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Stress from the Neonatal Intensive Care Unit to Home: Paternal and Maternal Cortisol Rhythms in Parents of Premature Infants

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Abstract

What was observed or investigated—To examine cortisol diurnal rhythms over the transition from the critical care setting to home for fathers and mothers of very low birth weight (VLBW) infants, including how cortisol is associated with psychosocial stress and parenting sense of competence (PSOC).

Subjects and methods—This cohort study in a level III neonatal intensive care unit and the general community had 86 parents complete salivary collection and self-reported psychosocial measures. Salivary samples were collected three times/day on the day before discharge, and on three subsequent days at home. Self-report measures included the Perceived Stress Scale and the PSOC, which measures parenting satisfaction.

Results and conclusions—Fathers showed increased physiological stress over the transition home, reflected by flattening of slopes, lower wakeup, and higher bedtime cortisol. Mothers reporting increases in perceived stress over the transition home had higher bedtime cortisol, suggesting a link between higher perceived stress and higher physiologic stress. Results were significant after controlling for breastfeeding, insurance status, and gestational age. This study examined a physiological marker of stress in parents with VLBW infants, finding sex disparities in diurnal cortisol patterns during the transition from NICU to the community. Fathers may be especially susceptible to stressors during this transition.

Keywords

cortisol; NICU; stress; fathers; mothers

Fragility, survivability, morbidity and mortality are all health issues synonymous with very low birth weight infants (VLBW, birth weight <1500g), a group that has been growing since

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the 1980s and now who represent 17% of all premature births.¹ While VLBW infants are dependent on medical intervention during their lengthy critical care hospitalization, parents provide all care for these infants after being discharged from the neonatal intensive care unit (NICU) and transitioning to home in the community. Although psychosocial adjustment of parents (primarily mothers) of VLBW NICU infants has been studied,^{2,3} the parental experience transitioning from NICU to home is not well known.^{4,5} Limited studies have reported parental stressors including role strain and communication challenges in the two weeks after NICU discharge.⁶ Despite the American Academy of Pediatrics (AAP) policy statement on the importance of involving parents from admission through to discharge,⁷ parents frequently feel unprepared for discharge,^{4,5,8} a fact that can lead to increased parental stress during an existing stressful time. In sum, parents of NICU infants may experience profound and unique stressors that have not received significant empirical considerations.

Parents with NICU infants experience high levels of self-reported stress;⁹ however, stress levels differ in prominent ways for fathers and mothers.¹⁰ Beyond self-reported stressors, no prior study has evaluated the “beneath the skin” or underreported stress experienced by couples transitioning home. The purpose of this study is to examine the changes across the day and over the transition from NICU to home in cortisol, a well-known hormone that is sensitive to stress and easily measured in small amounts of saliva. The limited prior studies focus on mothers only, using cross-sectional designs, and reporting high levels of self-reported stress that are associated with cortisol, providing a cross-linkage between self-reported and physiologic stress.⁹ Maternal, but not paternal, cortisol has been measured in the NICU.^{11,12} In this study, salivary cortisol is measured across the day and over multiple days is examined to investigate patterns of physiological stress in fathers and mothers with NICU infants transitioning from the NICU to home.

Cortisol is an easily obtained stress-sensitive hormone that is the main end product of the hypothalamic-pituitary-adrenal (HPA) axis, which comprises the primary neuroendocrine stress response system. It has significant diurnal variation, with peak levels approximately 30 minutes after waking, and a gradual decline across the day, reaching a nighttime nadir,¹³ Both morning and bedtime levels of cortisol are linked to stress responses and exposure; diurnal/basal HPA axis functioning is often measured by the rate of cortisol decline across the day (slope), which is affected by stress exposure¹⁴ and is associated with health outcomes.¹⁵ Slower rates of decline in cortisol across the day (flatter cortisol slopes) have been found in individuals with difficulty in interpersonal relationships and work and home demands¹⁶ and predicts poor health outcomes including cardiovascular risk and reduced cancer survivorship.^{17–19} HPA-axis functioning is also associated with regulation of interconnected physiological systems, including immune, metabolic, and cardiovascular processes²⁰ and is responsive to social contexts, including positive social relationships, which are beneficial for health and stress regulation.²¹

