Changing family routines at kindergarten entry predict biomarkers of parental stress

Jason A. DeCaro¹ and Carol M. Worthman²

Abstract
This study tested associations among parenting stress prior to a child's kindergarten entry, the sustainability of family routines, and biomarkers of stress among parents following the kindergarten transition. Parents (N = 51) with higher prekindergarten scores on the Parenting Stress Index Short Form reported lower Family Routines Inventory scores following school entry relative to their baseline. Declining family routines, in turn, were associated following kindergarten entry with greater 5-day mean and variance in evening cortisol, and higher C-reactive protein, an inflammatory mediator. However, only the cortisol findings remained significant controlling for baseline physiology. These findings support a family systems, social-ecological approach to life course development, wherein even mild challenges posed by children's normative transitions may reveal differences in parents' biobehavioral functioning.

Keywords
cortisol, C-reactive protein, family routines, parenting stress, school entry

The successful transition into parenthood represents an important milestone in behavioral development of adults (Cowan, Cowan, Heming, & Miller, 1991), which is followed by a series of adjustments related to the developmental milestones experienced by their children. Correlations between a child’s response to school entry and subsequent social, academic, and psychobiological functioning are well documented (Davis, Donzella, Krueger, & Gunnar, 1999; Ladd & Burgess, 2001; Wideinger, McIntyre, Fiese, & Eckert, 2008). Yet even if the child previously attended preschool, kindergarten entry involves adjustments by the entire family, including altered schedules and changing expectations of parenting (McClelland, 1995; Wideinger et al., 2008). School entry therefore represents a potentially stressful normative challenge for parents as well. Family differences in the ability to maintain protective daily routines in the face of a challenge should be reflected in physiological markers of parental well-being.

Family routines and well-being
Family routines play substantive roles in family well-being. Meaningful family routines or rituals sustain a sense of identity, stability, and belonging, and several studies have highlighted the importance of family routines to behavioral development and psychobiological adaptation in children (DeCaro & Worthman, 2008; Fiese et al., 2002). Among adults, robust routines or rituals during the transition into early parenting are associated by the entire family, including altered schedules and changing expectations of parenting (McClelland, 1995; Wideinger et al., 2008). School entry therefore represents a potentially stressful normative challenge for parents as well. Family differences in the ability to maintain protective daily routines in the face of a challenge should be reflected in physiological markers of parental well-being.

Biomarkers reveal the internalization of stress
Biomarkers that reflect the internalization of daily experience can help clarify complex pathways through which reported stress interacts with family functioning to produce differential outcomes in biobehavioral development (DeCaro & Worthman, 2008; Flinn, 2006; Granger et al., 1998; Pendry & Adam, 2007). One effective marker of the physiological burden of stress is cortisol, the primary endocrine product of the HPA axis. Circulating cortisol levels vary widely within and across days, including a diurnal rhythm comprising high early morning levels that are mildly responsive to acute stimulation and provide a physiological boost in

