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## Quality in home-based childcare : Impact and improvement

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## Caregivers' cortisol levels and perceived stress in home-based and center-based childcare

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### ABSTRACT

The current study examined professional caregivers' perceived and physiological stress, and associations with the quality of care they provide. Participants were 55 female caregivers from childcare homes and 46 female caregivers from childcare centers. In both types of settings equivalent measures and procedures were used. On non-work days, caregivers' salivary cortisol levels decreased between 11 AM and 3 PM, whereas on work days caregivers' cortisol levels remained at the same level during this period. Caregivers' cortisol levels and perceived stress did not differ across the two types of settings. In home-based childcare, caregivers offered higher-quality caregiving, compared to caregivers in center-based childcare. Caregivers' negative appraisal in home-based childcare –but not in center care– was associated with less positive caregiver behavior. These findings suggest that work at childcare influences cortisol secretion in professional caregivers, and that perceived stress but not cortisol is associated with quality of care.

*Keywords: caregiver behavior, childcare, cortisol, perceived stress, professional caregivers*

### INTRODUCTION

Work-related stress has been shown to negatively affect employees' physical and psychological wellbeing. Employees who experienced more stress during work reported more health complaints, fatigue, and negative moods (Äkerstedt et al., 2004; Repetti, 1993). Stress can also affect behavioral responses. At days when reported workload was higher, mothers showed more behavioral and emotional withdrawal during reunion with their children (Repetti & Wood, 1997). For professional caregivers in childcare (hereafter: caregivers), potential stress in the work situation is inextricably connected to interacting with a group of children. Our aim is to examine caregivers' stress and associations with the quality of care they provide.

Perceived stress is generally measured as a global feeling of stress, for example over the last month, or as a context-specific feeling of stress related to a specific

moment. Physiological stress can be measured by collecting salivary cortisol. Hypothalamic-pituitary-adrenal (HPA)-axis activation, which is triggered by physiological stress, results in elevations of cortisol. During acute stress, cortisol is essential to cognitive performance and the immune response (increase of natural-killer cell activity and the numbers of some types of leukocytes), but chronic exposure to stress can have a negative effect on brain function and immune response (decrease of the number and activity of natural-killer cells) (Eigenbaum, Otto, & Cohen, 1992; Glaser & Kiecolt-Glaser, 2005; Segerstrom & Miller, 2004).

Normally, cortisol levels peak about half an hour after waking up and gradually reach their lowest point around midnight (Kirschbaum & Hellhammer, 1994). Cortisol levels may vary not only within days (diurnal patterns), but also across days. Schlotz, Hellhammer, Schultz, and Stone (2004), for instance, found that participants who reported higher levels of chronic work overload and worrying showed a stronger increase and higher cortisol levels after awakening on weekdays but not on weekend days. Therefore, we collected caregivers' salivary cortisol during a work day and a non-work day.

Furthermore, we tested whether (perceived and physiological) stress was associated with the quality of care caregivers provide. The core feature of quality of care is sensitive caregiving behavior. Children cared for by highly sensitive caregivers are more often securely attached to their caregiver than children cared for by less sensitive caregivers. Securely attached children use caregivers as a secure base and seek comfort from them (Goossens & Van IJzendoorn, 1990). Sensitive caregiving is not only beneficial for children's social-emotional development, but also for their cognitive development. Peisner-Feinberg et al. (2001) for instance showed that closeness of caregiver-child relationships in childcare was related to children's cognitive and social skills.

Stress may negatively affect caregiving behavior. Studies on associations between stress and caregiver behavior have mainly focused on parenting and care-giving of adults with a chronic disease. As for parents, Belsky, Crnic, and Woodworth (1995) found that daily hassles mediated the effect of mother's neuroticism on her sensitivity and expression of negative effect to her toddler. Also, reported maternal stress has been associated with less positive and more conflictive mother-child interaction (Crnic, Gaze, & Hoffman, 2005), more maternal depression, and a higher frequency of spanking (Coyle, Roggman, Newland, 2002). In a meta-analysis, it was found that caregivers of a parent or spouse with dementia had a 23% higher level of stress hormones than non-caregivers (matched on age and sex) (Vitaliano, Zhang, & Scanlan, 2005). Besides higher cortisol levels, it has been reported that these caregivers experience adverse psychological and physiological consequences (Baumgarten et al. 1992; Son Erno, Shea, Femia, Zarit, & Stephens, 2007; Wright, Hickey, Buckwalter, Hendrix, & Kelechi, 1999).

