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Attachment Style and Respiratory Sinus Arrhythmia Predict Post-Treatment Quality of Life in Breast Cancer Survivors

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Abstract

Objective—Breast cancer is the most frequent malignant tumor among women in the industrialized world. The vast majority of these tumors can now be successfully treated. A subset of breast cancer survivors report quality of life (QOL) difficulties well after treatment is completed. The current study examined how individual differences in attachment style and self-regulatory capacity (as indexed by RSA) were associated quality of life among post-treatment breast cancer survivors.

Methods—Women who had completed treatment for stage 0-IIIA breast cancer within the past two years participated in the study (N = 96). RSA was assessed using Electrocardiography (ECG) data that was continuously measured non-invasively for 10 minutes. Attachment orientation was measured using a modified version of the Experiences in Close relationships Scale, and Overall QOL by the Functional Assessment of Cancer Therapy-Breast scale.

Results—Breast cancer survivors with more attachment anxiety reported poorer QOL than those with less attachment anxiety. Women who were more avoidantly attached also reported poorer QOL compared with those who were less avoidantly attached. Furthermore, attachment avoidance interacted with RSA to predict QOL such that those with higher attachment avoidance were only vulnerable to poorer QOL if they also had lower self-regulatory capacity, as indexed by lower RSA.

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Conclusion—A better understanding of how attachment style and RSA contribute to breast cancer survivor QOL will help identify people at risk for QOL problems after treatment completion.

Keywords

Cancer survivorship; Psycho-oncology; Attachment Theory; Quality of Life; Respiratory Sinus Arrhythmia; Self-regulation

Breast cancer is the most frequent malignant tumor among women in the industrialized world. The vast majority of these tumors can now be successfully treated [1]. However, a subset of breast cancer survivors report quality of life (QOL) difficulties well after treatment is completed [2-4]. Accordingly, it is important to understand why some survivors are more at risk for QOL issues than others.

Attachment theory may be a useful framework for understanding QOL difficulties among breast cancer survivors; attachment theory provides a basis for understanding differences in both physical and emotional well-being in response to stress, which has been empirically supported in a number of non-cancer populations [5-8]. Specifically, attachment theory suggests that people who have responsive and supportive parents during childhood develop a sense of emotional security that lasts into adulthood, while those who have unresponsive and unsupportive parents develop a sense of emotional insecurity [9, 10]. There are two patterns of attachment insecurity: attachment anxiety and attachment avoidance [11].

People with high attachment anxiety use “hyperactivating” emotional coping strategies, essentially exaggerating negative experiences [12-15]. Prior research using a non-cancer population demonstrated that people with more attachment anxiety consistently report poorer emotional well-being after a stressful life event compared with their less anxiously attached counterparts [5-8]. Attachment anxiety has also been linked to more physical health symptoms, such as pain [16-21]. Accordingly, breast cancer survivors with higher attachment anxiety may be particularly vulnerable to post-treatment QOL difficulties.

In contrast to the hyperactivating emotional style of anxiously attached individuals, people with high attachment avoidance are uncomfortable depending on others for support and use “deactivating” coping strategies that inhibit or suppress distressing experiences [12, 13]. Attachment avoidance is not consistently related to physical or emotional well-being [21-26], perhaps because suppressing negative emotional experiences is difficult and often unsuccessful. Accordingly, attachment avoidance and the corresponding desire for emotion suppression may only be maladaptive for those who cannot effectively self-regulate their emotions.

Recently developed models have identified parasympathetic nervous system activity, which can be indexed by the variability in heart rate attributable to respiration, as an important contributor to self-regulation. [27, 28]. Briefly, heart rate increases and decreases with one's breathing, a pattern known as respiratory sinus arrhythmia (RSA). According to both polyvagal theory and the neurovisceral integration model, a set of brain structures and circuits called the ventral vagus complex play a key role in parasympathetic modulation of

emotion and physiological responses [27, 28]. Accordingly, resting RSA levels reflect an individual's capacity for self-regulation because they provide an index of tonic parasympathetic influence over heart rate [27, 28].

In support of the argument that avoidant attachment is maladaptive for those who are unable to successfully suppress their emotions, recent work demonstrated that the association between attachment avoidance and well-being depends upon self-regulatory capacity, as indexed by RSA[5]. For example, among adolescents with lower RSA, those with more attachment avoidance had poorer loss adjustment [5].