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Table 1. Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Fathers</th>
<th>Mothers</th>
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<tr>
<td></td>
<td>$M \pm SD$</td>
<td>$M \pm SD$</td>
<td>$M \pm SD$</td>
</tr>
<tr>
<td>(N = 51)</td>
<td></td>
<td>(n = 22)</td>
<td>(n = 29)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>37 ± 5.1</td>
<td>38 ± 5.2</td>
<td>36 ± 4.7</td>
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<td>Household income ($/yr)</td>
<td>$80,000$</td>
<td>$44,000^*$</td>
<td>$44,000^*$</td>
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<tr>
<td>Hollingshead education</td>
<td>6.2 ± 0.88</td>
<td>6.2 ± 0.97</td>
<td>6.1 ± 0.82</td>
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<td>Number of children</td>
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<tr>
<td>T1 total parenting stress</td>
<td>65 ± 17</td>
<td>64 ± 15</td>
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<td>23 ± 5.6</td>
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<td>T1 difficult child</td>
<td>25 ± 8.0</td>
<td>25 ± 7.1</td>
<td>25 ± 8.7</td>
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<td>T1 dysfunctional interactions</td>
<td>17 ± 4.4</td>
<td>17 ± 4.5</td>
<td>16 ± 4.5</td>
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<td>T1 Family Routines Inventory</td>
<td>52 ± 6.9</td>
<td>49 ± 6.2</td>
<td>55 ± 6.2</td>
</tr>
<tr>
<td>T2 Family Routines Inventory</td>
<td>52 ± 7.9</td>
<td>49 ± 7.9</td>
<td>55 ± 7.0</td>
</tr>
<tr>
<td>T2 log CRP (mg/L, serum equivalent)</td>
<td>−.43 ± 1.4</td>
<td>−.76 ± 1.1</td>
<td>−.17 ± 1.6</td>
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<tr>
<td>T2 log AM CORT (ln µg/dL)</td>
<td>−.94 ± 0.44</td>
<td>−.93 ± 0.55</td>
<td>−.95 ± 0.53</td>
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<tr>
<td>T2 log AM CORT STDV</td>
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<td>−.21 ± 0.71</td>
<td>−.22 ± 0.65</td>
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<tr>
<td>T2 log PM CORT (ln µg/dL)</td>
<td>−.27 ± 0.072</td>
<td>−.29 ± 0.12</td>
<td>−.26 ± 0.068</td>
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<tr>
<td>T2 log PM CORT STDV</td>
<td>−.36 ± 1.2</td>
<td>−.39 ± 1.2</td>
<td>−.34 ± 1.2</td>
</tr>
<tr>
<td>T2 CORT SLOPE (p.m.–a.m.)</td>
<td>−.34 ± 0.016</td>
<td>−.36 ± 0.023</td>
<td>−.33 ± 0.021</td>
</tr>
</tbody>
</table>

Note. *This value represents the average per participating household (n = 29), not per individual adult. †Log AM CORT, log PM CORT, and CORT SLOPE descriptive statistics are based on intercept estimates from a random effects model.

The present study

Consequently, we took a family systems approach to investigate whether an event for one family member (a child’s school transition) influenced family function and thence the welfare of another family member (parent). We hypothesized that lower parenting stress prior to kindergarten entry would be associated with stable or strengthened family routines during the child’s transition into kindergarten. We further hypothesized that stable or strengthened routines would be associated with lower values of stress-related biomarkers following kindergarten entry, including lower morning and evening cortisol, less variant day-to-day cortisol measures, a flatter diurnal rhythm, and lower CRP.

Methods

Participants

This research was approved by the Institutional Review Boards of Emory University and the University of Alabama. Between November 2002 and May 2003, 66 parents from 38 households were recruited through letters sent home at preschool programs in metropolitan Atlanta, Georgia, USA. In all cases, at least one focal child in the household was currently attending preschool and preparing to enter kindergarten the following fall. Of these, 51 non-pregnant parents from 29 households (76%) were retained through the transition into kindergarten and provided sufficiently complete data at both times to remain in the present analyses. The primary source of attrition was families moving away from the metropolitan region (additional details in DeCaro & Worthman, 2008).

Demographic and socioeconomic characteristics of the sample are displayed in Table 1. The average parent was in his/her mid-thirties ($M = 37$ years of age, $SD = 5.1$), affluent (household income $M = $80,000 annually, $SD = 44,000), and well educated (Hollingshead education score $M = 6.2, SD = .88$, indicating a college degree), although substantial variation was evident in all these parameters. The average number of children per household was 2.1 ($SD = .77$), and in 22 households (76%) the focal child was the oldest. Seven households (24%) were headed by a single mother, while the rest were headed by married heterosexual couples; the full sample of adults was 57% female. Two adults (3.9%) were at least occasional smokers.

