Quality in home-based childcare : Impact and improvement

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2 Children's wellbeing and cortisol levels in home-based and center-based childcare

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Abstract

The central question in this study is whether individual variability in children's cortisol levels and wellbeing at childcare can be explained by indices of quality of care and child characteristics. Participants were 71 children from childcare homes and 45 children from childcare centers in the age range of 20–40 months. In both types of settings equivalent measures and procedures were used. In home-based childcare, children experienced higher caregiver sensitivity, lower noise levels, and showed higher wellbeing compared to children in childcare centers. Caregiver sensitivity in home-based childcare – but not in center care – was positively associated with children's wellbeing. Additionally, children displayed higher cortisol levels at childcare than at home, irrespective of type of care. In home-based childcare, lower caregiver sensitivity was associated with higher total production of salivary cortisol during the day. In center-based childcare, lower global quality of care was associated with a rise in cortisol between 11 AM and 3 PM during the day. Quality of care is an important factor in young children's wellbeing and HPA stress reactivity.

Keywords: home-based childcare, center-based childcare, salivary cortisol, wellbeing, quality of care, caregiver sensitivity

Introduction

In the Netherlands, the number of children visiting childcare has been increasing rapidly. This increase encompasses both center-based childcare, with large groups of children with more than one caregiver present, and home-based childcare, with less children and one caregiver present. In the out-of-home environment as well as in the home environment, caregivers and parents strive to make children feel at ease to explore the environment and to provide opportunities for cognitive and social-emotional development. In our view, providing children with a feeling of security is one of the most fundamental aspects of all types of childcare. In the present study, the children's feeling of security in childcare is operationalized in two different ways: We focus on both their social-emotional wellbeing and their stress levels as indexed by their cortisol production during a day at childcare.

Meta-analytic results have shown that children in childcare centers display higher cortisol levels during a day in childcare than during a day at home (Geoffroy, Côté, Parent, & Séguin, 2006; Vermeer & Van IJzendoorn, 2006). Cortisol is a well known stress hormone which in humans is the final product of the hypothalamic-pituitary-adrenal (HPA) axis. Cortisol can be measured from urine, plasma, and saliva. Salivary measurement is preferred in children because it is a practical, reliable, and noninvasive approach (Shimada, Takahashi, Ohkawa, Segawa, & Higurashi, 1995). Normally, cortisol levels peak about half an hour after waking up and gradually reach their lowest point around midnight (Kirschbaum & Hellhammer, 1994). In childcare centers however, diurnal patterns revealed significant increases from morning to afternoon (Vermeer & Van IJzendoorn, 2006). For the same children, these patterns were not observed during a day at home.

Although stress responses are necessary for survival, long-term stressors are assumed to have a negative influence on the development of children (Gunnar & Donzella, 2002). The hormones secreted by the adrenal cortex are essential to cognitive performance and improve the immune response by increasing the natural-killer cell activity and the numbers of some types of leukocytes (Segerstrom & Miller, 2004). However, when there is chronic exposure to stress the effects of these hormones can change from adaptive into maladaptive (De Kloet, Oitzl, & Joëls, 1999). In adults, stress may affect brain function, especially of the hippocampus, which is important for verbal memory and memory of the context of experiences (Eigenbaum, Otto, & Cohen, 1992). Furthermore, long-term stressors decrease the immune response by decreasing the number and activity of natural-killer cells (Glaser & Kiecolt-Glaser, 2005). Possible long-term impacts of stressors on the developing brain and the endocrine and immune system of young children have not yet been thoroughly studied. Also, it is still unclear what elements in the childcare environment may activate the HPA axis in children.

Childcare quality

Although cortisol levels have been reported to increase in childcare, we do not know yet what the underlying mechanisms are for these elevated cortisol levels. It is assumed that both childcare quality and child characteristics may contribute to individual differences in children's cortisol levels. As for childcare quality, structural features of childcare are assumed to influence children's cortisol levels and wellbeing. Legendre (2003) for instance showed that cortisol increases were related to large group sizes ($n > 15$), large age differences among children within the group (> 6 months), less available area per child in the playrooms (< 5 m^2), and large numbers of adults in the room (> 4 adults). The children's actual experiences in childcare (process quality) may also influence their cortisol levels. The children in most studies included in the Vermeer and Van IJzendoorn meta-analysis (2006) were recruited from high-quality centers, resulting in a rather homogeneous group which did not allow an analysis of variations in quality. However, results from studies in which children's cortisol levels were investigated in relation to quality of care point in the direction of an association between lower-quality care and higher cortisol levels in children (Dettling, Parker, Lane, Sebanc, & Gunnar,

2000; Sims, Guilfoyle, & Perry, 2006; Tout, de Haan, Kipp Campbell, & Gunnar, 1998).

The core feature of process quality– caregiver sensitivity –may also contribute to individual differences in children's cortisol levels. As for parent-child relations, it was shown that children with insecure relationships and less sensitive mothers showed more increases in cortisol levels during a stressful period (Nachmias, Gunnar, Mangelsdorf, Parritz, & Buss, 1996). Even maternal sensitivity at a young age (6–36 months) affected the average awakening response of children at age 15 (Roisman et al., 2009). Moreover, the availability of sensitive caregivers besides the parents can act as buffer against stress responses (Gunnar, Larson, Hertsgaard, Harris, & Broderson, 1992; Gunnar, Talge, & Herrera, 2009). In a laboratory study Gunnar et al. (1992) showed that infants cared for by sensitively interacting babysitters showed no cortisol elevations, whereas infants cared for by less sensitively interacting babysitters showed cortisol elevations. In home-based childcare, more focused attention and stimulation of the caregiver was related to a decrease in cortisol during a day in childcare, whereas less focused attention and stimulation resulted in an increase in cortisol (Dettling et al., 2000).