Three studies examined caregiver stress in the context of childcare. Atkinson (1992) reported that mothers working in home-based childcare reported higher stress levels than either mothers employed outside the home or non-employed mothers. Kontos and Riesen (1993) found that caregivers who experienced more

job stress perceived less social support than caregivers who experienced less job stress. In this home-based study, no association was present between job stress and reported childrearing values. Only one study examined associations between caregiver cortisol and quality of care. De Schipper, Riksen-Walraven, Geurts, and De Weerth (2009) reported that lower-quality caregiver behavior in childcare centers was predicted by caregivers' higher cortisol levels and reports of higher physical workload. In this pioneering study the authors measured cortisol only during the morning at childcare, which makes it impossible to examine changes in cortisol throughout the day.

In the study reported here, we measured caregivers' cortisol at four times during a work day and a non-work day. We included caregivers from home-based and center-based childcare in order to extend the variety in caregiver behavior and perceived stress. Howes (1983) reported that caregivers in home-based childcare spent more time with the children than caregivers in center-based childcare. Furthermore, home-based childcare was characterized by more stable child-caregiver relationships. In the Netherlands, fewer children are present and caregiver-child ratios are more favourable in home-based childcare than in center-based childcare. These variations in structural features across home-based childcare and center-based childcare may contribute to individual differences in caregiver stress levels. Due to the larger groups, caregivers in center-based childcare might be more stressed than caregivers in home-based childcare.

It is expected that caregivers who are more stressed offer lower-quality caregiver behavior. Caregivers' working hours may moderate this association. In a study of Eller, Netterstrøm, and Hansen (2006), a rise in cortisol levels during the working day was shown in women who worked more than 37 hours per week, whereas a decrease in cortisol levels was found in women who worked less than 37 hours per week.

In the current study, four questions are central: (1) Do caregivers' cortisol levels differ between a work day and a non-work day? (2) Do caregiver (physiological and perceived) stress and caregiver behavior differ across home-based childcare and center-based childcare? (3) Do associations exist between (physiological and perceived) stress indices and caregiver behavior? and (4) Does the number of working hours moderate associations between (physiological and perceived) stress and caregiver behavior?

We hypothesize that cortisol levels are higher on a work day compared to a non-work day. Because of more favorable aspects of home-based childcare (less children, more home-like environment) we expect higher-quality caregiver behavior and lower (physiological and perceived) stress in caregivers in home-based childcare, compared to caregivers in center-based childcare. Higher perceived stress and higher cortisol levels will be associated with lower-quality caregiver behavior. Finally, we hypothesize that caregivers who work more hours per week show higher-quality caregiver behavior when they are less stressed (compared to caregivers with less working hours), but that caregivers who work more hours per week show lower-quality caregiver behavior when they are more stressed (for so many hours per week).

## METHOD

*Participants*

Hundred-and-one female caregivers participated in this study: 46 caregivers from childcare centers and 55 caregivers from home-based childcare. Similar recruitment strategies were used in both childcare settings. From national samples 250 childcare centers and 147 home-based childcare organizations were randomly selected. Directors of 26 centers and 21 home-based childcare organizations agreed to participate in the study. In center-based childcare, one group per center was randomly selected which resulted in a total of 46 caregivers. In home-based childcare, 110 caregivers agreed to participate, from which 55 caregivers received permission of the parents of all children for the videotaped episodes

The low participation rate can be attributed to the following reasons: (1) childcare providers felt uncomfortable with video recordings, (2) childcare providers disliked the idea of saliva sampling, and (3) disappointing results indicating low-quality of center care in the Netherlands had just been published (Vermeer et al. 2008).

Demographic information is summarized in Table 3.1. Caregiver-child ratios differed significantly between the two types of settings, and were in favor of childcare homes ( $t(99) = -9.77, p < .01, d = -1.70$ ). In home-based care, one caregiver was on average responsible for almost three children, whereas in center-based care one caregiver was responsible for more than five children. In centers, the number of caregivers per group varied from one to three ( $M = 2.02, SD = 0.46$ ). In home-based childcare, eleven of the caregivers (20%) took care of their own child beyond the guest children. Mean ages of caregivers differed significantly between the two settings: Caregivers in home-based childcare were significantly older than caregivers in center-based childcare ( $t(76) = 7.73, p < .01, d = 1.83$ ). Caregiver education, which was coded as the number of years of education after primary school entry (from age six), was comparable across settings. The nationality of almost all caregivers was Dutch (in home-based childcare 90.9%; in center-based childcare 97.8%).