Procedures

Immediately following recruitment, while focal children were still in prekindergarten, and again between September and December 2003 after kindergarten entry, adults self-collected unstimulated saliva samples immediately after awakening (AM CORT) and at 7 p.m. (PM CORT) for 5 consecutive weekdays using Salivette collection devices (Sarstedt, Germany) from a single lot. Weekend and 30-min postawakening samples also were collected, but are not considered in this analysis. Parents were instructed to use electronic timers to ensure they saturated the swab with saliva for a minimum of 60 s. Parents stored samples in their home freezer no longer than 1 week, after which they were transported on ultralow cold packs to a −28°C laboratory freezer. Participants were instructed not to eat, drink, or brush their teeth during the 10 min prior to collection, and to discard immediate postawakening samples missed by more than 5 min, or 7 p.m. samples missed by more than ±1 hr. Where applicable, adults also were instructed not to smoke at least 30 min prior to collection. Participants wrote exact sampling and wake times on a record sheet, as well as the last time they ate or smoked. Following in-home participant training, interviewers visited participants’ homes every 2–3 days during each sampling period to enhance compliance.

At the conclusion of each sampling, adults independently completed the Family Routines Inventory (FRI) and Parenting Stress Index Short Form (see below). During this same visit, dried blood spots (DBS) were collected from each adult. Parents’ hands were washed in warm water, dried, and swabbed with alcohol. A sterile, disposable lancet was used to collect drops of capillary whole blood, approximately 50 µL each, from a finger of the nondominant hand onto Whatman 903 specimen collection paper. DBS were allowed to dry overnight at room temperature, and stored in a −28°C laboratory freezer until analysis.
The interval between kindergarten entry and Time 2 data collection varied from 22–94 days ($M = 52$ days/1.7 months), and the interval between Time 1 and Time 2 visits varied from 4.5–11 months ($M = 6.8$ months).

**Measures**

**Family Routines Inventory.** The FRI is an instrument designed to assess routinization and predictability in daily family life (Boyce, Jensen, James, & Peacock, 1983; Jensen, James, Boyce, & Hartnett, 1983). Participants rate the frequency of 28 routines, largely focused on social interactions among family members (e.g., “Parent(s) have some time each day for just talking with the children”), but also on the consistency of key scheduling routines (e.g., “Working parent(s) come home from work at the same time each day”). These reflect routines that a socioeconomically and ethnically diverse sample of U.S. adult women rated as most important for maintaining strong families. The FRI was validated against the Moos Family Environment Scale, and shows good test-retest reliability (Jensen et al., 1983).

The FRI is scored by adding 3 points for each routine that occurs “always/every day,” 2 points for “3–5 times per week,” 1 point for “1–2 times per week,” and 0 points for “almost never.” Hence, high values represent more frequent family routines. In the present study, two routines that assumed the presence of a nonworking parent were omitted from scoring, yielding 26 items with a range of possible scores from 0–78. The FRI showed acceptable internal consistency reliability (at Time 1, Cronbach’s $\alpha = .62$; at Time 2, $\alpha = .74$), and scores were expectably correlated across times, $r(49) = .77$.

FRI change, the independent variable of interest in this study, was calculated as a residualized difference score. Time 2 (T2) FRI was linearly predicted from Time 1 (T1) FRI using generalized estimating equations (GEE; see following lines), and the residuals standardized. Hence, positive FRI-change scores indicate that family routines were more frequent following kindergarten entry than expected from the T1 baseline, and negative FRI-change scores indicate that family routines were less frequent than expected. The linear prediction is $T2 \text{FRI} = .87 \times T1 \text{FRI} + 6.9$. The correlation in FRI-change scores within dual parent households was modest, $r(20) = .36$, suggesting spousal differences in the perception of family routines.

**Parenting Stress Index Short Form.** The Parenting Stress Index Short Form is a well-validated, 36-item subset of the full Parenting Stress Index generated through exploratory factor analysis, assessing stress experienced within the parental role, comprising three 12-item subscales (Abidin, 1995). Higher values represent greater parenting stress. Difficult child concerns children’s behavioral characteristics (e.g., “My child generally wakes up in a bad mood”). Parent distress concerns distress related to parenting-related personal factors (e.g., “I feel trapped by my responsibilities as a parent”). Parent–child dysfunctional interactions (dysfunctional interactions) concerns parent’s perceptions of nonreinforcing interactions and unmet expectations (e.g., “My child smiles at me much less than I expected”). Items are rated on a 5-point scale, either 1 (strongly disagree) through 5 (strongly agree), or item specific, and added to produce total stress or subscale scores. For all subscales, Cronbach’s $\alpha > .80$.

