



Cardiac Vagal Control as a Predictor of Outcome in a Stress Reduction Intervention During Pregnancy

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Abstract

Thirty-two moderately anxious pregnant women participated in a study examining whether relaxation training could improve mood and reduce the incidence of complications over the course of pregnancy and during labor and delivery. Women were between 14 and 20 weeks gestation when they completed the baseline laboratory questionnaires and psychophysiological assessment (Time 1). They were randomized to receive six weeks of relaxation training or to receive a list of tips for reducing stress (control). Women repeated the laboratory tasks post-treatment (Time 2) and again between 34 and 36 weeks gestation (Time 3). Higher baseline respiratory sinus arrhythmia predicted lower levels of trait anxiety and stress post-treatment for those receiving relaxation training but not for those in the control condition. For all subjects, higher baseline respiratory sinus arrhythmia predicted lower Time 3 levels of depression, state anxiety, and trait anxiety. At Time 3, participants in the relaxation group had higher respiratory sinus arrhythmia than those in the control group. More frequent relaxation practice among those in the relaxation group predicted lower levels of self-reported stress post-treatment and at Time 3, and lower salivary cortisol upon awakening at Time 3. Findings are interpreted in light of Polyvagal Theory (Porges, 2007) and the Neurovisceral Integration Model (Friedman, 2007).

Introduction

- While complications during pregnancy, labor, and delivery occur in approximately 48% of pregnancies, high levels of stress during pregnancy appears to increase the incidence of such complications to 65%.
 - Complications during pregnancy: hypertension, preeclampsia, eclampsia, gestational diabetes, and placenta previa
 - Intrapartum complications: prolonged interval between water breaking and delivery, induced labor, prolonged labor, mode of delivery (i.e. use of forceps, cesarean)
 - Infant outcome: premature birth, low birthweight for gestational age
- Proposed mediators to explain these findings include cardiovascular vasoconstriction, neuroendocrine effects, and immune inflammatory responses.
- Respiratory sinus arrhythmia has been found to moderate treatment of uncomplicated bereavement and moderate health outcomes after a disclosure task (O'Connor et al., 2005; Sloan & Epstein, 2005)
- Two studies have reduced stress during pregnancy through relaxation methods with pregnant adolescents and mothers (de Anda, Darroch, Davidson, Gilly, & Morejon, 1990; Liebman & MacLaren, 1991)
- Hypnotic relaxation in addition to medication prolonged pregnancy in women who were hospitalized for premature contractions and resulted in greater infant weight than in women who only received medication (Omer, Friedlander, & Palti, 1986)
- No study to date has examined whether relaxation methods can reduce stress during pregnancy and thereby reduce associated complications.

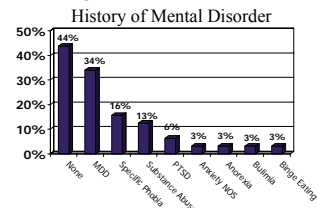
- The following hypotheses were tested:
 - HYPOTHESIS 1:** Relaxation training would reduce levels of negative mood (i.e. stress, anxiety, and depression) in comparison to a psychoeducation intervention
 - HYPOTHESIS 2:** Reduction in negative mood would reduce rates of complications during pregnancy, labor, and delivery as well as negative infant outcome.
 - HYPOTHESIS 3:** Relaxation would reduce arousal at 2nd and 3rd trimesters as measured by muscle tension, resting heart rate, skin conductance, and cortisol upon awakening, and would increase resting levels of respiratory sinus arrhythmia.
 - HYPOTHESIS 4:** Resting levels of respiratory sinus arrhythmia would moderate treatment outcome, such that those with higher resting levels of RSA at baseline would have greater symptom reduction.