Table 3.1  
*Information on childcare settings and subject demographics*

Characteristics	Centers		Home-based	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Childcare settings	<i>(n = 26)</i>		<i>(n = 55)</i>	
Group size	10.88	2.70	2.88**	1.45
Caregiver-child ratio	1 : 5.35	1.52	1 : 2.88**	1.45
Caregivers	<i>(n = 46)</i>		<i>(n = 55)</i>	
Age	28.97	7.31	44.30**	9.30
Education (years)	12.87	1.41	12.34	2.08
Experience (years)	7.19	5.56	8.49	7.26
Working hours per week	31.09	12.99	28.05	7.25

\*  $p < .01$ , \*\* $p < .01$

### Procedure

Data collection took place in 2006-2007. All procedures were carried out with adequate understanding and written consent of caregivers and parents. Ethical approval for this study was provided by the Leiden Institute of Education and Child Studies. Each setting was visited once by an observer who videotaped three different 10-minute episodes at predetermined time points for each caregiver. Caregivers collected their saliva four times during a work day (including two measures at home) and four times during a non-work day. In addition, they were asked to complete a questionnaire about daily schedules, the use of medicine, illnesses, and food on the collection days.

A few weeks after the observation, caregivers were sent questionnaires concerning their perceived stress during the last month. Video-taped episodes were rated afterwards by coders who met the criteria to reliably assess these scales. To obtain independency in ratings, observers who visited a childcare setting did not rate caregiver sensitivity or talking and explaining for that particular setting, and none of the coders rated both scales.

### Measures

**Cortisol levels.** Caregivers' stress levels were assessed by measuring their salivary cortisol levels, using cellulose-cotton tip sorbettes (Strazdins et al., 2005), at four time points during one work day and one non-work day: immediately after awakening, at 11 AM, at 3 PM and just before dinner (around 6 PM). Caregivers were mailed sampling kits including the material needed for collection and detailed written instruction how to obtain the samples. During the work day, 11 AM and 3 PM sampling took place at childcare. Mean cortisol sampling times on the non-work day were 07:49 AM ( $SD = 00:57$ ), 11:11 AM ( $SD = 00:27$ ), 03:19 PM ( $SD = 00:36$ ), and 06:20 PM ( $SD = 00:38$ ). Mean cortisol sampling times on the work day were 06:56 AM ( $SD = 00:33$ ), 11 AM ( $SD = 00:04$ ), 03:06 PM ( $SD = 00:17$ ), and 06:31 PM ( $SD = 00:44$ ). Correlational analyses revealed one significant association between mean cortisol sampling time and cortisol values within these time points (6 PM non-work day;  $r = 0.31$ ,  $p < .01$ ); the other cortisol values were not significantly associated with sampling times. Cortisol sampling time since awakening and hours of sleep on the collection day were not significantly associated with cortisol levels. Ten percent of the caregivers reported that they were feeling unwell (e.g., having a cold) on the non-work day, compared to 12.9% of the caregivers on the work day. Mean cortisol levels did not differ between the group of healthy caregivers and the group of caregivers feeling unwell, neither on the work day nor on the non-work day. In total, 21.7% of the caregivers reported the use of medicine on the non-work day, compared to 19.8% of the caregivers on the work day. Mean cortisol levels differed between the two groups for the collection at 6 PM on the non-work day only: Cortisol levels of caregivers who reported the use of medicine were lower than cortisol levels of caregivers who did not report the use of medicine ( $t(70) = -2.16$ ,  $p < .05$ ,  $d = 0.57$ ). For this reason, we controlled for the use of medicine when comparing diurnal cortisol patterns (including the 6 PM measure) during a non-work and a work day.

Caregivers mouthed the sorbette under the tongue for at least 1 minute. Once the sorbette was saturated, it was placed in a 2-ml plastic cryovial and sealed. Samples were stored at  $-18^{\circ}\text{C}$  until being assayed by the Research Center for Psychobiology at the University of Trier. Caregivers returned cortisol samples by mail, which should not affect cortisol levels (Kirschbaum & Hellhammer, 1994).