In this study, we examined cortisol changes over time and throughout the day for fathers and mothers transitioning home with their VLBW infants. We accounted for diurnal patterns in this examination, including the decline across the day (slope) in the stress-responsive hormone cortisol for VLBW parents as they transition from the NICU to the home

environment on the day before discharge, and at one and fourteen days post-discharge. We hypothesized that the fathers in our study will have disparate diurnal cortisol patterns compared to mothers, given that men often (but not always) have heightened responses to psychosocial stress compared to women.²² As such, and due to differences in perceived stress between mother and fathers of NICU infants, we expect to find flatter slopes in fathers compared to mothers over the transition home. We expected to find that the transition from NICU to home would be more physiologically stressful for fathers than mothers because fathers may be more reliant on hospital staff for infant care while in NICU, making the transition home a more pronounced change. Finally, we expected to find links between increased self-reported psychosocial stress (using the Perceived Stress Scale), and more dysregulated cortisol patterns, and between increased parenting competence reports (using the Parenting Sense of Competence Scale) and more adaptive cortisol patterns such as steeper slopes, higher wakeup cortisol, and lower bedtime cortisol levels. In sum, the purpose of this study was to examine cortisol diurnal rhythms for fathers and mothers of VLBW infants over the transition from NICU to home by gender, psychosocial stress and parenting competence to best identify the physiological stress patterns of this understudied group of new parents.

METHODS

Study Design and Participants

This report is a prospective cohort analysis of data collected for a randomized controlled trial using a smartphone technology application designed to support parents of VLBW NICU infants during the transition to home.²³ The sample size from the original data collection was computed to detect a 0.63 SD change in a psychometric measure for a longitudinal study design. As no sociodemographic or physiological differences as a function of randomization in the initial study were found, intervention and control parents are combined in the current study. This was a planned secondary, pilot cohort study of prospective biomarker patterns among parents with infants in the NICU transitioning to home environments. The retention rate throughout the study was 77% with at least 70% providing cortisol data for wake and bed at any given time period within the study. Missing data were multiply imputed (see below).

Participants were ≥ 18 years old, English speaking, and caring for a living VLBW infant together. The study period included the final two NICU weeks, discharge, and two weeks at home; four-weeks in total. The study was conducted in accord with prevailing ethical principles and reviewed and approved by Northwestern University's Institutional Review Board and registered at clinicaltrials.gov (NCT01987180).

Recruitment and Procedures

Recruitment took place from January 2013 through February 2014. Recruitment began when the infant transitioned from an isolette into an open crib (~34 weeks). Parents were informed of the study by research staff not involved in infant care and, if eligible, consented, and completed baseline questionnaires. All participants completed measurement tools and data collection via self-report surveys at three time points: baseline (approximately 14 days prior

to discharge, T-14), one day prior to discharge (T-1), and 14 days after discharge (T+14). Parents completed the surveys independently of each other.

In the NICU, participants were also given salivary sampling kits and instructed on how to prepare the samples at home. Salivary samples were self-collected on the day before discharge (T-1; the last day parents received help from NICU staff), and on subsequent days at home [day after discharge (T+1), five days post-discharge (T+5), and two weeks post-discharge (T+14)]. Parents self-collected saliva at wakeup, wake+30 minutes, and bedtime by expelling saliva through straws into sterile 5 mL cryogenic vials.

Morning and bedtime diaries were completed immediately after collecting wakeup and bedtime samples, respectively. Diaries information included time of waking and other daily behaviors, such as nicotine use and medications. All completed diaries and salivary samples were mailed to Northwestern University, where they were immediately logged and frozen at -80 degrees Celsius until being shipped for assay to ZRT Laboratories. Salivary cortisol assays used competitive luminescence immunoassay with reported detection limits of 0.015 µg/dL. The intra- and inter-assay coefficients of variance were 5.5% and 7.6%, respectively

Outcomes and Measures

Salivary measures—The primary salivary outcome was diurnal decline (slope), which was calculated as follows: (bedtime cortisol - wakeup cortisol)/(bedtime - waketime). Slope values are negative, reflecting the normative decline across the day in cortisol levels. Additional cortisol measures of interest were wakeup and bedtime cortisol values. These values are presented in µg/dL units.