**Salivary cortisol and high sensitivity C-reactive protein.** Saliva was extracted from the Salivette devices by centrifugation, and a competitive high-sensitivity enzyme linked immunoassay kit (Salimetrics #1-0102/1-0112, State College, PA) sensitive to <.007 $\mu$g/dL was used for the quantification of cortisol concentrations. Interassay coefficients of variation (CVs) were 5.6% for the high control ($M = 1.0 \mu$g/dL) and 20% for the low control ($M = .11 \mu$g/dL). Intra-assay CVs were 6.2% and 4.3%, respectively. Measures used in this study are AM CORT and PM CORT for each weekday, the standard deviations in cortisol at these two times across the 5 weekdays (AM CORT STDV, PM CORT STDV), and diurnal cortisol slope for each weekday (CORT SLOPE). CORT SLOPE is calculated as PM–AM CORT, such that a more negative value indicates greater absolute magnitude of the expected diurnal decline.

Blood spot samples were eluted using established procedures (Worthman & Stallings, 1997) and assayed for CRP using a time-resolved fluoroimmunoassay, a solid phase, two-site fluoroimmunoometric method. Assay sensitivity is <.005 mg/L. Interassay CVs for the high ($M = 3.0 \text{mg/L}$), medium ($M = 1.1 \text{mg/L}$), and low ($M = .25 \text{mg/L}$) controls were 11%, 11%, and 9.8%, respectively. Intra-assay CVs were 4.1%, 3.9%, and 3.1%, respectively. Values are converted to serum equivalents with the following algorithm derived from matched serum-blood spot samples, $N = 29$, $r(27) = .98$: serum CRP = 1.7 $\times$ DBS CRP.

**Statistical analyses**

All analyses were conducted in STATA 9.2. AM CORT, PM CORT, AM CORT STDV, PM CORT STDV, and CRP were expectedly skewed, so prior to analysis each was log transformed to improve normality. Parents from the same household cannot be assumed statistically independent. Linear models for individual-level dependent variables (FRI change, CRP, AM CORT STDV, and PM CORT STDV) therefore were fit using generalized estimating equations (GEE) under the xtgee command, with household as the group variable. GEE estimates population-averaged effects accounting for the nonindependence of observations grouped within households, and is appropriate for use in unbalanced designs such as the current study where some households contributed one participant while others had two. For AM CORT, PM CORT, and CORT SLOPE, it was necessary to account for an additional source of nonindependence: the nesting of days within individuals. 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covariates, after precluding interactions. However, there remains some risk of model overfitting, which is of greatest concern if the artifact falsely confirms a study hypothesis. Therefore, in the special case where the full model notably strengthened the hypothesized association between an independent and dependent variable, we used reverse stepwise selection to fit a third model with \( z = .05 \). This allows comparing coefficients and errors from the full model against an alternative model with minimal covariates, as well as against the bivariate association. Finally, when predicting Time 2 physiology from family routines, we constructed a model controlling for baseline values of the same biomarker at Time 1 to assess whether any association was specific to Time 2.

**Results**

**Description of the sample and key variables**

Descriptive statistics for the independent and dependent variables are displayed in Table 1. The average adult was at or near the 40th percentile for Parenting Stress Index Short Form scores based on published norms (Abidin, 1995), and reported relatively stable family routines between T1 and T2, albeit with substantial individual variation. Means for CRP, AM CORT, and PM CORT were within the range expected for generally healthy, young to middle-aged adults (Pearson et al., 2003; van Cauter, Leproult, & Kupfer, 1996). In no case did T2 CRP exceed 10 mg/L, a level indicative of severe acute inflammation warranting exclusion from the sample (Pearson et al., 2003). Hence, all 51 subjects were retained.