As for the saliva sampling protocol, all caregivers were mailed detailed written instruction how to obtain the samples. Caregivers were explained how important it is to have “clean” saliva before sampling, e.g. they were not allowed to eat or drink or brush their teeth at least 30 minutes before sampling. During the work day, the observer (who videotaped caregiver behavior, see below) was present to assist with the procedure, if necessary. To increase compliance in collecting cortisol samples, research staff telephoned caregivers the day before the observation day to remind them of the collection. Cryovials were labelled beforehand, so caregivers only had to note the exact time they collected their saliva in a pre-printed table.

Cortisol was assayed using a time-resolved fluorescence immunoassay. The intra-assay coefficient of variation of this immunoassay was between 4.0% and 6.7%, and the corresponding inter-assay coefficients of variation were between 7.1% and 9.0%. Samples were run in duplicate and mean values were calculated for each sample. The detection limit for cortisol ranged from 0.1 to 100 nmol/L. More than 99% of salivary cortisol measures were within this assay detection limit. Samples lower than 0.1 nmol/L and higher than 100 nmol/L were coded as missing because of their impossible values. In total 19% of the saliva samples were not mailed by caregivers to the laboratory. Missing samples were imputed (using maximum likelihood estimation) for caregivers who had only one missing sample per day. In the analyses of within-subjects differences between cortisol levels on a work day and a non-work day 71 complete sample sets were used. On a work day, saliva samples were available from 77 caregivers. No significant differences were present in perceived stress or caregiver behavior between caregivers with and without missing cortisol samples.

*Perceived stress.* Caregiver perceived stress was assessed with two self-report questionnaires measuring work related stress (workload) and stress related to the caregiver’s life in general (negative appraisal). Workload was measured by a subscale of the Trier Inventory for the Assessment of Chronic Stress (TICS; Schulz & Schlotz, 1999; Dutch translation by De Vries, 1999) consisting of 13 items on a 5-point rating scale, ranging from 1 (never) to 5 (very often). Negative appraisal was measured by the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983; Dutch translation by De Vries, 1998). Responses on the 14 items are given on a 4-point scale ranging from 1 (never) to 4 (always). Internal consistencies (Cronbach’s alpha’s) of workload and negative appraisal were 0.88 and 0.83, respectively.

*Caregiver behavior.* Caregiver behavior in the group setting was examined by means of two rating scales developed and validated by the Dutch Consortium for Child Care Research (NCKO; De Kruijf et al., 2007): caregiver sensitivity and talking and explaining. The caregiver sensitivity rating scale is based on scales developed to measure sensitivity in a parent-child context (Ainsworth,

Bell, & Stayton, 1974; Erickson, Sroufe, & Egeland, 1985), and was adjusted for group settings by the NCKO. Scoring was based on three video-fragments of ten minutes, each taped during the observation day at childcare. Sensitivity ratings are presented on a seven-point scale, ranging from (1) very low to (7) very high. Caregivers scoring high on this scale provide emotional support to all children who need this support, both during stressful and non-stressful situations. Caregivers scoring low on this scale do not succeed in providing emotional support to children when they need it. In a Dutch study, the Caregiver Interaction Scale (Arnett, 1989) was positively correlated ( $r = 0.48$ ,  $p < .01$ ) with this sensitivity scale (De Kruif et al., 2007).

The caregiver talking and explaining scale covers the verbal interactions between caregiver and children in a group setting, in which frequency, style and content play an important role (based on Harms, Cryer, & Clifford, 2003; McWilliam, Zulli, & De Kruif, 1998). Scoring of talking and explaining was based on the same three video-fragments of ten minutes. Ratings are on a seven-point scale, ranging from very low (1) to very high (7).

Seven observers were trained on the same dataset to reliably assess caregiver behavior. Mean intra-class correlations (two-way mixed, absolute agreement) were 0.75 (range 0.72 to 0.80) for caregiver sensitivity and 0.83 (range 0.76 to 0.88) for talking and explaining. Internal consistencies (Cronbach's alpha's) were 0.81 and 0.77, respectively. To create an overall caregiver behavior composite score, ratings of both scales were combined by standardizing the mean scores and calculating the sum of these scores. Internal consistency of the combined scale of caregiver behavior was 0.86.

#### *Data analysis*

Distributions of cortisol measurements were positively skewed, therefore  $\log_{10}$  transformations were used for analysis. Cortisol diurnal patterns were analyzed in two ways: (1) cortisol levels on the four time points and (2) mean ratios of cortisol diurnal change (*RDC*). To examine differences in caregivers' cortisol levels across the two days and the two types of care, a MANOVA with repeated measures (caregivers' cortisol levels at four time points) was performed.

