# CARDIAC VAGAL CONTROL AND PERCEIVED SOCIAL SUPPORT IN BREAST CANCER

**Anya V. Kogan, John J.B. Allen, & Karen L. Weihs**
**The University of Arizona**

## Abstract


- Social support is an important protective factor for physical and psychosocial well-being in breast cancer patients.
- Despite evidence of an association between cardiac vagal control (CVC), measured by respiratory sinus arrhythmia (RSA), and social functioning, this has not be studied in breast cancer survivors.
- The present study investigated cardiac vagal control as a predictor of perceived social support in 42 women diagnosed with breast cancer.
- The multilevel analysis of change revealed an overall significant decrease in perceived social support over time and indicated that participants with lower RSA evidenced a greater drop in perceived social support over the follow-up period compared to individuals with higher baseline RSA.
- The results suggest that reduced CVC, as indexed by RSA, may reflect an actual compromise in social functioning or alternatively indicate a more negative perception of relationships over time. This finding suggests that RSA may be a biomarker for capacity for social functioning while coping with the breast cancer diagnosis and treatment.


## Introduction

- The Social Engagement System (Porges, 1998) has been theorized to link together social behavior and cardiac vagal control (CVC). The Social Engagement System consists of the brain stem nuclei that regulate the myelinated vagus and control striated muscles of the head and face used for vocalization, facial expression, and auditory reception.
- Individuals with high CVC at rest and decreased CVC during stress should exhibit better social functioning and have greater ability to self-regulate in response to stressors.
- In the literature, higher resting RSA has been linked to the increased connectedness to others and positive emotions (Kok & Fredrickson, 2010), better social support (Horsten et al., 1999), and greater marital quality (Smith et al., 2010).
- Cancer patients often experience diminished active support after completion of treatment (Stanton et al., 2005). The first year post-diagnosis may be especially stressful for women with breast cancer as they cope with treatment and transition to survivorship (Stanton et al., 2005).
- *Study Aim*: To examine baseline cardiac vagal control, measured by RSA, as an index of social functioning in women coping with stressors of breast cancer diagnosis, treatment, and survivorship.

## Method

***Subjects***

- 106 female participants with stage 0, I, II, or III breast cancer participated in the study.
- A final sample consisted of 42 participants who were not undergoing cardio-toxic chemotherapy regimens, not taking anxiolytic medications or those that affect cardiac functioning, and had at least 3 available observations for assessment of social support (Mean age = 53, SD = 8.8; Mean time since diagnosis = 4.5 months, SD = 3.9 months; min = 0.3 months, max = 17.7 months).

***Procedure***

- J & J Amplifier System (Poulsbo, WA) was used to record ECG signal. Gel free Ag – AgCl electrodes were attached to the left and right wrist and the ground electrode was attached to the lower right forearm. Sample rate of 512 Hz was used. Participants were given no instructions on how to breathe.
- At the initial visit, a 5-minute resting ECG segment was recorded.
- Multidimensional Scale of Perceived Social Support (MSPSS) was filled out by participants at each study visit. Observations every three months for up to 1 year period after the initial visit were included in the analyses.

***ECG Data Reduction***

- The raw digitized ECG signal from a 5-minute resting session was analyzed off-line. QRSTool Software (Allen, Chambers, & Towers, 2007) was used to extract interbeat interval (IBI) series from the raw ECG recording. The extracted interbeat series was inspected for artifacts such as missed, erroneous, or ectopic beats and hand-corrected. CMetX Cardiac Metric Software (Allen et al., 2007) was used to calculate an estimate of respiratory sinus arrhythmia, by deriving heart rate variability in the HF band (0.12–0.4 Hz), which is assumed to be related to respiration and under vagal control. CMetX converts IBI series to a time-series sampled at 10 Hz with linear interpolation and then applies a 241-point optimal finite impulse response digital filter designed using FWTGEN V3.8 (Cook & Miller, 1992) with half-amplitude frequencies of a .12 and .40 Hz. The natural log of the variance of the filtered waveform was used as the estimate of RSA.

## Results

- Consistent with literature on RSA, there was a significant negative association between RSA and age in the subset of subjects free of medications ($r$ = -.37, $p$ < .05). Therefore, age was entered in the regression model as a predictor of RSA and nonstandardized residuals were calculated. Values of RSA residualized on age were used in all of the following analyses.

- **RSA was not significantly associated with perceived social support at the initial assessment.**

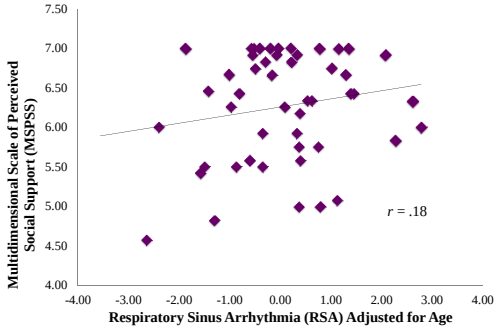


*Figure 1.* The association between RSA and perceived social support at baseline was not statistically significant ($r$ = .18, ns)

- **RSA predicted the slope of change in MSPSS scores assessed at multiple time points over a 1-year period.**