Children's wellbeing in childcare is related to the quality of care as well. De Schipper, Van IJzendoorn, and Tavecchio (2004) investigated whether daily stability in childcare centers was related to children's wellbeing. They found that children who were enrolled in fewer care arrangements and experienced more stable program features of the childcare environment felt more at ease in the center as reported by their caregivers. Also, children were rated higher on wellbeing when trusted caregivers were more available. Caregiver-child ratios, educational level of the caregivers, and staff turnover rate were not associated with the wellbeing of children. Attunement between parents and professional caregivers is also important for children's wellbeing. When caregivers were more authoritarian or less supportive than mothers, children showed lower wellbeing in the childcare setting (Van IJzendoorn, Tavecchio, Stams, Verhoeven, & Reiling 1998). Thus far, little is known about the impact of global quality and caregiver sensitivity on the wellbeing of children in childcare. The few studies that examined children's wellbeing have used questionnaires that were completed by caregivers or parents. However, an independent and context-specific measure of wellbeing is important, especially if the association between caregiver sensitivity and wellbeing is examined. Therefore, observed wellbeing (by independent observers) during a day at childcare was included in the present study as well.

In the current study, children's wellbeing and cortisol levels in home-based childcare and center-based childcare are compared, because these two types of care vary substantially in structural features of childcare quality. In home-based childcare, fewer children and caregivers are present than in center-based childcare. Howes (1983) reported that caregivers in home-based childcare spent more time with the children during childcare than caregivers in center-based childcare. Furthermore, center-based childcare was characterized by less stable child-caregivers relationships and larger group sizes than home-based childcare, but the caregiver-child ratio was comparable. These variations in structural features across home-based childcare and center-based childcare may contribute

to individual differences in children's wellbeing and stress levels. Young children may not yet have the social skills to deal with a large number of children, they cannot communicate easily, and they may experience difficulties concentrating on play for a long period (Clarke-Stewart & Allhusen, 2005). Dettling et al. (2000) compared the cortisol levels of children in home-based and center-based childcare. Results showed a rise in cortisol levels over the day for children in home-based childcare of low-quality (less focused attention and stimulation from the caregiver) and for children in center-based childcare, irrespective of quality. In the present study, we measured process quality in both types of care, distinguishing between global childcare quality, caregiver sensitivity, and noise levels.

Noise as indicator of process quality?

We propose to consider noise – an important aspect of environmental chaos theory – to be an indicator of process quality in childcare. Environmental chaos theory (Evans, Maxwell, & Hart, 1999; Wachs, 1989) was originally developed for home settings. Chaotic environments are characterized by high levels of noise, crowding, environmental traffic, and a lack of physical and temporal structure (Wachs, Gurkas, & Kontos, 2004).

For home settings, it has been demonstrated that environmental chaos is associated with a variety of adverse consequences, including impairments in cognitive performance, attention, and motivation in children, and less responsiveness, involvement, and verbal stimulation in caregivers (Corapci & Wachs, 2002; Evans et al., 1999; Wachs & Camli, 1991; Wachs & Corapci, 2003). Evans, Bullinger, and Hygge (1998) showed that chronic noise exposure after the inauguration of an airport significantly elevated cortisol levels of children. Furthermore, children in the noisier areas, due to local road and rail traffic, showed elevated resting overnight urinary cortisol levels, and rated themselves higher in perceived stress symptoms after exposure to a discrete stressor in the laboratory (Evans, Lercher, Meis, Ising, & Kofler, 2001). In childcare, social withdrawal in children was higher when interacting under more crowded conditions (e.g., Liddell & Kuger, 1989), and children were less compliant in a more chaotic setting (Wachs et al., 2004). Although indices of environmental chaos on children's development have been studied for many years, little is known about the impact of noise levels in childcare environments on children's wellbeing and cortisol levels. Therefore, noise levels as an indicator of quality of care were included in the present study as well.

Child characteristics

It is important to bear in mind the child characteristics (e.g., age, gender) that might affect wellbeing and cortisol levels of children in childcare. De Schipper, Tavecchio, Van IJzendoorn, and Van Zeijl (2004) reported no gender or age differences in children's wellbeing in childcare centers. Two meta-analyses (Geoffroy et al., 2006; Vermeer & Van IJzendoorn, 2006) showed that the effect of day care attendance on cortisol excretion was especially notable in children younger than 36 months with a peak around 2–3 years of age. Thus far, in most

studies in which gender was examined in relation to cortisol levels, no significant differences in boys' and girls' cortisol levels were reported. In a recent publication however (Roisman et al., 2009) it was reported that 15-year-old males showed higher awakening cortisol levels than females.

Aims of this study

In this study, we (1) compared children's cortisol levels during a childcare day (home-based care versus center-based care) and during a day at home, (2) examined differences in children's wellbeing and cortisol in home-based childcare versus center-based childcare, and (3) investigated which quality of care indices and child characteristics were associated with children's wellbeing and cortisol levels.

Derived from the meta-analytic results reported earlier, we expect higher cortisol during a childcare day compared to a day at home (aim 1). As for the comparison between home-based childcare versus center-based childcare, we propose the following hypotheses. Home-based childcare settings are more similar to the home setting than center-based childcare, because of the fewer children present and the home-like environment (childcare in the caregivers' home). In addition, taking into account the higher cortisol increases that have been reported for larger group sizes (Legendre, 2003), we hypothesize higher cortisol levels in children attending childcare centers compared to children attending home-based childcare (aim 2). Drawing on the study by De Schipper, Tavecchio, et al. (2004), in which positive associations were shown between wellbeing and the availability of a trusted caregiver, we hypothesize higher wellbeing in children attending home-based childcare, compared to their peers in center-based childcare (aim 2).

We further expect that children in lower-quality childcare (lower global quality, lower caregiver sensitivity, and higher noise levels) show higher cortisol levels and lower wellbeing than their peers in higher-quality childcare (aim 3). We expect no associations between gender, age and children's wellbeing and cortisol levels (aim 3).

Method

Participants

A total of 116 children and 102 caregivers participated in this study. Twenty-six childcare centers and 55 childcare homes were involved. Similar recruitment strategies were used in both childcare settings.