To answer the second research question (differences in stress and caregiver behavior during work between the two types of care), we calculated the *RDC*. This mean ratio of cortisol change on a work day ( $RDC_w$ ) and on a non-work day ( $RDC_{nw}$ ) was defined as the diurnal change between 11 AM and 3 PM, controlled for the measurement at 11 AM ( $\Delta\text{cortisol} / 11 \text{ AM}$ ). A constant of 1 was added to the computed *RDC* in order to make  $\log_{10}$  transformation possible and to avoid negative values. In childcare research, measurements during the mid-morning (11 AM) and the mid-afternoon (3 PM) are frequently used to represent changes in cortisol patterns (for a review see Vermeer & Van IJzendoorn, 2008). In our study, we used the *RDC* as an index of an increase (positive number) or a decrease (negative number) of caregivers' cortisol levels during work. In this analysis, the morning (7 AM) and evening (6 PM) measurements were excluded, since these were not administered during work.

Cortisol measures and *RDC* were inspected for outliers, which were defined as values with *SD* greater than 3.29 above the mean. By means of winsorizing, outliers were made equal to the most extreme value that was accurately measured (Tabachnick & Fidell, 1996). Because caregivers in home-based childcare were significantly older than caregivers in center-based childcare, we controlled for age before analyzing differences between the two types of care.

Due to substantial differences between the two types of care, correlations for stress indices and caregiver behavior were calculated for each type of care separately, to avoid artificial associations. Next, multiple regression analyses were performed to test whether stress indices predicted caregiver behavior (research question 3). In these hierarchical regression analyses, type of care was added in the first step to control for differences between the two types of care. Finally, we tested whether the number of hours working in childcare served as a moderator between stress indices and caregiver behavior (research question 4).

## RESULTS

### *Diurnal cortisol on a work day and a non-work day*

In Figure 3.1 caregivers' (untransformed) cortisol values are shown of caregivers during a work day and a non-work day. After log-transforming, analyses of cortisol levels were performed using a 2 (Context: work day versus non-work day) by 4 (Time of day) by 2 (Type of care) MANCOVA with repeated measures, controlled for the use of medicine during at least one of the collection days. There was a significant main effect of time of day, demonstrating declining cortisol levels throughout the day (*Pillais F* (3, 66) = 66.37,  $p < .001$ ,  $\eta^2 = 0.75$ ), confirming the daily cortisol curve. Although no main effect of context emerged (*Pillais F* (1, 68) = 1.23,  $p = .27$ ,  $\eta^2 = 0.02$ ), a significant interaction effect of context by time was present (*Pillais F* (3, 66) = 3.63,  $p < .05$ ,  $\eta^2 = 0.14$ ). There was a significant difference in caregivers' cortisol levels at 11 AM: cortisol levels at 11 AM were higher during a non-work day ( $M = 4.91$ ,  $SD = 3.20$ ), compared to a work day ( $M = 3.80$ ,  $SD = 2.68$ ,  $t$  (70) = -2.93,  $p < .01$ ,  $d = 0.42$ ). Figure 3.1 shows that cortisol levels remained at the same level between 11 AM and 3 PM on a work day and decreased during a non-work day. Analyses using ratios of diurnal change indeed showed that (transformed) *RDC* differed across the two contexts (non-work day  $M = -0.11$ ,  $SD = 0.91$ ; work day  $M = 0.24$ ,  $SD = 1.54$ ),  $t$  (70) = -2.46,  $p < .05$ ,  $d = 0.39$ ). There was no main effect of type of care (*Pillais F* (1, 68) = 0.15,  $p = .70$ ,  $\eta^2 = 0.00$ ). No interaction with type of care was present either (*Pillais F* (3, 65) = 0.21,  $p = .89$ ,  $\eta^2 = 0.00$ ).

### *Differences between caregivers across type of care*

*Physiological stress.* Caregiver  $RDC_w$  did not differ significantly across both types of care ( $t$  (75) = 1.53,  $p = .13$ ,  $d = 0.42$ ). This was also true when we controlled for age ( $F$  (1, 66) = 1.01,  $p = .32$ ).

