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Effect of holding on co-regulation in preterm infants: A randomized controlled trial

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ABSTRACT

Objective: To determine whether kangaroo holding of healthy preterm infants over the first eight weeks of an infant's life facilitates co-regulation of salivary cortisol between mother and infant.
Study Design: Randomized control trial. Infants were assigned to receive 1 h of daily kangaroo (skin-to-skin contact on the chest of mother) or blanket holding (dressed and held in mother's arms). A registered nurse visited mothers weekly for eight weeks to encourage holding and provide information about infant development. A control group had no holding restrictions and received weekly brief social visits.
Subjects: The study included 79 preterm infants, born between 32 and 35 weeks gestational age and were a mean of 15 days (±5.7) at enrollment.
Outcome Measures: Co-regulation was conceptualized as progressive reduction in the absolute difference between mother and infant cortisol levels across 60 min of holding at each holding session. Mother and infant cortisol levels were measured before holding and at 30 and 60 min after holding began during three holding sessions (baseline and at two and eight weeks after study initiation). Primary analyses were conducted using hierarchical linear models.
Results: There was much variability in cortisol levels. Levels of mother and infant cortisol decreased during holding. No significant co-regulation occurred in any group at any holding session or over time.
Conclusions: Decreasing level of cortisol in both mothers and infants suggests that holding promoted the expected decline in stress hormone levels. However, supported holding methods did not differentially affect co-regulation compared to controls. Holding is pleasurable and stress may need to be present in order for mothers and infants to demonstrate co-regulation in cortisol levels.

1. Introduction

1.1. Preterm birth

Stress from painful or disruptive procedures on infants hospitalized in the neonatal intensive care unit has been well documented [1–6]. Stress activates the hypothalamic–pituitary adrenocortical (HPA) axis, initiating a complex feedback loop involving interaction among the hypothalamus and pituitary and adrenal glands, and results in the secretion of the glucocorticoid cortisol. In a well-regulated system the increase in cortisol levels suppresses further stimulation by the hypothalamus, ending glucocorticoid production [7]. Research using salivary cortisol as an indicator of the activity of the HPA system suggests that early developmental experiences influence long-term response of the HPA system to stress [8–11]. Even minor stressors, such as a non-invasive physical examination, can trigger an HPA response in young infants [12]. Stressful procedures and early trauma may contribute to a less resilient HPA response system in preterm infants throughout their development.

1.2. Holding as a method to decrease stress in preterm infants

Holding is one of the earliest and most frequent caregiving events that mothers provide to their infants. The close physical contact between mother and infant during holding may reduce stress by facilitating maternal–infant co-regulation. Co-regulation is a form of supportive interaction in which each member of the dyad continuously adjusts their behavior by anticipating the actions of their partner. Through repeated co-regulatory interchanges, each partner learns to expect a behavioral pattern in the other. Dyads who develop a strong co-regulatory

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relationship also adapt to novel behavior that occurs between them [13–15]. Infant self-regulation (e.g. smoothly transitioning from one state to another as in cry to calm or sleep to awake) may be enhanced with high quality mother–infant interaction such as co-regulation. Infants who are better self-regulated may demonstrate a more modulated stress response than less regulated infants.

In the kangaroo method of holding, the infant, naked except for a diaper, is placed between the mother's breasts. The infant's ventral surface is in tactile contact with the mother, allowing both the mother and infant to sense the other's heartbeat and respiration. Close physical proximity may enable mothers to better co-regulate physiologically with the infant than with typical blanket holding in which the baby is dressed, wrapped in a blanket, and held in the mother's arms. In a randomized controlled trial (RCT), mothers and their infants who experienced kangaroo holding demonstrated better interactive co-regulation at 6 months infant age than those who experienced traditional blanket holding [15]. Co-regulation was operationalized as a joint focus of attention with mother and infant both contributing actively to the interaction [16]. When kangaroo holding is compared to infants lying in their beds, the physiologic stability, optimal gas exchange, enhanced sleep organization, and reduced pain responses and cortisol levels found in infants during kangaroo holding suggests an effect on physiological homeostasis as well [6,17–21].