From a national sample, 250 childcare centers were randomly selected. Twenty-six centers agreed to participate in the study. Parents of one randomly selected group per childcare center were approached for permission, and depending on their response, one to four children per center were randomly selected to participate. Children in the Netherlands attend on average only 2–3 days per week childcare. During the other days, parents – most of the time mothers – take care of their children. Because observations were scheduled during one day at childcare, not all children from whom we received permission could participate

in the study. A total of 45 children between 20 and 40 months were selected; their mean age was 32.0 months (SD = 4.4). The sample consisted of 23 boys and 22 girls. Forty-seven caregivers participated in the study. The number of children in each group varied from 4 to 15 (M = 10.8, SD = 2.7).

One hundred and forty-seven home-based child care organizations in the Netherlands were randomly selected from a national sample. Twenty-one of these organizations agreed to participate in the study. The number of host parents registered in these organizations ranged from 43 to 500 (M = 305.3, SD = 184.5). Host parents were approached for permission, and 110 of them agreed to participate. Eventually, the parents of the children were approached for permission. In total, 71 children between 20 and 40 months of age (M = 29.2, SD = 6.3) and their 55 host parents participated in the study. The sample consisted of 39 boys and 32 girls.

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

The educational background of the parents of children cared for in home-based childcare and center-based childcare was comparable. Mothers of children in home-based childcare had on average 13.70 years (SD = 1.90) of education after primary school entrance, and mothers of children in center-based childcare had on average 13.58 years of education after age 6 (SD = 2.26, t (98) = -.36, p = .72, d = .06). For fathers, no differences in level of education between the two types of care were present either (home-based childcare M =13.25, SD = 2.40; center-based M = 13.39, SD = 2.72, t (98) = -.26, p = .80, d = -.14). The mean age of the mothers differed between settings (home-based: M = 33.86, SD = 3.95, centers: M = 35.81, SD = 3.78, t (98) = -2.43, $p < .05$, d = -.51). There was no age difference for the fathers in both types of settings (home-based: M = 37.32, SD = 6.41, centers: M = 37.24, SD = 4.13, t (98) = .06, p = .95, d = .02). The family structure across the two groups of children was also similar: All children were raised in two-parent families. In home-based childcare 77.5% of the children had one or more siblings, and in center-based childcare 73.3% of the children had one or more siblings (t (98) = .84, p = .40, d = .16). The nationality of almost all parents was Dutch (in home-based childcare: mothers 98.4% and fathers 93.7%; in center-based childcare: mothers 100% and fathers 97.3%).

Demographic information for both center-based childcare and home-based childcare is summarized in Table 2.1. Caregiver-child ratios differed significantly between the two types of settings, and were in favor of the childcare homes (t (79) = -7.07, $p < .01$, 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. Mean age of the caregivers differed significantly as well: Caregivers in home-based childcare were older than caregivers in center-based childcare (t (77) = 7.44, $p < .01$, d = 1.71). Caregiver educational level was coded as the number of years of education after primary school entry (from age 6). Although caregivers in the two types of care had

comparable educational levels, a difference was present in the type of education. All the caregivers in center-based childcare completed a vocational education directed at various domains of care with various age groups, whereas only 30% of the caregivers in home-based childcare completed an education in the field of (child)care. Children in both types of care did not differ in age and time spent at childcare. Furthermore, gender was equally distributed across both types of childcare (51.1% of boys in center-based childcare and 54.9% of boys in home-based childcare).

Table 2.1
Information on childcare settings and subject demographics

Characteristics	Childcare Centers		Childcare Homes	
	M	*SD*	*M*	*SD*
Child care settings	(n = 26)		(n = 55)	
Group size	10.8	2.7	2.9**	1.4
Caregiver-child ratio	1:5.3	1.5	1:2.9*	1.4
Caregivers	(n = 47)		(n = 55)	
Age[a]	29.5	7.7	44.3**	9.3
Education[a]	12.9	1.4	12.3	2.1
Children	(n = 45)		(n = 71)	
Age[b]	32.0	4.4	29.2	6.3
Time spent at childcare[c]	21.0	7.3	19.4	7.0
Quality of care				
Global quality	3.38	.47	36.98	3.35
Sensitivity	3.97	.83	4.89**	.86
Noise	62.65	3.58	56.49**	2.93

Note: Global quality was measured using two different instruments: in center-based childcare the ECERS-R was used, in home-based childcare the IT-CC-HOME was used.
[a]in years; [b]in months; [c]in hours per week.
* $p < .05$, ** $p < .01$.

Procedure

Data collection took place in 2006 and 2007. All procedures were carried out with the adequate understanding and written consent of the children's caregivers and parents. Each setting was visited by an observer who spent a morning in the childcare homes or three-quarter of the day in the childcare centers. The observers administered either the Early Childhood Environment Rating Scale-Revised (ECERS-R; Harms, Clifford, & Cryer, 1998) or the Infant Toddler Child Care Home Observation for Measurement of the Environment inventory (IT-CC-HOME; Caldwell & Bradley, 2003) to measure global childcare quality. Furthermore, the observer video-taped three different 10-minute episodes at predetermined time points for each child and each caregiver that participated in the study. The children's saliva was collected four times during the observation

day (including two measures at home and two measures at childcare) to measure their cortisol levels. The visit was completed with an interview with (one of the) caregivers, to obtain information on either the ECERS-R or the IT-CC-HOME items that could not be coded by direct observation.

Parents were asked to collect their child's saliva at home as well, resulting in cortisol measurements during two different days, one childcare day and one day at home. Parents and caregivers were asked to complete a questionnaire about the child's illnesses, use of medicine, mood, naps, and food on the collection days.

Video-taped episodes of the children and caregivers were rated afterwards on child wellbeing and caregiver sensitivity respectively by coders who met the criteria to reliably assess these scales. To obtain independency in ratings, observers who visited the childcare setting did not rate caregiver sensitivity or child wellbeing in this specific setting, and coders who rated the caregiver fragments did not rate the child fragments, and vice versa.