*Perceived stress.* Caregivers in center-based childcare reported higher workload ( $M = 2.19$ ,  $SD = 0.47$ ) and higher negative appraisal ( $M = 2.36$ ,  $SD = 0.37$ ) compared to caregivers in home-based childcare (workload  $M = 1.80$ ,  $SD = 0.61$ ,  $t$  (99) = -3.60,  $p < .01$ ,  $d = 0.73$ ; appraisal  $M = 2.11$ ,  $SD = 0.47$ ,  $t$  (99) = -2.90,  $p < .01$ ,  $d =$

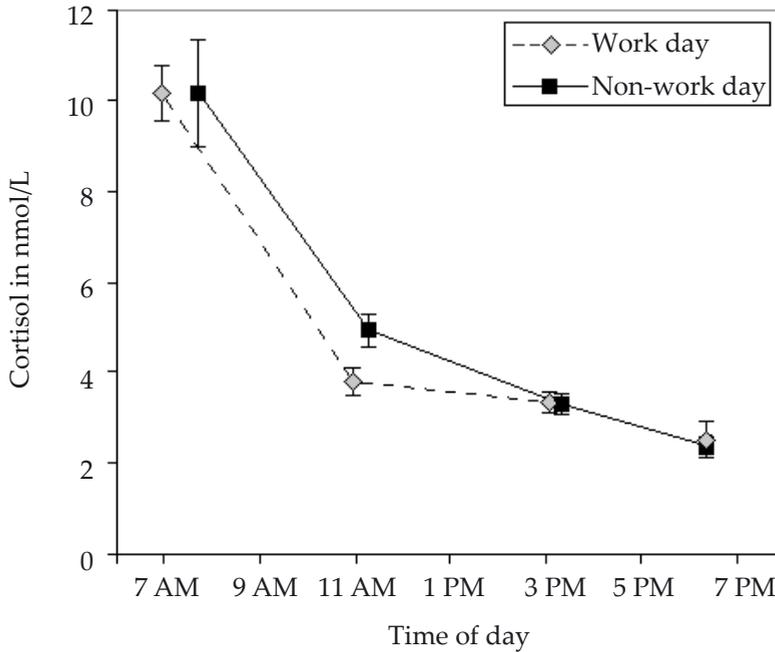


Figure 3.1. Caregivers' cortisol levels (in nmol/L) during a non-work day and a work day ( $n = 71$ )

0.58). However, after controlling for age, both types of perceived stress were no longer significantly different across type of care (workload  $F(1, 78) = 1.50, p = .23$ ; appraisal  $F(1, 78) = 1.65, p = .20$ ).

*Caregiver behavior.* The composite score of caregiver behavior was higher in home-based childcare ( $M = 0.84, SD = 1.61$ ) than in center-based childcare ( $M = -1.01, SD = 1.67; t(99) = 5.66, p < .01, d = 1.14$ ), indicating that caregivers in home-based childcare showed higher-quality caregiving behavior than caregivers in center-based care. This effect remained significant after controlling for age ( $F(1, 78) = 5.82, p < .05$ ).

A binary logistic regression for type of care was performed, controlling for caregiver age. Type of care was significantly predicted from caregiver age ( $B = -0.26, S.E. = 0.06, Wald = 17.51, Exp(B) = 0.77, p < .01, R^2 = 0.76$ ). Stress indices and caregiver behavior did not significantly add to this prediction. Due to the differences across the two types of care, data from caregivers in home-based childcare and caregivers in center-based childcare were analyzed separately in the next section.

#### *Correlations between stress, caregiver behavior, and background variables*

In Table 3.2 Pearson correlations are shown between background variables, stress indices, and caregiver behavior. In center-based childcare, one significant association was present, namely between negative appraisal and working hours ( $r = -0.37, p < .05$ ): Caregivers who perceived more stress in their lives, worked less

hours per week in childcare centers. This negative association was also present in home-based childcare ( $r = -0.29, p < .05$ ).

For home-based childcare, a significant positive association was present between  $RDC_w$  and both types of perceived stress (workload;  $r = 0.30, p < .05$ ; negative appraisal;  $r = 0.30, p < .05$ ). To further examine this association, we dichotomized the perceived stress scales using a median-split procedure (median workload at 1.77, median negative appraisal at 2.07). In Figures 3.2a and 3.2b, cortisol patterns are shown of caregivers reporting lower perceived stress versus higher perceived stress. Caregivers' cortisol levels during the work day decreased when reporting lower workload or lower negative appraisal, whereas caregivers' cortisol levels slightly increased when reporting higher workload or higher negative appraisal. For caregivers in center-based childcare, no significant associations were present between perceived stress and physiological stress levels.