Those participants whose Time 2 data collection occurred in the early fall semester following kindergarten entry (22–50 days; \( n = 26 \)) did not differ from late-semester participants (52–94 days; \( n = 25 \)) with respect to any of the independent or dependent variables listed in Table 1, nor with respect to FRI change. Similarly, those who had a shorter interval between Time 1 and Time 2 (4.5–6.5 months; \( n = 25 \)) did not differ from longer interval participants (6.8–11 months; \( n = 26 \)), except that shorter interval participants on average had higher FRI change scores (short interval: \( M = .31, SD = .91 \); long interval: \( M = -.30, SD = 1.0, p < .05 \)). Parents who provided data at Time 1, but were then lost to follow up, did not significantly differ from the parents included in this analysis in terms of age, household income, number of children, education, parenting stress, or FRI scores.

**Lower Time 1 parenting stress predicts improving family routines**

Our first hypothesis was that parents experiencing lower Time 1 role stress also would report more frequent family routines at Time 2 relative to their Time 1 baseline (FRI change). This hypothesis was largely supported. Parents reporting lower T1 total parenting stress reported more positive/less negative FRI change scores, \( b = -.19, p < .05 \). Parents reporting lower T1 difficult child, \( b = -.036, p < .05 \), and lower dysfunctional interactions, \( b = -.090, p < .01 \), also reported higher FRI change. Only parent distress showed no significant association with FRI change. These effects were not meaningfully diminished when sex, single-parent status, first child, months since school entry, and months between visits were included as covariates. Among these covariates, only months between visits was independently significant, with longer gaps predicting lower FRI-change scores. Regression coefficients for these models are displayed in Table 2. Differences in total stress between those with negative and positive FRI change scores (i.e., declining and strengthening family routines, respectively) are displayed in Figure 1a.

**Improving family routines predict stress biomarkers**

Our second hypothesis was that frequent family routines at Time 2 relative to a parent’s Time 1 baseline would predict lower values of stress-related biomarkers, including lower CRP, lower cortisol in the morning and evening, less variable cortisol from day to day at each time point, and a steeper diurnal slope. This hypothesis was supported with respect to evening cortisol and evening cortisol variability, and partially with respect to CRP. Regression coefficients are displayed in Table 3.

In the bivariate models, higher FRI-change scores significantly predicted lower PM cortisol, \( b = -.16, p < .05 \), and lower standard deviation in PM cortisol across 5 days, \( b = -.41, p < .05 \). Adding the covariates to these models did not diminish the magnitude or significance of the regression coefficients. Among the covariates, none were independently significant except single-parent status, which in the full model was associated with higher PM CORT STDV. Further, these effects were undiminished controlling for Time 1 cortisol.

While parents with higher FRI change had lower CRP values, this finding was not significant in the bivariate model, \( b = -.26, p = ns \). However, in the full model, the effect was larger and was significant, \( b = -.43, p < .05 \). Given the change in the effect size, in accordance with the modeling procedures described earlier, the full model was reduced using reverse stepwise selection. In the resulting model, only one covariate was retained (single-parent status; \( b = 2.0, p < .01 \)). The effect of FRI change diminished relative to the full model but remained significant, \( b = -.34, p < .05 \). The effect of FRI change diminished nearly to zero when controlling for Time 1 CRP, however.

Differences in PM CORT, PM CORT STDV, and CRP between those with negative and positive FRI-change scores are displayed in Figure 1b–d.

**Discussion**

Developmental transitions serve as natural experiments that unmask latent individual or family-level differences in both capacity to adapt and consequent biobehavioral functioning (Halfon & Hochstein, 2002). Child development researchers have
demonstrated repeatedly that individual differences in responses to kindergarten transition predict subsequent child well-being (e.g., Davis et al., 1999; Ladd & Burgess, 2001; Wildenger et al., 2008). Differential mental, behavioral, or physical health risk among adults similarly may be unmasked or induced during life-changing transitions such as marriage, having a child, entering the workforce, caring for a seriously ill child or parent, or retiring (Cox & Paley, 1997; Dura & Kiecolt-Glaser, 1991; Halfon & Hochstein, 2002). Yet adult and child developmental transitions are not separate domains: navigating children’s developmental pathways presents adaptive challenges for the entire family. Parents have an inherent (if variable) interest in their children’s psychosocial and physical well-being, and their everyday schedules, relationships, and responsibilities change whether children start kindergarten or college, undergo the transition into adolescence, or leave and re-enter the home (Cowan, 1991; Cox & Paley, 1997; Dennerstein, Dudley, & Guthrie, 2002; McClelland, 1995; Wildenger et al., 2008).