Measures

Cortisol levels. Children's stress levels were assessed by measuring their salivary cortisol levels. Based on results of the study of Strazdins et al. (2005), in which three saliva collection methods for measuring cortisol were compared, cellulose-cotton tip sorbettes were used. Saliva samples were collected during one day at home and during one childcare day at four time points during these days (7 AM; 11 AM; 3 PM; 6 PM). Parents were mailed sampling kits including the material needed for collection and detailed written instruction how to obtain the samples. Parents were asked to collect their child's saliva four times at home: immediately after awaking, at 11 AM, at 3 PM, and just before dinner (around 6 PM). During the observation day, parents were asked to collect their child's saliva at two times: immediately after awaking and half an hour after having picked up their child (around 6 PM). Caregivers were asked to collect the children's saliva on the observation day at 11 AM and 3 PM. Mean cortisol sampling times at home were 6:57 AM (*SD* = 0:28), 10:59 AM (*SD* = 0:05), 3:10 PM (*SD* = 0:22), and 6:06 PM (*SD* = 0:38). Mean cortisol sampling times at childcare were 7:32 AM (*SD* = 0:44), 11:10 AM (*SD* = 0:28), 3:19 AM (*SD* = 0:35), and 6:16 PM (*SD* = 0:37). Correlational analyses revealed no significant associations between mean cortisol sampling time and cortisol values within these time points. In total, 51.7% of the children took a nap at home and 70.2% of the children took a nap at childcare before sampling in the mid-afternoon. Mean cortisol levels of these children did not differ from the cortisol levels of children who did not take a nap in the afternoon, neither in childcare nor at home. In addition, mean time between the nap and cortisol sampling in the mid-afternoon did not correlate with cortisol levels (home r = -.13, p = .29; childcare r = -.02, p = .87). Parents of 18.1% of the children reported that their child was feeling unwell (e.g., having a cold) on the collection day at home, compared to 25.9% of the children on the childcare day. Mean cortisol levels did not differ between the group of healthy children and the group of children feeling unwell, neither in childcare nor at home.

Children were not allowed to eat or drink at least 30 minutes before sampling. The children 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°C until being assayed by the Research Center for Psychobiology at the University of Trier.

Parents and caregivers returned the cortisol samples by mail, which should not affect the cortisol levels (Kirschbaum & Hellhammer, 1994). To increase compliance in collecting cortisol samples on the observation day, research staff telephoned parents and caregivers the day before the observation day to remind them of the collection.

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 then 100 nmol/L were coded as missing because of their impossible values. In total, 12% of the saliva samples were not mailed by parents to the laboratory, and 18% of the tubes did not contain enough saliva for the immunoassay. Missing samples were only imputed for children who had a maximum of one missing sample per day. A total of 79 children with complete sample sets of a childcare day (of all four time points) were used in the analyses. Of these children, a total of 66 children also had a complete cortisol sample set for the day at home. We also examined diurnal change scores using children's cortisol levels sampled at 11 AM and 3 PM at childcare only (see Data analysis). These data were available from 98 children. No significant differences were present in wellbeing or quality of care (global quality, sensitivity, and noise) between the group of children with and without missing cortisol samples.

Wellbeing. Children's wellbeing was measured with the Wellbeing Scale, developed and validated by the Dutch Consortium for Child Care Research (NCKO; De Kruif et al., 2007). This scale contains several indicators of the child's wellbeing, such as pleasure, self-confidence, and relaxation. Scores were based on three video-fragments of 10 min each of the child at childcare. Every 2 min a score was registered, resulting in three periods of five scores. Wellbeing scores are presented on a seven-point scale, ranging from (1) a very low wellbeing (signals of discomfort are clearly present, e.g., crying, screaming) to (7) a very high wellbeing (signals of comfort are clearly present, e.g., enjoyment, smiling). Scores were aggregated across the time periods.

Eight observers were trained to reliably assess the children's wellbeing. All observers met the criterion of reliability: mean intra-class correlation (two-way mixed, absolute agreement) was .79 (range from .74 to .81). Internal consistency of the fifteen intervals was .80.

Quality of childcare. Three aspects of the quality of childcare were measured: global quality, caregiver sensitivity, and noise levels.

Global quality. In childcare centers, the ECERS-R (Harms et al., 1998) was used to examine the process quality of the centers. This instrument is a revision of the ECERS, which is a reliable and valid scale that has been used extensively

worldwide. The predictive validity with respect to children's development has been demonstrated repeatedly (e.g., Peisner-Feinberg & Burchinal, 1997). The scale comprises seven subscales: (a) Space and Furnishings, (b) Personal Care Routines, (c) Language-Reasoning, (d) Activities, (e) Interaction, (f) Program Structure, and (g) Parents and Staff. The 43 items of the ECERS-R are presented on a seven-point scale with detailed descriptions for 1 (*inadequate*), 3 (*minimal*), 5 (*good*), and 7 (*excellent*). For each item a score is given from 1 to 7, resulting in an average score for global quality across all items. Scoring is based on observation as well as caregiver responses to questions about aspects of the program that are not directly observable. *Inadequate* encompasses childcare that does not even meet custodial care needs, *minimal* describes childcare that meets custodial and to some small degree basic developmental needs, *good* describes the basic dimensions of developmental care, and *excellent* describes high-quality personalized care.

A Dutch translated version of the ECERS(-R) has been validated and included in several studies in the Netherlands in the past 15 years (see Vermeer et al., 2008). For the present study, three observers had received an in-depth training prior to the study by expert trainers in the ECERS-R. After a general introduction, each observer completed at least four field observations supervised by an expert trainer. Interrater reliability was established to a criterion of 80% agreement within one rating point for three consecutive observations. The mean percent of agreement for the three consecutive observations above the 80% agreement level was 86% (range 83%–87%); the mean weighted Kappa was .88 (range .86–.90). Internal consistency (Cronbach's alpha) of the ECERS-R was .85. The mean ECERS-R score for the 26 centers was 3.4 (SD = .47), indicating mediocre quality of care in the centers of this study (see Table 2.1). This mean score is comparable with that of previous studies of center-based childcare quality in the Netherlands (Vermeer et al., 2008).