Methods

- Subjects**
 - 32 pregnant women between 14 and 20 weeks gestation
 - Between 18 and 40 years of age
 - ≥40 on the State or Trait Anxiety Inventory
 - No current biological children
 - ≤ 1 previous miscarriage
 - No current psychotropic medications or use of street drugs
- Study Design**
 - Random assignment to the Relax group involving 6 weeks of relaxation training or to the Control condition involving reading a list of helpful tips for reducing stress (e.g. exercise, diet)
 - Relaxation training 1x/week for 6 weeks: progressive muscle relaxation, self-monitoring, diaphragmatic breathing, guided imagery, applied relaxation, cognitive strategies, differential relaxation
 - Subjects assessed at baseline (Time 1), post-treatment (Time 2), and between 34 and 36 weeks gestation (Time 3):
 - Structured Clinical Interview based on the DSM-IV at baseline
 - Completed Questionnaires
 - Five-minute resting baseline recording and recording during stress tasks of Stroop and Serial Subtraction
 - Signals amplified with Neuroscan Synamps2 amplifier; signals passed from 0-5000 Hz and its high level input of Neuroscan Synamps2 with a DC amplifier for respiration and SCL
 - Recording sites (except for SCL and respiration) abraded and cleaned with alcohol & silver-silver-chloride electrodes filled with conductance gel
 - Heart rate: EKG electrodes placed on right and left arm just below the elbow; signals sampled at 1024 Hz
 - Skin Conductance (SCL), preamplified with WOrx's GSR-200, isotonic paste placed onto sensors on distal phalanges of index and pointer fingers on non-dominant hand. Surface area was held constant for participants by using collar with an 8mm diameter
 - Electrocardiography from electrodes places on the lateral frontals placed from the non-dominant side of the body and from the gastrocnemius muscle of both legs
 - Respiration: Compumedics Pizo Respiratory Effort Belt placed around chest
 - Ground electrode placed on left knee
 - Six salivary cortisol samples were provided using Sarstedt Salivettes across one weekend day upon awakening, 40 minutes after awakening, before lunch, 3pm, before dinner, before bed.
- Measures**
 - Perceived Stress Scale; State Trait Anxiety Inventory; Edinburgh Depression Scale; Depression, Anxiety, Stress Scale; Prenatal Life Events Scale
 - Respiratory Sinus Arrhythmia (RSA)
 - Interbeat interval (IBI) series hand corrected for artifacts.
 - IBI series were passed through an optimal finite impulse response digital filter with a 12-40 Hz band pass, sampled at 10Hz.
 - Natural log transformed variance in this 12-40 Hz signal was extracted as the index of cardiac vagal control (Allen, 2002, CMEI software available at <http://www.psychofizz.org>)
 - Excluded data for participants whose respiration peak was outside of the high-frequency range (total of 8 recordings)
 - SCL
 - Signals were calibrated off-line
 - ANSLAB used to visually inspect, correct artifacts, and derive mean SCL per condition
 - EMG
 - Signals filtered with a 12 Hz high pass filter and rectified. Average rectified amplitude was obtained
 - Salivary Cortisol
 - Saliva was analyzed for cortisol levels with the Salimetric Saliva Assay Kit (EIA).
 - Pregnancy & Intrapartum Complications & Infant Outcome
 - Medical records were scored by a blinded Obstetrician. Total number of complications were summed during gestation and intrapartum. Birth weight in grams, gestational age, and Apgar scores at 1 and 5 minutes were derived from the participants' medical chart.

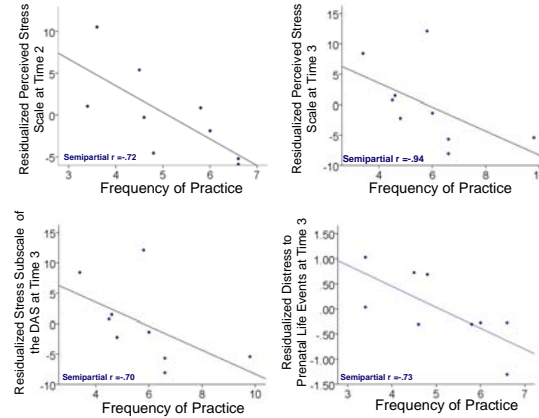
Results

- PARTICIPANTS**
- 32 women between the ages of 22 – 39 (x = 29.31; s.d.=4.5) at 17 weeks gestation on average (s.d. = 2.3)
 - Ethnicity: 88% Caucasian, 6% Hawaiian Native, 3% African American, 3% Latina
 - Marital Status: 93.8% Married or Co-habiting, 3.1% Living Apart, 3.1% Single
 - History of Axis I Disorder: Whereas 44% of the sample had no history of a mental disorder, rates of the history of other disorders ranged from 34% for Major Depressive Disorder, to 3% for eating disorders. There were no differences between those with and without history of mental illness on symptoms measures at pre-treatment assessment (All results F [1, 26] < .82, p > .37)



HYPOTHESIS 1: Did relaxation training reduce levels of negative mood in comparison to a psychoeducation control? NO. Within group analyses, however, reveal relationships between frequency of daily practice and mood.