The current study examined how individual differences in breast cancer survivor's attachment style and self-regulatory capacity (as indexed by RSA) were associated with quality of life (QOL) among cancer survivors [29]. We expected that women who were more anxiously attached would experience poorer quality of life compared with those who were less anxiously attached. We also hypothesized that the effect of attachment avoidance on QOL would depend on self-regulatory capacity.

Participants

The study data were drawn from the baseline sample of 96 women who participated in a randomized controlled trial (RCT) addressing the potential benefits of yoga for breast cancer survivors. Participants were recruited through breast cancer clinics and media announcements. Eligible women had completed treatment for stage 0-IIIA breast cancer within the past two years (except for tamoxifen/aromatase inhibitors) and were at least two months post-surgery, radiation, or chemotherapy (whichever occurred last). Screening exclusions included a prior history of breast or any other cancer except basal or squamous cell skin carcinomas, more than five hours a week of vigorous physical exercise, diabetes, chronic obstructive pulmonary disease, uncontrolled hypertension, evidence of liver or kidney failure, and symptomatic ischemic heart disease. Furthermore, women could not have practiced yoga for more than 3 months prior to enrolling in the study. All data were collected before women were randomized for the intervention. The Ohio State Biomedical Research Review Committee approved the project; all subjects gave written informed consent prior to participation.

Questionnaires

Attachment orientation was measured using a modified version of the Experiences in Close relationships Scale (i.e. ECR-M16) [30]. The ECR-M16 was designed to assess attachment orientation in patients of diverse ages across a variety of medical settings. The 16-item self-report measure evaluates attachment orientations within peoples' close relationships; it contains two 8-item subscales, one assessing attachment anxiety and the other assessing attachment avoidance. The anxiety subscale includes items such as “I worry about being abandoned” and “I need a lot of reassurance that I am loved by people with whom I feel close to.” The following items are representative of the avoidance scale: “I get uncomfortable when other people want to be very close to me,” and “I don't feel comfortable

opening up to other people." Cronbach's alpha in our sample was .89 for attachment anxiety and .91 for attachment avoidance.

Overall QOL was assessed by the Functional Assessment of Cancer Therapy-Breast scale (FACT-B) [29]. The FACT-B assesses physical, functional, emotional, social or family, and general well-being (Fact-General scale), plus a breast cancer-specific scale that indexes quality of life problems explicit to having had breast cancer such as breast pain. Consistent with prior literature, all of the items were summed to create the Fact-B total score. [31]. Cronbach's alpha in our sample was .82.

The Charlson index was used to assess medical comorbidities [32]. It is a widely used measure that reliably indexes 19 major medical conditions that increase mortality risk.

The Interpersonal Support Evaluation List (ISEL) provided a comprehensive measure of perceived social support [33]. Items are rated on a four-point scale (i.e. definitely false, probably false, probably true, and definitely true). The ISEL measures the perceived availability of the following kinds of support: emotional (someone to confide in), belonging (people with whom one can do things with), self-esteem (positive social comparison), and tangible (provision of material aid). The Cronbach's alpha for the total score was .93.

Participants answered questions about their age, race, smoking status, and weekly average alcohol consumption. Body mass index (BMI; kg/m2) was calculated from height and weight data obtained during the visit.

Breast cancer stage was obtained through the Cancer Registry or electronic medical records. Breast cancer stage takes into account the size of the tumor, whether the cancer is invasive or non-invasive, whether the cancer is in the lymph nodes (and how many lymph nodes are involved), and whether the cancer has spread to other parts of the body [34]. Importantly, five year survival rates are based on cancer stage. Additionally, the work-up recommendations and cancer treatment procedures are dictated by cancer stage according to the National Comprehensive Cancer Network (NCCN) guidelines.

RSA

To assess RSA, Electrocardiography (ECG) data was continuously measured non-invasively for 10 minutes in a sitting position with the Polar s810 wristwatch and Wearlink 31 belt band; the 1000 Hz sampling rate provides valid and reliable ECG data [35, 36]. Before analyzing the ECG data, we preprocessed the raw interbeat intervals for artifacts using KUBIOS heart rate variability analysis software [37]. The KUBIOS software produced values for vagally-mediated (parasympathetic) RSA using the time-domain method, square root of mean successive differences (RMSSD) between R-Waves (which indexes RSA). RMSSD was determined by calculating the differences between consecutive interbeat (RR) intervals before squaring and summing them; the values are then averaged and the square root obtained [38, 39]. All procedures followed the recommendations of the Task Force of the European Society of Cardiology and the North American Society of Pacing Electrophysiology [38].