In home-based childcare, the IT-CC-HOME (Caldwell & Bradley, 2003) was used to measure global quality of care. The HOME attempts direct, relatively standardized measurement of environmental and interaction factors. The IT-CC-HOME is designed to measure the quality and quantity of stimulation and support available to a child in the childcare home environment and consists of six subscales: responsitivity, acceptation, organization, learning materials, involvement, and variation. A positive (1) or a negative (0) score is achieved for each of the 43 items. Internal consistency (Cronbach's alpha) of this scale was .66. The total IT-CC-HOME score is a summation across the 43 item scores (1 or 0).

For the IT-CC-HOME six observers were trained prior to the study. After a general introduction, observers visited at least four caregivers in pairs, to complete the IT-CC-HOME. Each observation was followed by an item-by-item debriefing with the trainer. Interrater reliability was established to a criterion of 80% agreement. The mean IT-CC-HOME score was 36.98 (SD = 3.35), which means that on average a total of 86% of the items of the IT-CC-HOME scale was scored positively. This is comparable with the mean total score of 36.3 (SD = 5.1) as reported by Bradley, Caldwell, and Corwyn (2003) from data collected as part of the NICHD Early Child Care Research Network.

The ECERS-R and the IT-CC-HOME measure aspects of the physical environment and the socio-emotional environment of the childcare setting. However, because of the use of different instruments, a direct comparison of the two types of childcare in terms of global quality is not possible here.

Caregiver sensitivity. Caregiver sensitivity in the group setting was examined by means of a scale developed and validated by the Dutch Consortium for Child Care Research (NCKO; De Kruif et al., 2007). This rating scale is based on scales developed to measure sensitivity in a parent-child context (Ainsworth, Bell, & Stayton, 1974; Erickson, Sroufe, & Egeland, 1985). Scoring was based on three video-fragments of 10 min, each taped during the observation day at the childcare setting. Sensitivity ratings are presented on a seven-point scale, ranging from (1) very low sensitivity to (7) very high sensitivity. A caregiver scoring high on this scale provides emotional support to all children who need this support, both during stressful and non-stressful situations. A caregiver scoring low on this scale does not succeed in providing emotional support to the children when they need it. In a Dutch study, the Caregiver Interaction Scale (Arnett, 1989) was positively correlated ($r = .48$, $p < .01$) with this sensitivity scale (De Kruif et al., 2007).

Seven observers were trained to reliably assess caregivers' sensitivity. All observers were trained and became reliable on the same dataset. Mean intra-class correlations (two-way mixed, absolute agreement) were .75 (range .72–.80). Internal consistency of this scale was .76.

Noise levels. A BG-5 Data Logger Sound Level Meter was used to measure noise levels in decibels at the childcare setting. This sound level meter was designed to register noise in much the same way as the human ear. The sound level meter was put in the room where the caregiver and children stayed during the observation. Three episodes of 30 minutes were recorded, which run parallel to the video-fragments.

Data analysis

Cortisol measures were inspected for outliers defined as values with *SD* greater than 3.29 above the mean (Tabachnick & Fidell, 1996). By means of winsorizing, outliers were made no more extreme than the most extreme value that was accurately measured (Tabachnick & Fidell, 1996). Because the distributions of the cortisol measurements were positively skewed, $\log_{10}$ transformations were used for analysis. Cortisol diurnal patterns were analyzed both utilizing the area under the curve with respect to the ground (AUC_G) and mean ratios of cortisol diurnal change (*RDC*). According to the formula specified by Pruessner, Kirschbaum, Meinlschmid, and Hellhammer (2003), the AUC_G was computed with the original (not log transformed) values to avoid negative values. Because the distribution of the AUC_G was positively skewed, a $\log_{10}$ transformation was used prior to analysis. Correlations of the AUC_G with the measurement points were all significant ($p < .01$), except for one (childcare day: 7 AM $r = .67$, 11 AM $r = .73$, 3 PM $r = .65$, and 6 PM $r = .17$, $p = .14$, day at home: .67, .72, .66, and .33, respectively). The mean *RDC* consisted of the diurnal change at childcare between 11 AM and 3 PM, controlled for the measurement at 11 AM (Δcortisol/11 AM). A constant of 1 was added to

the computed *RDC* in order to make $\log_{10}$ transformation possible and to avoid negative values.

To test whether differences in cortisol levels were present across the 2 days and the two types of care, a multivariate analysis of variance with repeated measures (the children's cortisol levels at four time points) was performed. Next, multiple regression analyses were performed to test whether noise, caregiver sensitivity, and global quality predicted children's wellbeing and cortisol levels in the two types of care. Because of the hierarchical structure of this dataset, with units grouped at different levels, multilevel regression analyses were performed as well, using MLwiN (Rasbash et al., 2000). In these analyses, the children were considered as Level-1 units, and the childcare settings as Level-2 units. It is important to take this multilevel structure into account, because children that are cared for in the same group might be more alike in their wellbeing and/or cortisol levels than children from different groups

Results

Differences between center-based childcare and home-based childcare

Cortisol. In Table 2.2, children's (untransformed) cortisol levels during the childcare day and during the day at home are shown. Analyses of children's cortisol levels at home and on a childcare day were performed using a 2 (Context: home versus childcare) by 4 (Time of day) by 2 (Type of care: childcare home versus center) multivariate analysis of variance with repeated measures. There was a significant main effect of time of day, demonstrating declining cortisol levels throughout the day (*Pillais F* (3, 62) = 130.7, $p < .01$, $\eta^2 = .87$) and a significant main effect of context (*Pillais F* (1, 64) = 8.0, $p < .01$, $\eta^2 = .11$), demonstrating higher cortisol levels during a childcare day than during a day at home. No main effects of type of care or interaction effects emerged. To test for influences of child characteristics, all analyses were repeated with age and gender included as between-subjects variable besides context. These analyses yielded no differences in cortisol levels while the effects of context remained significant.

Wellbeing. Children in home-based childcare were rated significantly higher in wellbeing than children in center-based childcare (t (114) = 5.53, $p < .01$; $d = 1.98$): Children in home-based childcare showed a mean score of 4.59 ($SD = .37$), whereas children in center-based childcare showed a mean score of 4.27 ($SD = .24$).