For home-based childcare, a negative association was present between negative appraisal and caregiver behavior ( $r = -0.30, p < .05$ ): Caregivers who perceived more stress in their lives showed lower-quality caregiver behavior. There was no significant association between  $RDC_w$  and caregiver behavior in either type of care.

Table 3.2

*Pearson correlations between working hours, stress indices, and caregiver behavior*

	1.	2.	3.	4.	5.
1. Working hours		-0.18	-0.20	-0.37*	-0.01
2. $RDC_w$	-0.16		0.18	0.03	0.10
3. Workload	-0.20	0.30*		0.16	0.03
4. Negative appraisal	-0.29*	0.30*	0.57**		-0.13
5. Caregiver behavior	-0.15	-0.04	-0.25	-0.30*	

\*  $p < .05$ , \*\*  $p < .01$

*Note.* Correlations within the home-based childcare sample are displayed below the diagonal and correlations within the center childcare sample are displayed above the diagonal.

#### *Predictors of caregiver behavior*

A multivariate regression analysis was performed to test whether stress predicted caregiver behavior, after working hours had been accounted for. Type of care was added in the first step to control for differences between the two types of care. In the second step, working hours were added, followed by the stress indices in the third step. Results are displayed in Table 3.3.

As expected, type of care significantly added to the prediction of caregiver behavior ( $\beta = -0.46, p < .01$ ). Controlled for working hours, only negative appraisal had a significant additional negative association with caregiver behavior ( $\beta = -0.33, p < .05$ ).

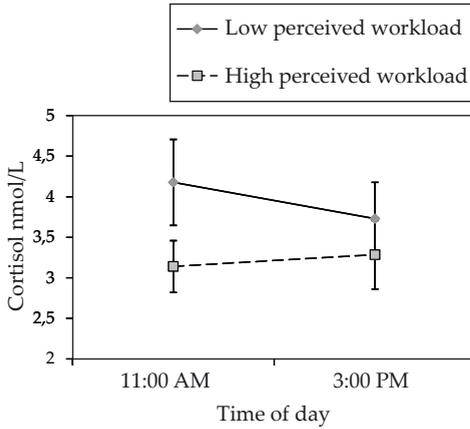


Figure 3.2a  
Caregivers' cortisol levels (in nmol/L) in childcare homes with low perceived workload ( $n = 23$ ) and high perceived workload ( $n = 22$ )

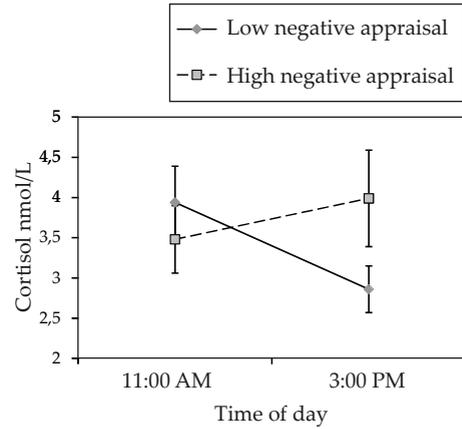


Figure 3.2b  
Caregivers' cortisol levels (in nmol/L) in childcare homes with low negative appraisal ( $n = 19$ ) and high negative appraisal ( $n = 26$ )

Table 3.3  
Hierarchical regression in predicting caregiver behavior

	<i>B</i>	<i>SEB</i>	$\beta$	$R^2$
Step 1				0.21**
Type of care	-1.87	0.45	-0.46**	
Step 2				0.21**
Working hours	0.01	0.02	0.03	
Step 3				0.29**
<i>RDC<sub>w</sub></i>	0.45	0.69	0.07	
Workload	0.15	0.54	0.04	
Negative appraisal	-1.76	0.81	-0.33*	

\*  $p < .05$ , \*\*  $p < .01$

*Moderator models*

In order to test the moderator models of caregiver behavior, we performed linear regression analyses predicting caregiver behavior including the interaction between stress indices (workload, appraisal,  $RDC_w$ ) and working hours after controlling for caregiver age and the main effects of the predictors in each type of care. Before testing the moderator effects, all variables were centered. None of the regression analyses showed a significant interaction effect in addition to main effects; the effects of stress on caregiver behavior were not moderated by caregivers' working hours.