RSA measured during a resting state (resting RSA) has been associated with adaptive coping strategies, negative emotional traits such as depression and anxiety, and regulation of negative affect [40-42]. On the other hand, changes in RSA in response to an acute task seem to be closely related to regulatory effort/strength and stress reactivity (depending upon the type of task) [27, 28, 43, 44]. Accordingly, resting RSA was chosen for the current study because the outcome was quality of life after treatment rather than in response to a specific stressor.

Analytic Method

Using ordinary least squared multiple regressions, we addressed whether attachment anxiety predicted the Fact-B total score, and whether attachment avoidance interacted with RSA to predict the QOL index. All independent variables were grand mean centered. We examined residuals to confirm that they distributed normally. In all analyses, we adjusted for age, BMI, cancer stage, comorbidities, time since treatment ended, and cardiovascular medication status (use of beta blockers, diuretics, or calcium channel blockers vs. none). We included the main effects of attachment anxiety, attachment avoidance, and RSA in the first step of the model. To test for moderation, we added the interaction between attachment avoidance and RSA in the second step of the model. We also tested for an interaction between attachment anxiety and RSA. None of the anxiety by RSA interactions were significant and thus the interaction term was omitted from the analysis. Attachment insecurity is associated with less perceived support [45]; in ancillary analyses, we included perceived support in the final regression models to determine if perceived support altered the findings.

Results

Means and standard deviations for all study variables are presented in Table 1. Table 2 summarizes the zero-order correlations between the study variables. First, we tested QOL using the FACT-B total score (see Table 3). Women with more attachment anxiety reported poorer QOL than those with less attachment anxiety. Likewise women with more attachment avoidance reported poorer (QOL) than those with less attachment avoidance. The interaction between attachment avoidance and RSA predicting QOL was significant. As expected, among women with lower RSA, those with higher attachment avoidance reported worse QOL than women with lower attachment avoidance (b = -.77, t = -3.19, p = .002). However, the association between attachment avoidance and QOL was not significant for those with higher RSA (b = .13, t = .50, p = .62).

In ancillary analyses, we added social support to the regression model as a last step. Perceived social support was associated with better quality of life (b = .39, t = 2.67, p = .001). Consistent with the primary analyses, attachment anxiety was associated with poorer QOL (b = -.49, t = -2.46, p = .016), even with perceived social support included in the model. Furthermore, the interaction between attachment avoidance and RSA predicting QOL was still significant (b = .84, t = 2.48, p = .015).

Discussion

Breast cancer survivors with more attachment anxiety reported poorer QOL than those with less attachment anxiety. Women who were more avoidantly attached also reported poorer QOL compared with those who were less avoidantly attached. Furthermore, attachment avoidance interacted with RSA to predict QOL such that those with higher attachment avoidance were only vulnerable to poorer QOL if they also had lower self-regulatory capacity, as indexed by lower RSA. Attachment anxiety has been previously linked to both emotional well-being after a stressful life event and more physical symptoms among people without a history of cancer [5-8]. Attachment avoidance was also recently related to poorer loss adjustment, but only for those with lower RSA [5]. The current study extends prior work in an important new direction by demonstrating that attachment anxiety and avoidance are risk factors for poor QOL among breast cancer survivors. A subset of breast cancer survivors experience QOL of life issues long after treatment completion. Accordingly, the current results demonstrate that attachment anxiety and the combination of attachment avoidance and low RSA are risk factors for poor QOL among an already vulnerable population. Future work should examine this relationship over time to determine if attachment insecurity and RSA before treatment predict post-treatment quality of life.

RSA was not directly related to quality of life among cancer survivors. Rather, RSA interacted with attachment avoidance to predict quality of life. These findings are consistent with work in developmental psychology suggesting that RSA interacts with psychosocial and environmental differences to predict health outcomes [46, 47]. A broader understanding of why RSA is differentially predictive of health outcomes is imperative for future quality of life research.