*Table 1. Parameters of the model with RSA and Time as predictors of trajectory of change in MSPSS.*

| Parameter | Variable Level | DF | *B* | SE β | T | *p* |
|---|---|---|---|---|---|---|
| Intercept | | 40 | 6.4*** | 0.11 | 56.1*** | <.0001 |
| Time since initial assessment | 1 | 137 | -0.001** | 0.0004 | -3.4** | <.001 |
| RSA | 2 | 137 | 0.09 | 0.1 | 0.9 | ns |
| RSA X Time since Initial assessment | n/a | 137 | 0.001* | 0.0003 | 2.3* | <.05 |

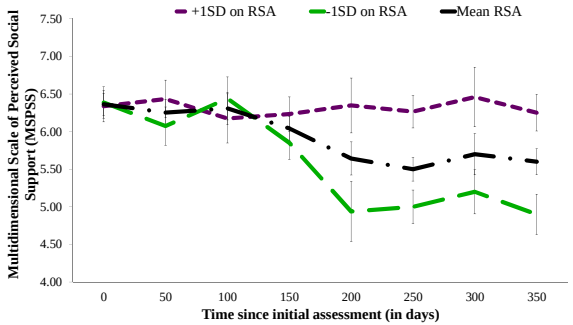


*Figure 2.* Those individuals with higher initial RSA showed unchanging level of perceived social support, while those with lower initial RSA showed a trajectory of decreased perceived social support over time.

## Results (cont.)

*Table 2. Parameters of the model with multiple predictors of trajectory of change in MSPSS.*

| Parameter | Variable Level | DF | *B* | SE β | T | *p* |
|---|---|---|---|---|---|---|
| Intercept | | 38 | 6.6*** | 0.42 | 15.7*** | <.0001 |
| Time since initial assessment | 1 | 137 | -0.001** | 0.0004 | -3.6** | <.001 |
| Nottingham Prognostic Index | 2 | 137 | -0.1 | 0.10 | -1.4 | ns |
| RSA | 2 | 137 | 0.1 | 0.09 | 1.18 | ns |
| Marital Status | 2 | 137 | 0.4 | 0.20 | 1.9 | ns |
| RSA X Time since Initial assessment | n/a | 137 | 0.001* | 0.0003 | 2.3* | <.05 |

## Discussion

- There was no significant association between RSA and perceived social support (MSPSS) at the initial study assessment.
- Baseline RSA was predictive of change in perceived social support over the course of a year after initial assessment, such that participants with lower baseline RSA evidence a decrease in perceived social support.
- Future investigations should examine vagal control as a predictor of social support in other chronic medical conditions.
- Patients low in vagal control at illness onset might constitute a vulnerable group in need of emotionally supportive interventions to improve coping with illness and treatment.
- Cardiac vagal control, as assessed by RSA, may be an index of capacity for social functioning in women diagnosed with breast cancer.

## References


Allen, J.J.B, Chambers, A.S., & Towers, D.N. (2007). The many metrics of cardiac chronotropy: A pragmatic primer and a brief comparison of metrics. *Biological Psychology, 74*, 243–262.

Cook III, E.W., & Miller, G.A. (1992). Digital filtering: Background and tutorial for psychophysiologists. *Psychophysiology, 29(3)*, 350–367.

Horsten, M., Ericson, M., Perski, A., Wamala, S.P., Schenck-Gustafsson, K., & Orth-Gom'er, K. (1999). Psychosocial factors and heart rate variability in healthy women. *Psychosomatic Medicine, 61*, 49–57.

Kok & Fredrickson (2010). Upward spirals of the heart: Autonomic flexibility, as indexed by vagal tone, reciprocally and prospectively predicts positive emotions and social connectedness. *Biological Psychology, 85*, 432–436.

Porges, S.W. (1998). Love: An emergent property of the mammalian autonomic nervous system. *Psychoneuroendocrinology, 23*, 837–861.

Smith, T. W., Cribbet, M. R., Nealey-Moore, J. B., Uchino, B. N., Williams, P. G., MacKenzie, J., & Thayer, J. F. (2011). Matters of the Variable Heart: Respiratory Sinus Arrhythmia Response to Marital Interaction and Associations With Marital Quality. *Journal of Personality and Social Psychology, 100*, 103–119.

Stanton, A. L., Ganz, P. A., Kwan, L., Meyerowitz, B. E., Bower, J. E., Krupnick, J. L., Rowland, J. H., Leedham, B., & Belin, T. R. (2005). Outcomes from the Moving Beyond Cancer psychoeducational, randomized, controlled trial with breast cancer patients. *Journal of Clinical Oncology, 23*, 6009–6018.

Stanton, A. L., Ganz, P. A., Rowland, J. H., Meyerowitz, B. E., Krupnick,J. L., & Sears, S. R. (2005). Promoting adjustment after treatment for cancer. *Cancer, 104*, 2608–2613.


The authors are grateful to Laura Eparvier, RN, for data collection and management of the study, to Roisin O'Donnell, BA, and Amanda Brody, MA, for their work on the ECG data reduction, and to Jan Degan, RN, Allison Stopeck, MD, Christina Kim, MD, Michele Ley, MD, and Amy Waer, MD, for referring their breast cancer patients to the study.

This work was funded by USA Medi Research & Materiel Command, Breast Cancer Research Program. Award Type/#: W81XWH-04-1-0603 - Idea Award to Karen Weihs, M.D

NCI P30CA023074 – University of Arizona Cancer Center Support Grant

Handouts available: www.psychofizz.org