Psychosocial measures—Our two validated psychosocial measures were the 10-item Perceived Stress Scale (PSS) and the 17-item Parenting Sense of Competence Scale (PSOC).^{24,25} The PSS measured frequency of stressful thoughts and feelings.²⁶ Positive questions were reverse coded; higher score indicate higher stress levels. Higher scores on the PSOC measure indicate a greater sense of parenting self-efficacy and satisfaction. Neither scale has a clinical cut-off value. In this study, we administered the PSS and PSOC at T-1 and T+14, with sums across all items.

Socio-demographic covariates—Cross-sectional ANOVAs were conducted at each time period as diagnostics to help determine parsimonious hierarchical linear models (HLMs). Independent variables that were significant ($p \leq 0.05$) at any time period were included in the HLMs, and independent variables that were non-significant ($p > 0.05$) were not. Variables not included in the model due to non-significance included income, medication use, employment, and education. Dichotomous variables included marital status (referent: not married) and infant feeding mode (referent: breastfeeding). Nominal/class variables included race (referent: White) and insurance type (referent: public). Age was included as a continuous measure. Marital status was the only socio-demographic characteristic retained in final analyses. Gestational age (weeks), a dichotomous measure of extremely low birth weight (<1000 grams), parity (referent: multiparous), and gestational number (referent: singleton) were not significantly associated with either cortisol or gender, but were included as control variables in our final models due to likely longitudinal effects,

while infant age at discharge was examined but not included in final models. For parsimony, additional variables, including wake time, length of NICU stay, medication use, shift work, hours of sleep for each parent, and nicotine use were also tested in initial models but were not included in final models because they were non-significant and did not alter main results. No participants reported use of oral contraception.

Statistical Analyses

As our primary objective was to examine differences in cortisol rhythms over time by gender, all models present cortisol data separately for fathers and mothers. We used a three-level hierarchical linear growth model with sample-level variables (Level 1), day-level variables (Level 2), and stable individual and couple-level variables (Level 3). HLM provides a method to estimate parameters of independent variables that may differ at multiple levels. Using the three-level hierarchical model allowed examining nested data-participant data within daily data, which were nested in couple data.

As no associations between any variables and data missingness could be found, data were considered to be missing completely at random (MCAR). Missing data due to drop-out necessitated a monotone imputation approach. Approximately 95% of the sociodemographic data were complete, 75% of all salivary data were complete at T-1, and 70% of all salivary data were complete at T+14. Approximately 85% of the participants included at least one salivary sample per day at each session. The imputations accounted for the missing outcomes and independent variables by implementing the hierarchical linear modeling as the regression model used to estimate the missing values. Using multiple imputation, 20 imputed data sets were produced for a total of 5160 observations using **proc mi** in SAS 9.4. The aggregated imputed data sets were analyzed using **proc mianalyze** to estimate the associations between the independent variables and the cortisol levels at each time period.

RESULTS

Cortisol Rhythms by Demographics and Gender

The 86 participants included a total of 43-paired (female, male) couples. Approximately 75% of the respondents returned all biomarker samples and 67% returned all surveys. As expected, there were no differences by gender in cortisol levels or psychosocial measures (PSOC or PSS) taken prior to discharge (baseline), or at any of the post-discharge collection times (Table 1). Most couples were married (90.7%), had private insurance (88.4%), and the focal infant typically was a first-born child (69.8%). Additional demographic data (not shown) included age, race, and wake time, which did not differ by gender. Our sample was primarily white and black with mothers average age was 33.3, and fathers 34.1. The average length of NICU stay from time of entry into the study (not length of stay from admission) was 16.5 days (SD = 12.6).