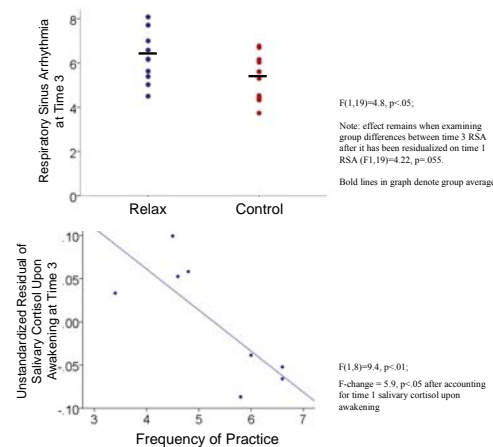
Within the relaxation group, greater frequency of practice (number of times per week) was associated with lower Stress at Time 2 and Time 3 (as measured with the Perceived Stress Scale and the Stress Subscale from the DAS) and with less distress in response to stressful life events after symptom scores were first residualized for baseline levels of each measure.



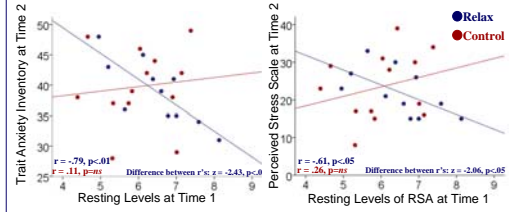
HYPOTHESIS 2: Did relaxation training reduce rates of complications? NO. groups did not differ in rate of complications across pregnancy. Total rate of complications was 67%, similar to the 65% figure among stressed samples in the literature.

HYPOTHESIS 3: Did relaxation training reduce arousal level as measured by muscle tension, heart rate, respiratory sinus arrhythmia (RSA), skin conductance, and cortisol level?

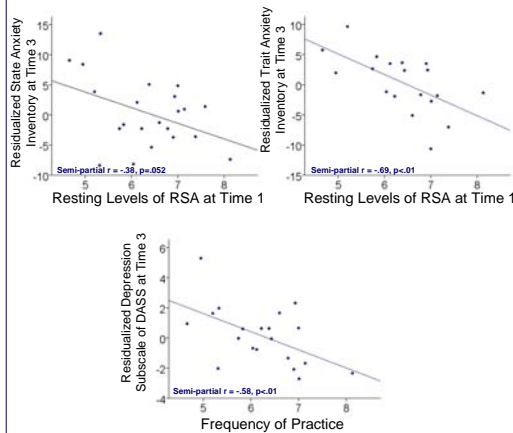
Yes, those in the relaxation group had greater RSA than those in the control group at Time 3. Within Group analyses revealed those in the relaxation group who practiced the relaxation methods more frequently had lower salivary cortisol levels upon awakening at Time 3 after accounting for Time 1 salivary cortisol level.



HYPOTHESIS 4: Did RSA moderate treatment outcome? YES. Those women in the relaxation group who began the study with higher levels of RSA had a greater reduction in perceived stress and trait anxiety at Time 2. No such relationship existed for those in the control condition.



For all participants, those who began the study with higher levels of RSA had a greater reduction in state and trait anxiety and depression by Time 3.



Summary & Discussion

- Regular relaxation practice during pregnancy was related to:
 - reduced self-reported stress and distress experienced in response to prenatal life stressors
 - lower salivary cortisol
 - higher levels of respiratory sinus arrhythmia
- Respiratory sinus arrhythmia moderated
 - self-reported stress and trait anxiety at Time 2 for those women in the relaxation group but not for those in the control group
 - self-reported stress, anxiety, and depression at Time 3 for all participants
- Cardiac vagal control, as measured by respiratory sinus arrhythmia, is thought to broadly reflect the "flexibility" of an individual (Friedman, 2007) and, more specifically, emotion regulation capabilities (Porges, 2007).
 - The women in the present study with greater baseline respiratory sinus arrhythmia might have entered into the study with greater systemic flexibility.
 - This flexibility might have provided a buffer to the accumulating stressors during pregnancy.
 - This flexibility may have facilitated their improvement in mood with the newly found skills of relaxation training, also found to increase RSA (Friedman, 2007).

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