Salivary cortisol correlates highly with serum or plasma cortisol measured in preterm infants [22], yet few studies examining maternal–infant co-regulation and stress regulation in infants as measured by salivary cortisol levels addressing kangaroo holding exist in the literature. In one study, salivary cortisol levels of mothers and their hospitalized infants during kangaroo holding were examined, but not the relationship between them. After 30 min of holding, infant cortisol levels increased or decreased, while their mother's levels typically decreased. The authors reported substantial variability in the infants' cortisol levels [23]. In a study in which kangaroo and blanket holding methods were compared, co-regulation (smaller difference between maternal and infant salivary cortisol levels after holding compared to before holding) of hospitalized preterm infants was found in most dyads regardless of holding method. Holding condition was not randomized. Moreover, cortisol levels were examined on only a single occasion while infants were hospitalized in the first three weeks of life [24]. Because interactive co-regulation develops over time through repeated interactions, we propose that over time kangaroo holding also will result in better physiologic co-regulation as assessed through salivary cortisol.

The primary aim of this study was to determine whether kangaroo holding of healthy preterm infants over the first eight weeks of the infant's life would facilitate co-regulation in salivary cortisol (as defined above) between mother and infant. We hypothesized that co-regulation between mother and infant assessed using salivary cortisol would be greater during periods of infant holding when dyads practice the kangaroo method compared to either blanket holding or a control group.

2. Methods

2.1. Design and sample

This was a randomized, 8-week controlled trial comparing supported kangaroo holding to supported blanket holding and a control group in promoting salivary cortisol co-regulation between mothers and their preterm infants. Parents of eligible infants in 5 neonatal intensive care units in a midsized city in the western United States were approached for enrollment. The Colorado Multi-Institutional Review Board as well as the relevant review boards at each study site approved this research, and informed consent was obtained from the mothers before randomization to study groups. The project director who was not involved in data collection coordinated randomization at each hospital using a computer random number generator.

Inclusion criteria for infants were: a) born between 32 and 35 weeks gestational age (determined by the attending physician), b) required less than 0.5 L oxygen per nasal cannula, and c) had no umbilical lines, intraventricular hemorrhage, physical anomalies, or anticipated major surgery. Inclusion criteria for mothers were: a) English or Spanish speaking, b) no recorded or stated illicit drug use, and c) no diagnosed serious chronic illness.

2.2. Instruments

Because maternal anxiety and depression may have influenced cortisol levels, mothers completed anxiety and depression questionnaires before the first holding assessment and again before the holding observation in Week 8. English or Spanish versions of all instruments were used. The first author or another RN (fluent in Spanish) conducted the supportive home visits and collected the questionnaires and daily holding diaries. Saliva samples were sent to the laboratory for assay coded by ID number only.

2.2.1. Demographic questionnaires

At baseline, mothers completed a demographic questionnaire asking the mother's age, ethnicity, education, occupation, and health. Hospital records were used to obtain information about the infant, birth and pregnancy. The Hollingshead Four Factor Index was used to measure socioeconomic status [25].

2.2.2. State–Trait Anxiety Inventory

The State–Trait Anxiety Inventory (STAI) [26] is a self-report instrument with two 20-item scales, one assessing state anxiety and the other assessing trait anxiety. State anxiety refers to anxiety that is temporary and exists at a certain time and under certain circumstances. Trait anxiety refers to a relatively stable trait. On the state scale, choices range from “not at all” (1) to “very much so” (4). On the trait scale choices range from “almost never” (1) to “almost always” (4). Test retest was reported as 0.70 for the trait scale and 0.77 for state anxiety. Concurrent validity of both scales with the Minnesota Multiphasic Personality Inventory was 0.70 [26]. The Spanish translation of the STAI has reported internal consistency of 0.87 and has been validated with Hispanic populations [27].

2.2.3. Center for Epidemiologic Studies-Depression Scale

The 20-item self-report Center for Epidemiologic Studies-Depression Scale (CES-D) [28] assessed maternal depressive symptoms during the past week. CES-D scores show good internal consistency and test–retest reliability in postpartum first-time mothers [29]. The CES-D has been validated against five reliable depression scales. Response choices range from the symptom occurring less than once a week (1) to occurring on 5 or more days (4). The CES-D has well established reliability and validity as a measure of depressed mood in Latino samples [30,31].

2.2.4. Holding diaries

Mothers were asked to record the total daily duration in minutes of kangaroo or blanket holding, holding while feeding or sleeping, and who held the infant in a holding diary. They kept this diary for 8 weeks.

2.2.5. Salivary cortisol

Filter papers, used to collect saliva from the infants and mothers, have been described previously [32]. The study nurse folded the filter paper (Whatman Grade 42, specially cut to 2.4 × 9 cm) in half lengthwise and placed it on the infant's tongue angled toward the cheek for 30 s to 2 min, until approximately 1 in. of the paper was completely wetted. Mothers placed the filter paper on their tongue for 20 s to saturate at least the first 2 in. of the paper. The study nurse marked the furthest extent of absorption of the saliva with a pencil, then dried the filter