Cortisol patterns for both fathers and mothers showed diurnal rhythms considered normative, based on high levels at wakeup and low levels at bedtime, and negative slopes (bedtime cortisol-wakeup cortisol)/(bedtime – waketime) at all time points of collection. Although there was a trend ($p < 0.10$) towards steeper slopes for fathers at T-1 and T+1 compared to

mothers, the later time points (T+5, T+14) did not differ by gender using paired t-testing. Overall, the cortisol slopes for men flattened over the four sessions whereas for women they were relatively even from the first to final session. Hierarchical linear modeling of cortisol rhythms supported our hypothesis of disparate rhythms for fathers and mothers over the transition home (Tables 2 and 3).

Paternal Cortisol Rhythms over the Transition Home

Fathers had significant cortisol session (time of collection) effects, in that fathers had flatter slopes ($\beta = 0.016$, $p < 0.0001$), lower morning cortisol ($\beta = -0.080$, $p < 0.0001$), and higher bedtime cortisol ($\beta = 0.203$, $p = 0.0002$) over the transition from NICU to home. Married fathers had steeper slopes ($\beta = -0.064$, $p = 0.011$) and higher morning cortisol ($\beta = 0.711$, $p = 0.0005$) compared to those in non-marital cohabiting relationships with mothers. Fathers with older children (in addition to the NICU infant) showed patterns consistent with a less adaptive physiological response, with flatter slopes ($\beta = 0.025$, $p = 0.037$) and higher bedtime cortisol ($\beta = 0.332$, $p = 0.043$). Higher PSOC was associated with steeper slopes ($\beta = -0.017$, $p = 0.009$) and lower bedtime ($\beta = -0.223$, $p = 0.0095$) cortisol for fathers. With the exception of an association between baseline PSS scores and higher morning cortisol ($\beta = 0.126$, $p = 0.0533$) that approached significance ($p < 0.10$), there were no further associations between father's cortisol and psychosocial measures.

Maternal Cortisol Rhythms over the Transition Home

Mothers did not show a similar pattern to fathers of cortisol change over the transition home, although there was a trend towards higher bedtime cortisol over time ($\beta = 0.031$, $p = 0.0587$). Unlike their partners, mothers had only a trending advantage (for morning cortisol) of lower cortisol if married ($\beta = 0.336$, $p = 0.0095$). Unlike fathers, having an extremely low birth weight baby (compared to very low birth weight) was associated with lower morning cortisol ($\beta = -0.389$, $p = 0.0231$) for mothers. An increase in PSS over the transition home was associated with higher bedtime cortisol ($\beta = 0.258$, $p = 0.0019$) with a trend for flatter slope ($\beta = 0.015$, $p = 0.084$); there were no significant associations between maternal cortisol and PSOC.

Cortisol Rhythms for Parents over the Transition Home

Figure 1 plots cortisol slope by time of collection by gender using least-squares means estimates calculated by the multilevel regressions (Tables 2, 3). Steeper slopes are reflected in a more negative overall value, while flatter slopes are seen as an increase upwards towards zero. Fathers show a linear flattening (i.e. decreased diurnal change across the day) of cortisol slope over the transition from NICU to home, while mothers show a flattening the day after NICU discharge, but recovery to pre-discharge T-1 levels by T+14. In sum, after controlling for covariates, we find that the diurnal declines for fathers two weeks post-discharge are significantly flatter than those for mothers, and that fathers show increased physiological stress profiles during the transition from NICU to home.

DISCUSSION

To our knowledge, this study is the first to examine cortisol diurnal rhythms for a paired group of fathers and mothers of VLBW infants over the transition from the critical care setting to home. Our hypotheses were supported as we found sex differences in cortisol rhythms across the transition home from the NICU into the community for parents in this study.

Paternal Diurnal Cortisol

Fathers exhibited flatter slopes, lower wakeup cortisol, and higher bedtime cortisol over this transition, a pattern typically associated with less adaptive functioning. In other words, fathers' physiological stress response worsens as they transition home, after controlling for key covariates. The last day in the NICU to two weeks at home is marked by a flattening of fathers' cortisol diurnal rhythm, even after controlling for factors related to the infant's health and the family social milieu.