The present study highlights that the normative challenge of kindergarten entry also unmasks differences in adaptive capacities with implications for adult well-being. The ability to sustain or enhance meaningful family routines is neither universal nor invariant. The Family Routines Inventory assesses the frequency of a small subset of daily routines that have been rated among

| Time 1 total parenting stress | 71.55 | 60.18 |
| Time 2 log PM CORT | 0.26 | -0.58 | -0.48 | -0.16 | -0.41 | -0.023 |
| Time 2 log PM CORT STDV | -2.65 | -2.80 |
| Time 2 log CRP | -2.70 | 0.25 | 0.13 | 0.25 | 0.13 | 0.045 |

**Figure 1.** Among those with negative or positive FRI Change scores (declining or strengthening family routines, respectively), means and standard errors for (a) Time 1 Total Parenting Stress; (b) Time 2 7pm cortisol; (c) Time 2 7pm cortisol standard deviation; (d) Time 2 serum CRP. All physiological variables are log transformed.

**Table 3.** Models predicting Time 2 physiology from FRI change (residualized difference scores). Values represent unstandardized regression coefficients.

<table>
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<th>Model</th>
<th>CRP</th>
<th>AM CORT</th>
<th>AM CORT STDV</th>
<th>PM CORT</th>
<th>PM CORT STDV</th>
<th>CORT slope (p.m.–a.m.)</th>
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<td>-0.48</td>
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<td>-0.41</td>
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<td>0.093</td>
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<td>0.13</td>
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<td>0.077</td>
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<td>-0.044</td>
<td>-0.65</td>
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<td>Months since school entry</td>
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<td>-0.0073</td>
<td>-0.041</td>
<td>-0.085</td>
</tr>
<tr>
<td></td>
<td>Months between visits</td>
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<td>0.063</td>
<td>-0.040</td>
<td>-0.019</td>
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<tr>
<td></td>
<td>Wake time (hrs)</td>
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<td>Wake time STDV</td>
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<tr>
<td>3</td>
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<td>0.0093</td>
<td>-0.31</td>
<td>0.21</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>Single parent (1 = yes)</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>FRI change</td>
<td>-0.074</td>
<td>-0.045</td>
<td>-0.22</td>
<td>-0.17</td>
<td>-0.41</td>
</tr>
<tr>
<td></td>
<td>Time 1 physiology</td>
<td>0.75</td>
<td>0.27</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note. *p < .05; **p < .01; ***p < .001.
Americans as most important for “keeping the family strong.” Adults who reported the lowest levels of parenting stress at Time 1, especially low stress due to parent–child dysfunctional interactions, had higher FRI-change scores (less postkindergarten decline or a greater increase in the frequency of family routines relative to expectations based on that adult’s Time 1 baseline). Parenting stress is associated broadly with family functioning, including formation of and changes within family identity during periods of challenge (Deater-Deckard, 1998; Patterson & Garwick, 1994), and shared meaning is central to the protective effect of routines and to their institutionalization as “family rituals” (Boyce et al., 1983; Fiese et al., 2002). Hence, families experiencing dysfunctional interactions may find family routines less meaningful and reinforcing for family identity, reducing the incentive among parents or children to sustain routines in the face of challenges to the daily schedule.

Additionally, the more that FRI scores improved, or the less they declined, the lower were mean levels and day-to-day variance in evening adrenocortical arousal following kindergarten entry, even after controlling for physiological baselines: the prekindergarten cortisol mean or standard deviation. Although those with higher FRI-change scores also displayed lower systemic inflammation, this effect disappeared when controlling for baseline, suggesting that the individual differences in inflammation very likely predated kindergarten entry. In either case the design of the present study does not permit any assertion regarding the nature or direction of causal pathways linking family routines to physiology. However, these findings are consistent with our expectation that differences in the capacity to maintain family routines should be associated with broader differences in parental adaptation revealed by stress-related biomarkers. Further, while cortisol at any time of day is responsive to the psychosocial environment, evening cortisol is most acutely sensitive, whereas morning cortisol strongly reflects basal diurnal rhythms (Adam et al., 2006). Hence, it is not surprising that recent changes in daily routines were most strongly associated with multiday evening averages. Similarly, if low FRI-change scores reflect unstable routines, this should be evident first in evening rather than morning cortisol variation.