Table 2.2
Cortisol levels (in nmol/L) of children during a day at home and at childcare

	Home ($n = 66$)		Childcare centers ($n = 24$)		Childcare homes ($n = 55$)	
	M	*SD*	*M*	*SD*	*M*	*SD*
7 AM	10.04	5.82	9.79	4.32	10.73	5.16
11 AM	3.74	3.56	3.30	2.85	3.45	2.25
3 PM	3.18	3.42	3.12	1.63	3.75	2.16
6 PM	1.72	1.75	1.78	.97	2.45	2.71

Quality of care. Caregiver sensitivity was higher in home-based childcare (M = 4.89, SD = .86) than in center-based childcare (M = 3.97, SD = .83; t (79) = 4.55, $p < .01$; d = 1.10). In terms of the physical environment, children in home-based childcare experienced less noise (M = 56.49, SD = 2.93) compared to children in center-based childcare (M = 62.65, SD = 3.58; t (79) = -8.21, $p < .01$; d = 1.98).

In Table 2.3, the outcomes of a binary logistic regression for type of care are presented. Controlled for gender and age, the type of care a child is attending was almost perfectly predicted from sensitivity, noise, and caregiver-child ratio (Nagelkerke R^2 = .83). For this reason, both types of care were analyzed separately in the following section.

Table 2.3
Binary logistic regression analyses: Predicting type of care (home-based childcare or center-based childcare)

	B	*S.E.*	*Wald*	*Exp(B)*
Constant	-37.15**	13.95	7.10	.00
Block 1				
Gender	1.25	.90	1.94	3.49
Age	.03	.07	.23	1.03
Block 2				
Sensitivity	-1.93**	.66	8.48	.15
Wellbeing	-1.32	1.45	.84	.26
Noise	.75**	.20	13.35	2.11
Caregiver-child ratio	.95**	.31	9.43	2.58

** $p < .01$ (2-tailed)

Associations between cortisol, wellbeing, and quality of care

In Table 2.4, the associations between children's wellbeing, their cortisol levels, and the quality measurements are presented, separately for type of care. A significant positive association was found between sensitivity and wellbeing, but only for home-based childcare (r = .27, $p < .05$). In both types of care, there was a positive association between caregiver sensitivity and global quality (home-based childcare: r = .34, $p < .01$; center-based childcare: r = .44, $p < .01$).

As shown in Table 2.4, there was no significant association between wellbeing and the *RDC* or the AUC_G in either type of care. In center-based childcare, there was a significant negative association between *RDC* and global quality (r = -.39, $p < .01$). To further examine this association, we dichotomized the ECERS-R scores by using a median-split procedure (median at 3.37). A significantly different pattern of cortisol levels was present in the group of children experiencing below-median global quality compared to children experiencing above-median global quality (Figure 2.1). Cortisol levels during the day in childcare centers decreased in the above-median group, whereas cortisol levels increased in the below-median group. Additional analyses revealed that associations between global quality and cortisol levels at 11 AM and 3 PM were (nearly) significant (11 AM r = .41, $p < .05$; 3 PM r = -.39, p = .06).

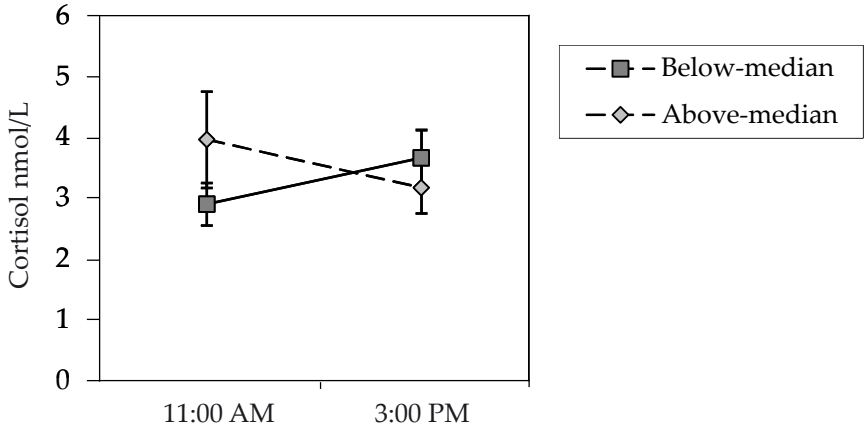

Figure 2.1. Cortisol levels of children in childcare centers with below-median (n = 19) and above-median (n = 17) global quality

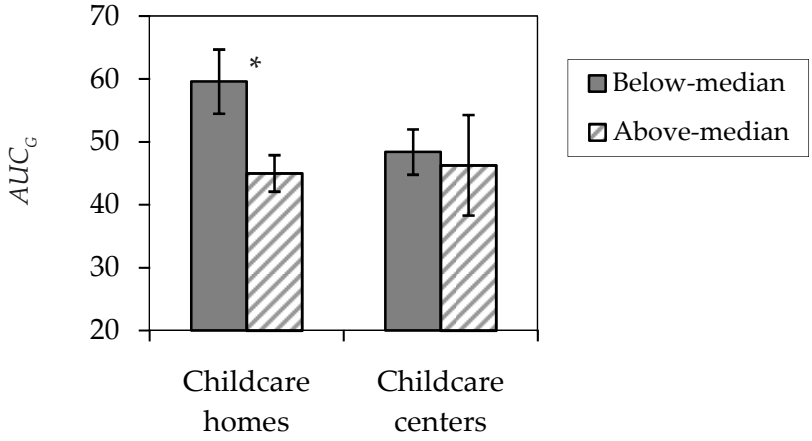

Figure 2.2. AUC_G of Children experiencing below-median (home-based childcare n = 29, center-based childcare (n = 14) and above-median (respectively n = 26 and n = 10) caregiver sensitivity
* $p < .05$

Table 2.4
Correlations between cortisol levels, wellbeing and quality of care split for type of care

		1.	2	3.	4.	5.	6.
1.	Wellbeing		.05	-.16	.09	.27*	-.06
2.	*RDC*	.29		.02	-.06	.10	-.13
3.	AUC_G	.04	.08		-.14	-.26	.01
4.	Global quality	-.24	-.39**	-.05		.34**	.21
5.	Sensitivity	.00	-.15	-.14	.44**		.04
6.	Noise	.04	.03	.00	-.13	-.06	

Note: Correlations within the center-based childcare sample are displayed below the diagonal and correlations within the home-based childcare sample are displayed above the diagonal.
* $p < .05$, ** $p < .01$.