## DISCUSSION

Caregivers' cortisol levels differed between a non-work day and a work day, but only during the morning: Cortisol levels at 11 AM were higher during a non-work day, compared to a work day. Also, cortisol levels decreased between 11 AM and 3 PM during a non-work day, and remained at the same level on a work day. These results suggest that work at childcare influences cortisol levels in caregivers.

### *Cortisol on a non-work day and a work day*

How can differences in morning cortisol across a non-work day and a work day be explained? Although time since awakening, hours of sleep, and mean time points of collecting cortisol slightly differed across a non-work day and a work day, no significant associations were present with cortisol levels. Also, the number of children present and caregiver-child ratio were not associated with caregivers' cortisol levels, and caregivers did not report more stressful events during the non-work day than during the work day. Rather than differences in caregivers' daily activities between a work day and a non-work day, it seems more likely that the relative lower cortisol levels during the morning at childcare reflect specific demands of the childcare context.

A possible explanation of the lower cortisol levels during a work day, compared to a non-work day, is suppression. Suppression might be particularly noticeable during the morning when cortisol levels are normally high. Caplan, Cobb, and French (1979) found that white collar workers who reported low workload showed the expected decrease in cortisol from morning to afternoon, while workers who reported high workload showed lower morning cortisol levels and an increase in cortisol during the mid-afternoon. These authors hypothesized that chronic stress was examined, rather than acute stress. During chronic stress, down-regulation in cortisol would be adaptive. A recent meta-analysis has shown that acute stressors elicited greater cortisol changes than chronic stressors in natural settings (Michaud, Matheson, Kelly, & Anisman, 2008). Caregivers' work might cause chronic stress as well, with hyporegulated cortisol during the morning anticipating a strenuous day at work. However, we can only speculate on this because no data are available on caregivers' chronic stress. To examine the stability of the lower cortisol levels at 11 AM during a work day, compared to a non-work day, cortisol samples should be collected on more than one day.

### *Home-based childcare and center-based childcare*

Cortisol levels were comparable across the two types of care. Although caregivers in center-based childcare reported higher workload and more negative appraisal than caregivers in home-based childcare, this difference could be accounted for by caregiver age. Because caregiver age and type of care are interrelated, it is unclear whether caregiver age or type of care is responsible for these differences. As was expected, the quality of caregiver behavior was higher in home-based childcare than in center-based childcare, even after controlling for caregiver age.

### *Stress and quality of care*

In home-based childcare, caregivers who reported more negative appraisal in their lives showed lower-quality caregiver behavior. This is consistent with findings in parents, where perceived stress has been found to negatively affect parenting (Belsky et al., 1995; Coyl et al., 2002; Crnic et al., 2005). No significant associations were found between quality of care and cortisol or perceived stress. Other variables might be involved in this association. For instance, Van IJzendoorn, Bakermans-Kranenburg, and Mesman (2008) reported that daily hassles led to less sensitive parenting, but only in mothers who have a particular genetic makeup (with a *DRD4-7R* and a *COMT* val allele).

### *Working hours*

We found an association between negative appraisal and working hours in both types of care: Caregivers who perceived more stress in their lives, worked less hours per week. A possible explanation is that caregivers who perceive more stress might not be able to manage as many working hours per week as caregivers who perceive less stress. Working hours was not related to quality of caregiver behavior and did not moderate the association between caregiver stress and caregiver behavior.

### *Limitations*

As we already briefly discussed, a limitation of this study is the sampling of cortisol on only one non-work and one work day. As cortisol levels may vary from day to day, caution is required when drawing conclusions relating individual differences in quality of care to variations in cortisol levels. It should be noted however that the one-day sampling does not affect comparisons across types of childcare. Also, the use of an electronic monitoring device would enhance the reliability of cortisol measurements (Kudielka, Broderick, & Kirschbaum, 2003).

### *Conclusion*

Results show that caregivers' cortisol levels differed between a work and a non-work day, irrespective of type of childcare. Caregivers showed lower cortisol levels during the mid-morning on a work day in childcare, compared to a non-work day. Cortisol levels decreased from morning to afternoon on a non-work day at home, but remained stable at childcare. Even caregivers in home-based childcare—who reported less stress and took care of fewer children—showed this cortisol patterning. Our data suggest that caregivers' perceived stress in home-based childcare is an important determinant of quality of care. This study confirms the impact of work on basic hormonal indices of stress in caregivers. Reduction of caregivers' stress is an important focus for the improvement of childcare quality, and, eventually, may positively contribute to children's development.