There is precedent for finding that the strength, meaningfulness, or sustainability of family routines are connected to adult well-being (Fiese et al., 1993; Sprunger et al., 1985; Weisner et al., 2005). If these findings are representative, transitions need not be life changing (such as birth of a child) to unmask differences in adaptation at the adult or family level. The sample was low-risk, with below-average parenting stress, high-average incomes and education levels, and generally healthy parents. The normative challenge was mild: entry into kindergarten for a child who already had attended preschool. Yet kindergarten entry is meaningful within Western and Westernized cultures, where primary school is an essential bridge to economic and social success for children even as it challenges adult routines. In protected environments, where adults are not coping with existential challenges such as hunger and personal safety but instead with complex scheduling demands, such a mild challenge may be all that is required to reveal meaningful variation in the sustainability of family routines with implications for adult biobehavioral development. Reciprocally, parental well-being, including mental health and relationship stress originating from inside and outside the home, influences child socioemotional development (Almeida, Wethington, & Chandler, 1999; Goodman & Gotlib, 1999). Thus, the developmental trajectories of children and adults are dynamically intertwined, and even within protected environments the baggage or resources that children carry into transitions such as kindergarten entry may include the effects of ongoing parental adaptation.

Limitations of the study
Our findings should be interpreted with caution until replicated, given several limitations. The sample was small, and the number of households from which it was drawn even smaller. While wake time was statistically controlled, some other potential confounders of adrenocortical activity or inflammation such as body mass index (BMI) and oral contraceptive use were not recorded. Routine users of steroid-based medications were not included in the sample; however, this was assessed only at enrollment and no complete list of medications was recorded, so other medications or short-term use of steroids could be an unmeasured confounder. No participant had such high CRP as to warrant exclusion based on likely current infection, but without detailed data on recent illness some of the variance still may have been infection-related. Finally, we cannot ascertain whether individual differences in biological risk were sustained beyond the early part of the kindergarten school year, nor can we preclude that physiological differences predated changes in family routines that accompanied the kindergarten transition, especially in the case of CRP.

Our findings notably cannot identify whether changing family routines mediate relations between parenting stress and cortisol or CRP. One possible interpretation, most plausible for the cortisol findings, links role stress among parents during kindergarten transition, especially if they have poor relations with the focal child, to increased difficulty in sustaining family routines during that challenge and consequent increases in physiological stress mediators. In the present sample we lack the statistical power to complete a robust test of mediation, however, and other plausible interpretations exist. For instance, Markson and Fiese (2000) found that family rituals moderated the effect of parenting stress on child asthma outcomes. Other potential confounds and moderators merit consideration, such as parenting styles, child behavior differences, family-level differences in the meaningfulness of routines, and school-related variables. Finally, the weak correlation in FRI-change scores among parents in the same household may indicate that individually variant perceptions are at least as important as the objective frequency or stability of family routines.

Conclusions
A well-established principle of ecological research paradigms is that children simultaneously shape and are shaped by their developmental contexts (Boyce et al., 1998; Bronfenbrenner & Ceci, 1994). In the same vein, parents both shape and are shaped by their children’s developmental transitions. Not all parents are equally equipped to adapt to changing schedules, roles and responsibilities as their children age. Biomarkers can help reveal the cumulative, internalized effects of these adaptive differences. Here, they identified relations among parenting stress, changing family routines, and stress physiology among parents during the mild ecological challenge of kindergarten entry. As such, the findings encourage an expansion in the scope of inquiry surrounding child-focused developmental transitions, toward attention to social systems such as families and an integrated life course approach to human development.
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References


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