The inclusion of NICU fathers is a particular strength of this study. With the existing research focusing on mothers,²⁷ ours is the first study to examine cortisol from fathers transitioning home. While mothers with VLBW infants report higher levels of short-term individual and family-level stressors compared to mothers with term infants, reports of stressors for VLBW fathers are not well known, despite fathers increasing time spent with their children.²⁸ In addition to the overall importance of fathers within the family, men in general may not report stress when asked; in our study, father's PSS reports were not correlated with their cortisol levels or diurnal decline, unlike mothers. Thus, the stress fathers report in surveys may be different from what they are actually experiencing. Including physiological stress biomarkers may be especially important for fathers as they may show less adaptive cortisol patterns over time that might be missed with self-report measures.

Maternal Diurnal Cortisol

Mothers, on the other hand, are more physiologically stable, perhaps suggesting they are better prepared for this transition. The significant changes for mothers are higher levels of bedtime cortisol during the transition from NICU to home, similar to their partners. Unlike fathers in our study, however, maternal bedtime cortisol is associated with an increase in self-reported perceived stress. These findings suggest sex differences in the experience of transitioning home from the NICU and provide important longitudinal, physiological data on stress hormone alterations over this key time-period; however, our results are tentative, based on a pilot sample of parents, and therefore require additional study to confirm our findings.

Parents in the NICU

Parents with NICU babies experience high levels of stress²⁹ while in critical care settings and once at home, including difficulties caring for sick infants.³⁰ Postpartum stressors, which are often experienced at higher rates by NICU families, are linked to higher rates of maternal postpartum depression and associated poorer outcomes for children.³¹ Less is known about paternal postpartum adjustment; however, fathers do experience significant

postpartum stress and depression.³² Most prior NICU research has focused on time within the critical care environment rather than the transition back into the community, despite this transition being a particularly vulnerable time for parents with premature infants.⁷ Previous studies of NICU families during the transition home have examined qualitative data on parenting challenges such as communication difficulties and concerns for their fragile infants.^{3,6,33,34} The present study collected longitudinal psychosocial and physiological data from fathers and mothers over the transition, a key time period for developing parenting independence from medical care,³⁵ and competence caring for medically fragile infants.²⁷

Successful transition home from the NICU is an important process from a pediatric perspective given the prevalence of premature births. Successful transitions are marked by effective communication with health professionals, social supports, and educational support for parents in general.⁷ Based on our findings a number of beneficial suggestions for NICU parents arise, especially for fathers, and include: 1) provision of additional paternal support while in the NICU; 2) preparation, anticipatory guidance and troubleshooting the transition to home; and 3) identifying sources of support for parents once they return home. Beneficial interventions could help buffer the stress of returning home from the critical care setting for particularly vulnerable new parents and focus on alleviating stress between parents.

Limitations and Future Directions

Limitations of our study include the mostly homogenous background of study participants. Since we only included paired groups of parents, we were unable to examine the unique patterns of parents not in a romantic relationships and parenting together. Furthermore, NICU parents often undergo significant sleep disruption in caring for their infants, and compliance with sample collection (especially the first wakeup which may be difficult to know for parents) was measured only by self-report. As we focused on the transition from NICU to home and the discharge experience, our methodological approach included four time points of collection with only one pre-discharge; future studies should ideally have a longer time course of collection to compare earlier pre-and possibly later post-discharge cortisol rhythms. Further, due to the nature of this study, data on individual baselines prior to having or taking home a VLBW infant are unknown and a focus of future work. Future research should also aim to collect detailed information about the amount of time each parent spends in the NICU, which may differ by gender. Finally, some variables typically included in cortisol research such as weight or BMI are not included here.

Despite these limitations, our study suggests that the experience of parenting NICU infants may differ by sex, over the transition back home to the community, and by psychosocial measures of self-reported stress and parenting sense of competence. If these findings are significant within this small group of high SES parents, the disparities within a heterogeneous group of parents may be more pronounced. Further, this study highlights the utility of expanding our understanding of the physiological underpinnings of parenting to include fathers and mothers. Fathers have been noticeably absent from prior NICU research and much of the research on newborns. These findings suggest the transition for fathers may be physiological stressful in ways that fathers either cannot, or do not, report using self-reported measures. Future studies may examine the multifaceted nature of hormonal patterns

beyond cortisol, and additional post-discharge factors (including healthcare access and utilization) and familial stressors such as employment and social supports particularly among new fathers. Given the growing understanding of father involvement in the health of children and families, investigations into the experiences and physiological profiles of fathers and infants may have consequences beyond the time-limited changes from NICU to home. We suggest additional investigation into the biological rhythms of this understudied population of new parents.