There is considerable evidence demonstrating that social support plays an important role in both the mental and physical health outcomes of cancer survivors such that those with more social support have a better quality of life compared with those who have less support [48]. Attachment theory suggests that previous interactions with close relationship partners contribute to the development of one's willingness and ability to use others for support [9, 10]. However, perceptions of support did not explain the associations between attachment insecurity and quality life. Accordingly, attachment insecurity is a unique predictor of quality of life over and above its relationship with social support.

Recent work demonstrated that those who were abused or neglected as children experienced more cancer-specific psychological distress, more fatigue, and poorer physical, emotional, functional, and breast cancer specific well-being after treatment [49]. Attachment insecurity to one's parents has been linked to child maltreatment [50, 51]. The current study investigated attachment relationships to other adults, which theoretically are based on an individuals' earliest attachment to his/her caregiver [52]. Accordingly, the current investigation may add to the emerging literature demonstrating a link between early life stress and post-treatment quality of life among cancer survivors [49]. However, attachment orientations do become “updated” over time based on people's current relationships [53-55]. Accordingly, someone's attachment orientation in adulthood is not necessarily reflective of their childhood attachment relationships.

RSA is theorized to reflect self-regulatory capacity. Having poor self-regulatory capacity, as indexed by lower RSA, has been associated with maladaptive coping strategies, negative emotional traits, poor regulation of negative affect, and depressive symptoms [40-42]. These characteristics have clear links to emotional well-being after a cancer diagnosis and its treatment. Indeed, one's capacity to regulate negative affect may reduce distressing thoughts that are common among breast cancer survivors such as fears of cancer recurrence, feelings of unattractiveness, and heightened preoccupation with death [2, 56-60]. Furthermore, chronic pain and fatigue, two of the most common physical problems among cancer survivors, are clearly related depression and one's ability to regulate negative affect [61-63]. Accordingly, RSA and these other factors likely simultaneously contribute to breast cancer survivor's physical well-being.

We did not control for respiration rate or depth, which can alter the validity of the RSA assessment [64]. We used the root mean square of successive differences (RMSSD) rather than HF-HRV because RMSSD is recommended for studies that do not control for respiratory rate and respiratory depth; RMSSD is less affected by changes in breathing frequency than HF-HRV [65]. Finally, we assessed RMSSD during a resting baseline assessment, which further reduces risk of respiratory artifacts.

We focused exclusively on female breast cancer survivors; thus, we do not know if our findings generalize to men. Future work assessing cancers that predominately affect males are needed in order to generalize our results to men. Additionally, our sample was predominately white, another limitation of our study that could be addressed in future work with a more diverse sample. Finally, our study design was cross-sectional. Additional research that prospectively examines the associations among attachment style, HRV, and QOL before and after cancer treatment would be beneficial to better understand the direction of these relationships. Well after treatment-related problems subside, many breast cancer survivors report QOL difficulties. This research demonstrated that attachment anxiety is a risk factor for poor QOL among breast cancer survivors. In addition, attachment avoidance enhances risk for QOL problems among people with lower self-regulatory capacity, as indexed by lower RSA. A better understanding of how attachment style and RSA contribute to breast cancer survivor QOL will help in identifying who is most at risk for quality of life difficulties after treatment.

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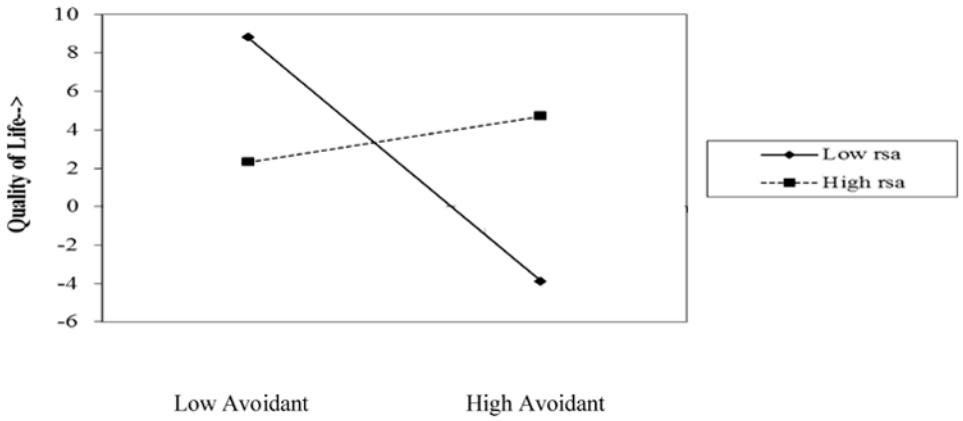

Figure 1.