Next, we dichotomized caregiver sensitivity scores by using a median-split procedure (median in home-based childcare at 5.0; median in center-based childcare at 4.0). A significantly different AUC_G was present in home-based childcare (t (53) = 2.20, $p < .05$, $d = .60$), indicating an overall lower level of cortisol in children experiencing above-median caregiver sensitivity in childcare homes (Figure 2.2). Additional analyses revealed a significant association between sensitivity and cortisol levels at 11 AM (AM $r = -.33$, $p < .05$), but not at 3 PM ($r = -.14$, $p = .32$). For childcare centers, no significant differences in AUC_G were present between children cared for by above-median or below-median sensitive caregivers (t (22) = .74, $p = .47$, $d = .36$).

Predictors of wellbeing and cortisol levels
Multivariate regression analyses were performed to test whether the quality indices predicted wellbeing, *RDC*, or AUC_G of children in each type of childcare (separately). In the hierarchical regression analyses, first age and gender were added, followed by global quality and sensitivity in the second step. Noise was not added as a predictor, because no significant correlations were found between noise and wellbeing, and between noise and children's cortisol levels in both types of care. Results of these analyses are displayed in Table 2.5 (home-based childcare) and Table 2.6 (center-based childcare). Multilevel analyses of these six models were performed as well, and results were comparable.[1]

[1] Results of the multilevel analyses of the models can be requested from the authors

Table 2.5
Hierarchical regressions in home-based childcare

Outcome	Wellbeing				*RDC*				AUC_G			
	B	*SEB*	*β*	R^2	*B*	*SEB*	*β*	R^2	*B*	*SEB*	*β*	R^2
Step 1				.04				.10				.06
Age	.00	.01	-.02		-.01	.01	-.19		-.01	.00	-.25	
Gender	.14	.09	.19		-.11	.07	-.20		.05	.05	.14	
Step 2				.10				.12				.15
Global quality	-.01	.61	.01		-.32	.47	-.09		.02	.30	.01	
Sensitivity	.11	.06	.25		.06	.05	.17		-.07	.03	-.32*	

* $p < .05$

Table 2.6
Hierarchical regressions in center-based childcare

Outcome	Wellbeing				*RDC*				AUC_G			
	B	*SEB*	*β*	R^2	*B*	*SEB*	*β*	R^2	*B*	*SEB*	*β*	R^2
Step 1				.08				.00				.23
Age	.02	.01	.28		.00	.01	.01		.00	.01	-.11	
Gender	-.01	.07	.02		.01	.11	.02		-.16	.07	-.47*	
Step 2				.15				.16				.25
Global quality	-.17	.10	-.29		-.29	.12	-.43*		.03	.08	.09	
Sensitivity	.04	.05	.13		.03	.08	-.07		-.04	.06	-.16	

* $p < .05$

Controlled for age and gender, sensitivity was a significant predictor of children's wellbeing in home-based childcare ($\beta = .25$, $p < .05$). By adding global quality, sensitivity showed a trend ($\beta = .25$, $p = .06$). None of the quality indices in home-based childcare was a significant predictor of *RDC*. As expected, a significant effect of sensitivity was present on the AUC_G of children in home-based childcare: Children who experienced less sensitive care showed higher levels of cortisol during the day, controlled for age and gender ($\beta = -.32$, $p < .05$).

To test whether the quality indices predicted children's wellbeing, *RDC*, and AUC_G in childcare centers, the three models were tested again (Table 2.6). In childcare centers, controlled for age and gender, global quality showed a trend in predicting the wellbeing of children ($\beta = -.29$, $p = .09$). As expected, global quality significantly predicted the *RDC*: Children who were cared for in higher-quality centers showed a decrease in cortisol levels during childcare, whereas children attending lower-quality centers showed an increase in cortisol levels ($\beta = -.43$, $p < .05$). Gender and age, and in a second step, caregiver sensitivity, did not significantly add to this model. Gender had a significant effect in the prediction of the AUC_G: Boys secreted a higher amount of cortisol during the day ($M = 1.72$, $SD = .15$), compared to girls ($M = 1.57$, $SD = .16$; $\beta = -.47$, $p < .05$). None of the other variables had a significant effect on AUC_G.

Discussion

We found that children displayed higher cortisol levels during a childcare day than during a day at home. Children's cortisol levels in home-based childcare and center-based childcare were similar. However, the following differences were found in favour of home-based childcare: (1) Children in home-based childcare appeared to feel more at ease than children in center-based childcare, (2) Caregiver sensitivity was higher in home-based childcare than in center-based childcare, and (3) Noise levels were lower in home-based childcare than in center-based childcare. Furthermore, children who experienced more sensitive care in home-based childcare showed higher observed wellbeing during childcare.

Sensitivity and wellbeing

The finding that caregiver sensitivity in home-based childcare – but not in center care – was positively associated with the child's wellbeing, raises the question why caregiver sensitivity in home-based childcare is a better predictor of the child's social-emotional wellbeing than caregiver sensitivity in the context of center-based childcare. In home-based childcare, the children are cared for by the same caregiver each day they attend childcare, whereas in center-based childcare children experience the care of more than one caregiver each day and multiple caregivers during the week. In other words, caregiver stability is higher in home-based childcare than in center-based childcare. It should be noted that caregiver sensitivity in center-based childcare in this study was defined as the mean caregiver sensitivity across the caregivers present during the observation day. This was decided because children in the group receive (an equal amount of) caregiving from both caregivers. Thus, individual differences in the sensitivity of caregivers within one group were not taken into account.