Conclusion

Our results reflect that the physiological experience of bringing a VLBW infant home from the NICU varies by sex, with fathers being more susceptible to being at-risk for heightened stress during this transition. Feeling more competent at parenting may help buffer this risk, in that fathers who report higher parenting competence scores have lower bedtime cortisol and steeper slopes. In-hospital and at-home interventions focused on the transition from the NICU to home could benefit both parents.

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Abbreviations

NICU	neonatal intensive care unit
VLBW	very low birth weight
PSOC	parenting sense of competence

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Figure 1.
Least Squares Estimates of Father and Mother Cortisol Slopes by Time of Collection during the Transition from NICU to Home

Table 1

Descriptive Statistics for NICU-2-HOME Paired Couples (N=43)

Family-Level Descriptive Statistics

	Frequency (%) / Mean (SD)
Married	39 (91%)
Breastfeeding	28 (85%)
Private Insurance	38 (88%)
White	32 (74%)
Parental Age	33.7 (5.8)
Birthweight <1000g	8 (19.1)
Adjusted length of stay (days) ^a	17.3 (9.6)
Singleton	31 (72.1)
Multiparous	13 (31.2)
Gestational Age ^b	29.69 (2.62)
Infant Age at Discharge (weeks)	31.5 (2.6)

Individual-Level Descriptive Statistics

Variable	Mothers (N = 43) Mean (SD)	Fathers (N = 43) Mean (SD)	t-value
Baseline PSOC ^c	72.84 (9.13)	68.77 (10.62)	1.61
Baseline PSS ^c	17.26 (7.66)	15.90 (6.88)	0.72
PSOC T+14	74.79 (11.41)	72.02 (11.73)	0.95
PSS T+14	15.70 (7.74)	14.86 (7.74)	0.42
Cortisol Slope T-1	-0.10 (0.05)	-0.12 (0.04)	1.77~
Cortisol at Wake T-1	0.45 (0.21)	0.54 (0.30)	-1.41
Cortisol at Bed T-1	0.07 (0.06)	0.11 (0.31)	-0.66
Cortisol Slope T+1	-0.09 (0.07)	-0.11 (0.04)	1.79~
Cortisol at Wake T+1	0.42 (0.26)	0.44 (0.29)	-0.26
Cortisol at Bed T+1	0.11 (0.14)	0.07 (0.07)	1.48
Cortisol Slope T+5	-0.09 (0.07)	-0.09 (0.08)	-0.30
Cortisol at Wake T+5	0.38 (0.20)	0.43 (0.22)	-1.14
Cortisol at Bed T+5	0.12 (0.22)	0.15 (0.18)	-0.46
Cortisol Slope T+14	-0.10 (0.06)	-0.09 (0.07)	-0.98
Cortisol at Wake T+14	0.41 (0.18)	0.45 (0.30)	-0.73
Cortisol at Bed T+14	0.10 (0.12)	0.17 (0.32)	-1.23

^aLength of stay adjusted to reflect time from admission into study until NICU discharge.^bGestational Age = Average gestational age at birth^cPSOC = parenting sense of competence; PSS = perceived stress scale

* p < 0.05,

** p < 0.01,

$\tilde{p} < 0.10$

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Table 2Multilevel Cortisol Change Model for Fathers Transitioning from the NICU to Home (N=43)^a