The moderating role of RSA in the relationship between attachment avoidance and quality of life. Regression lines for individuals scoring 1 SD above and below the sample means are plotted on each of the predictor variables.

Table 1

Study sample characteristics.

Characteristic	n= 96
	Number(%) or Mean(SD)
Ethnicity	
Asian	3(3.1)
Black	11(11.5)
White	81(84.4)
Native American	1(1.0)
Marital Status	
Single	11(11.5)
Married	68(70.8)
Common Law	1(1.0)
Separated/Divorced/Widowed	16(16.7)
Cancer Stage	
Stage 0	10(10.4)
Stage 1	41(42.7)
Stage 2A	29(30.2)
Stage 2B	6(6.3)
Stage 3A	10(10.4)
Type of Treatment	
Surgery Only	12(12.5)
Surgery + Radiation	27(28.1)
Surgery + Chemotherapy	25(26.0)
Surgery + Chemotherapy + Radiation	32(33.3)
Tamoxifen	
No	62(64.6)
Yes	34(35.4)
Aromatase Inhibitor	
No	59(61.5)
Yes	37(38.5)
Cardiac Meds	
No	78(81.3)
Yes	18(18.8)
Age	51.83(9.47)
BMI	27.97(6.06)
ECR 16 anxiety scale	20.37(8.88)
ECR 16 avoidance scale	21.54(8.36)
RMSSD (ms)	27.48(17.92)
Months since treatment ended	10.56(7.71)

Table 2

Raw correlations between study variables.

Variable	1	2	3	4	5	6	7	8	9
1. Attachment anxiety	---								
2. Attachment avoidance	.388***	---							
3.RSA	-.117	.001	---						
4. Age	-.029	-.014	-.251	---					
5. Cancer Stage	-.097	-.026	-.024	-.080	---				
6. BMI	.037	-.072	-.166	.136	-.057	---			
7. Comorbidities	-.004	-.021	-.106	.158	.068	-.007	---		
8. Time Since Tx	.013	.059	-.055	.075	-.146	.131	.032	---	
9. Cardiac Meds	.077	-.025	-.067	.360***	.087	.257*	.230*	.132	---
10 Fact-B Total Score	-.397**	-.312**	.079	.003	-.183	-.210*	-.087	-.052	-.108

Note.

* $p<.05$,

** $p<.01$,

*** $p<.001$

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Table 3

Linear regression output for primary analyses.

		Fact B total Score				
Model	**Variable**	***b***	**SE**	***p***	**$R^{2change}$**	**95% CI**
Step 1	Cancer Stage	-2.732	1.564	.084	.027	-5.843, .379
	Comorbidities	-3.221	3.518	.363	.008	-10.218, 3.775
	Cardiac Meds	-1.577	4.861	.746	.001	-11.243, 8.089
	BMI	-.576	.296	.055	.033	-1.165, .014
	Age	.096	.196	.627	.002	-.295, .486
	Time Since Tx	-.075	.221	.736	.001	-.513, .364
	RSA	1.341	2.737	.625	.002	-4.102, 6.783
	Anxiety	-.568	.208	.008	.063	-.983, -.153
	Avoidance	-.444	.220	.047	.036	-.881, -.007
	F	3.361		.001		
	df	(9,84)				
	R^2	.265				
Step 2	Cancer Stage	-3.061	1.543	.051	.034	-6.131, .008
	Comorbidities	-3.096	3.453	.372	.007	-9.963, 3.771
	Cardiac Meds	-1.810	4.77	.705	.002	-11.298, 7.678
	BMI	-.601	.291	.042	.036	-1.180, -.022
	Age	.120	.193	.536	.004	-.264, .504
	Time Since Tx	-.179	.222	.423	.006	-.621, .263
	RSA	.853	2.69	.753	.001	-4.509, 6.214
	Anxiety	-.585	.205	.005	.097	-.993, -.178
	Avoidance	-.408	.216	.063	.030	-.838, .022
	Avoidance × RSA	.718	.348	.042	.036	.026, 1.410
	F	3.567		.001		
	df	(10, 83)				
	R^2	.301				