Quality of care and cortisol

In line with our expectations, quality of care was significantly associated with children's cortisol levels. However, these associations were different in home-based childcare compared to center-based childcare. Lower caregiver sensitivity was associated with a higher total production of salivary cortisol during the day (AUC_G), but in home-based childcare only. To examine this association across the two settings, we combined the groups using the original criteria for 'below-median caregiver sensitivity' and 'above-median caregiver sensitivity' for each setting separately. When doing so, children in the above-median and the below-median groups significantly differed in the AUC_G (d = .51), indicating an overall lower level of cortisol in children experiencing above-median caregiver sensitivity. However, median caregiver sensitivity in home-based childcare is not equivalent to median caregiver sensitivity in center-based childcare. In home-based care, children experiencing caregiver sensitivity of, for example, a score of 4.3 would be classified in 'below-median sensitivity', but in center-based care children receiving the same amount of caregiving would be classified in 'above-median sensitivity'. In addition, it would not be justifiable to dichotomize caregiver sensitivity scores across the two settings. In this way, 67% of the home-

based caregivers would be classified in the 'above-median sensitivity' group, but only 19% of the center-based caregivers would be classified in this category. In other words, the range in sensitivity scores would be too restricted in both types of settings.

The same reasoning can be followed for reported associations between global quality and *RDC*. After analyzing the two types of care separately, quality of care was associated with *RDC*, but for center care only. When combining the children receiving above-median quality and children receiving below-median quality from both types of settings, a significant difference was present in *RDC* (d = .43) for the total group of children. Children's cortisol levels during the day at childcare decreased in the above-median group, and increased in the below-median group. Again, we could not combine the two types of care, due to the two different measures of global quality.

This however leaves the question unanswered why caregiver sensitivity predicted the total output of salivary cortisol during the day, whereas the mean ratios of diurnal change were predicted by global quality. A recent study of Watamura, Kryzer, and Robertson (2009) showed a negative association between quality of childcare centers (ORCE ratings of emotional climate, community building, expressed community, [reversed] chaos, and [reversed] over-control) and rise in cortisol from mid-morning to mid-afternoon: A better climate during the morning was associated with a decrease in cortisol. Consistent with our results, Watamura et al. (2009) did not find an association between sensitivity and changes in cortisol. They suggest that this failure to find an association may have been due to their presence; caregivers might have an idea which child is being observed, and may try to not interfere with the observation. Although we did not observe the sensitivity of the caregivers to a specific child, we did not find an association between sensitivity and ratio of diurnal change either.

Child characteristics

Overall, children's cortisol levels were not associated with gender and age. It should be noted that in this study, the age range was restricted to 20-40-months-old children, because previous studies found that children's elevated cortisol levels were especially notable in 2-3-year-old children. As for gender, one difference was present in childcare centers: Boys produced a higher amount of cortisol during the day at childcare centers compared to girls. Although focusing on another age group, this finding is in line with a recent publication of the NICHD Early Child Care Research Network (Roisman et al., 2009) reporting that 15-year-old males showed higher awakening cortisol levels than females. Again, this main effect of gender did not affect the association between quality indices and AUC_G.

Noise

In our study, no association was present between noise and wellbeing or cortisol patterns of the children. Although we expected higher noise levels to result in lower wellbeing and higher cortisol levels in children, this could not be confirmed in the current study. This might be due to the source and intensity of noise levels.

In the study of Evans et al. (1998) the noise source was an airport resulting in higher noise levels than in childcare settings. Another explanation is a lack of variance in noise: The present study did not allow a comparison of children in very quiet childcare settings with children in very noisy childcare settings. For future studies, it would be worthwhile to take into account sources of noise and to include childcare settings with substantial variances in noise.

Limitations

A limitation of this study is the sampling of cortisol on only one day at home and one childcare 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 will not have affected the comparisons across different types of childcare. Our data do support findings from studies, showing associations between quality of care and children's cortisol levels (Sims et al., 2006; Vermeer & Van IJzendoorn, 2006), suggesting validity of our findings. However, in future studies it would be better to collect saliva across different days at home as well as at childcare to get a more stable pattern. Also, the use of an electronic monitoring device would enhance the reliability of the (home) measurements of cortisol (Kudielka, Broderick, & Kirschbaum, 2003). Another limitation is the relatively small sample size, although the size of our sample is not deviating from those in other recent studies in this area (e.g., Watamura et al., 2009). As for childcare quality, the moderate internal consistency of the CC-IT-HOME should be taken into account. Except for the NICHD (Vandell, 1996) study in which an internal consistency of .81 was reported, we are not aware of other studies that used the CC-IT-HOME in home-based childcare. The authors of the CC-HOME inventories stated: "We no longer report internal consistencies estimates for the HOME Inventories. The CC-HOMEs are composed of cause rather than effect indicators and reliability estimates such as the alpha coefficient assume effect indicators." (Bradley et al., 2003, p. 308).

Implications for policy and practice

This study confirms the importance of childcare quality in both types of childcare as basic hormonal indices of stress and wellbeing seem to be affected by quality of care. Children appear to feel more at ease and less stressed when they are cared for by caregivers who provide more emotional support during both stressful and non-stressful situations. Although we do not know the impact of elevated cortisol levels and lower wellbeing on children's development in the long run, parents want childcare to be a place where their children feel secure and happy here and now (Fukkink, Tavecchio, De Kruijf, Vermeer, & Van, Zeijl, 2005). In childcare settings of lower quality, children's stress-regulation and behavior demonstrate that this parental wish is not fully fulfilled. Therefore, investments in the improvement of childcare quality, enhancing both the socio-emotional and physical environment of the children, are needed.

Conclusion

In conclusion, results from the present study show that children's cortisol levels on a childcare day are elevated compared to their cortisol levels at home, irrespective of type of childcare. Even home-based childcare – with fewer children and lower noise levels – can be a stressful situation for children. Our data suggest that quality of care is an important determinant of individual differences in children's cortisol levels. Dependent on the type of care, lower levels of global quality (center-based childcare) or caregiver sensitivity (home-based childcare) may result in elevated cortisol levels. Therefore, we conclude that high-quality sensitive caregiving in both types of childcare is important for children's wellbeing and stress-regulation.