Parameter	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept	-0.102 (0.092)	-0.283 0.079	-1.115 (0.792)	-2.667 0.437	-2.449* (1.245)	-4.889 -0.010
Session	0.016** (0.002)	0.012 0.021	-0.080** (0.010)	-0.099 -0.061	0.203** (0.024)	0.143 0.264
Married	-0.064** (0.023)	-0.112 -0.016	0.711** (0.203)	0.314 1.109	-0.339 (0.336)	-1.103 0.425
BW <1000g ^b	0.011 (0.020)	-0.028 0.050	-0.009 (0.175)	-0.351 0.334	0.064 (0.271)	-0.466 0.595
Private Insurance	-0.005 (0.018)	-0.041 0.031	-0.046 (0.162)	-0.365 0.273	-0.113 (0.254)	-0.618 0.391
Gestational Age	0.000 (0.003)	-0.006 0.006	-0.009 (0.026)	-0.060 0.043	-0.015 (0.041)	-0.096 0.066
Multiparous	0.025* (0.012)	0.002 0.049	-0.098 (0.111)	-0.316 0.120	0.332* (0.164)	0.011 0.653
PSS (T-1) ^c	-0.012 (0.008)	-0.027 0.003	0.126* (0.065)	-0.002 0.253	-0.112 (0.102)	-0.311 0.087
PSOC (T-1) ^c	-0.017** (0.006)	-0.029 -0.004	0.063 (0.056)	-0.047 0.173	-0.223** (0.086)	-0.391 -0.054
PSS (T-14-T+1)	-0.002 (0.007)	-0.017 0.012	0.017 (0.066)	-0.111 0.146	-0.045 (0.101)	-0.242 0.152
PSOC (T-14-T+1)	-0.003 (0.005)	-0.013 0.007	-0.003 (0.047)	-0.095 0.088	-0.083 (0.071)	-0.222 0.057

^a Breastfeeding, intervention status, and singleton (v. multiples) were controlled in analysis, but not significantly associated with cortisol measures in any models.^b Comparative group is infants whose birthweight was below 1000g (referent were VLBW infants > 1000g & < 1500g)^c PSS = Perceived Stress Scale; PSOC = Parenting Sense of Competence^{*} p < 0.05,^{**} p < 0.01,[~] p < 0.10

Table 3

Multilevel Cortisol Change Model for Mothers Transitioning from the NICU to Home (N=43) ^a

Parameter	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept	-0.157 [*] (0.08)	-0.314 0.000	-1.124 (0.750)	-2.594 0.347	-3.825 ^{**} (0.780)	-5.353 -2.297
Session	0.001 (0.001)	-0.002 0.004	-0.014 (0.013)	-0.040 0.012	0.031 [*] (0.016)	-0.001 0.063
Married	-0.032 (0.021)	-0.073 0.010	0.336 [~] (0.199)	-0.053 0.726	-0.141 (0.208)	-0.549 0.267
BW <1000g ^b	0.017 (0.018)	-0.019 0.053	-0.389 [*] (0.171)	-0.724 -0.053	-0.007 (0.178)	-0.355 0.342
Private Insurance	-0.004 (0.015)	-0.032 0.025	0.085 (0.136)	-0.182 0.352	-0.001 (0.141)	-0.279 0.275
Gestational Age	0.003 (0.003)	-0.003 0.008	-0.010 (0.025)	-0.059 0.039	0.036 (0.026)	-0.014 0.087
Multiparous	0.003 (0.013)	-0.023 0.029	0.036 (0.123)	-0.206 0.277	0.079 (0.128)	-0.173 0.330
PSS (T-1) ^c	-0.002 (0.008)	-0.016 0.013	0.060 (0.070)	-0.078 0.198	0.064 (0.073)	-0.080 0.207
PSOC (T-1) ^c	-0.004 (0.006)	-0.017 0.009	-0.036 (0.060)	-0.154 0.083	-0.061 (0.063)	-0.184 0.062
PSS (T-14-T+1)	0.015 [~] (0.009)	-0.002 0.032	-0.029 (0.080)	-0.186 0.127	0.258 ^{**} (0.083)	0.095 0.421
PSOC (T-14-T+1)	-0.004 (0.008)	-0.020 0.012	0.042 (0.075)	-0.105 0.189	-0.037 (0.078)	-0.190 0.116

^a Breastfeeding, intervention status, and singleton (v. multiples) were controlled in analysis, but not significantly associated with cortisol measures in any models.^b Comparative group is infants whose birthweight was below 1000g (referent were VLBW infants > 1000g & < 1500g)^c PSS = Perceived Stress Scale; PSOC = Parenting Sense of Competence

* p < 0.05,

** p < 0.01,

~ p < 0.10