment, everyday stressors and challenges may increase in salience, particularly those involving interpersonal tensions. Therapeutic interventions with stress management components that target strategies for coping with everyday life demands may have an added benefit of optimizing cancer survivors' QOL.

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