

# Cortisol Changes and the Quality of Child Care in Australian Preschool and Kindergarten Children

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## Abstract

*Many consider child care a risk factor for poor child outcomes, particularly those who believe that parental rearing is essential for children's well-being. It is possible to identify the immediate impact of the child-care environment on children using biomarkers of stress such as cortisol. Children (aged 3–6 years) attending a range of child-care centers of varying quality participated in the study. Center quality was measured using the Australian national quality assurance system. Salivary cortisol levels were obtained from the children and the change in cortisol across the child-care day was determined. Specific trajectories of cortisol were identified and used in the analysis. Children who demonstrated a normative decline in cortisol across the child-care day were consistently associated with high-quality child-care programs, whereas those demonstrating an increase in cortisol were more likely associated with unsatisfactory programs. Cortisol changes were more susceptible to changes in quality rated by those principles linked to the relationship dimensions of quality service. Thus, program quality was associated with different cortisol trajectories; in particular, children attending low-quality services are more likely to demonstrate cortisol trajectories that are linked in the extant research with poorer outcomes. We argue that this result has important implications for micro systems of child care.*

**Keywords:** stress, child development, preschool children

## Introduction

Early childhood experiences affect developing brain circuits and physiological systems in ways that modify the stress response (National Scientific Council on the Developing Child, 2005; Steptoe, van Jaarsveld, Semmier, Plomin, & Wardle, 2009). A problem in children's development

arises when there is an ongoing pattern of chronic stress related to regular exposure to stressors. Chronic atypical cortisol responses are linked to a range of known undesirable outcomes for children. In this paper we investigate the associations between quality of child care and these regular patterns of stress in young children, given that an increasing number of Australian children are using alternative forms of care (a national study, the Longitudinal Study of Australian Children, identified 65.3% of 2-year-olds as using child care centers; Australian Institute of Family Studies, 2006).

We know that the outside world influences our bodies' stress responses through the hypothalamic-pituitary-adrenocortical (HPA) axis, which is responsible for releasing cortisol (Dickerson & Kemeny, 2004). Cortisol provides energy by increasing blood glucose levels, and this fuels our metabolic functioning, resulting in increased levels of arousal and alertness, coupled with increases in body temperature and blood pressure that are linked to inhibition in functions such as reproduction, appetite, and the immune response (Charmandari, Tsigos, & Chrousos, 2005; Dickerson & Kemeny, 2004; Segerstrom & Miller, 2004). Cortisol is responsible for diverting the energy needed to fuel these latter systems into those most necessary to ensure survival from the stressor.

When the stress-triggering incident is ephemeral, the long-term consequences to the individual of this inhibition in reproduction, appetite, and immunity are negligible. When the stress is chronic, however, negative effects often appear. Arguing from a developmental perspective, Smider, Essex, Kalin, Buss, Klein, and Davidson (2002) showed that atypical cortisol activation suppresses the human

growth hormone so that children are likely to achieve an adult height 7.5 to 8 cm shorter than their potential. In addition, cortisol activation is associated with a hyperactive or hyperreactive amygdala, which has implications for a wide range of psychosocial behaviors such as personality disorders, chronic anxiety, conduct disorders, melancholic depression, eating disorders, and substance and alcohol abuse. Depression and anxiety are also linked to increased vulnerability to illness, and people with atypical cortisol levels are likely to experience a range of autoimmune problems. It is also suggested that abnormal cortisol activation results in a smaller hippocampus and affects other areas of the brain, resulting in problems with memory and learning.

When considering the effects of stress on young children, it is important to note that cortisol levels do not normally remain steady throughout a day. Rather, they peak soon after rising in the morning and usually reach their nadir soon after going to bed at night. Atypical cortisol trajectories can be mapped onto and compared with these normal patterns. Meyerkort, Strazdins, Meyerkort, Lucas, and Nicholson (2004, p. 26) suggest that "extreme stress, especially early in life, generally results in cortisol suppression. In contrast, less extreme stress, acute or chronic, is linked to cortisol elevations." Thus, although some cortisol reactivity is normal, two worrisome trajectories have been identified.

Chronic cortisol activation can result in trajectories that begin high and remain high across the day (hypercortisolism). These patterns are associated with highly stressful rearing environments and a range of undesirable long-term outcomes in terms of physical, mental, and emotional health, well-being, and development. Reviews such as those undertaken by Charmandari et al. (2005) and Gunnar (Gunnar, 2006; Gunnar & Quevedo, 2008) indicate that the following are associated with chronically increased levels of HPA activity: melancholic depression, anorexia nervosa, malnutrition,

obsessive-compulsive disorder, panic disorder, obligate athleticism, chronic active alcoholism, diabetes mellitus, metabolic Syndrome X, psychosocial short stature, attachment disorders, "functional" gastrointestinal disease, hyperthyroidism, and Cushing syndrome.

Chronic stress may also result in trajectories that begin low and continue low throughout the day, a condition known as hypocortisolism. Hypocortisolism is also associated with a (different) range of undesirable mental, physical, and emotional health, well-being, and developmental outcomes. The same reviews identify the following associated with this pattern of HPA axis activity levels: adrenal insufficiency, atypical/seasonal depression, chronic fatigue syndrome, fibromyalgia, hypothyroidism, premenstrual tension syndrome, and rheumatoid arthritis.

Importantly, research has shown that cortisol reactions in young children are mediated by their relationship with their caregivers (Balbernie, 2001; Mayes, Magidson, Lejeuz, & Nicholls, 2009). Secure attachments serve as a buffer, moderating the young child's cortisol responsivity and protecting the child from the negative outcomes associated with atypical cortisol activation (Gunnar, Bruce, & Hickman, 2001; McCain, Mustard, & Shanker, 2007). Self-management of stress reactivity is learned through early attachment relationships with adults, as adult management of stress gradually evolves into self-management. Recent epigenetic research with laboratory animals, particularly rats and rhesus monkeys, strongly supports the thesis that the adult-child relationship affects neuronal circuitry, which itself influences physiology. Such neuronal and physiological changes are shown by animal research to transcend generations (Kaffman & Meaney, 2007; Meaney, 2010; Rutter, 2006; Shannon, Schwandt, Cahampoux, Shoaf, & Suomi, 2005), perhaps through changes in DNA methylation of promoter elements controlling the expression of certain genes.

Nonparental care for children under the age of 3 years is often posited as undesirable because separation of children from their parents is thought to result in high stress levels and thus risk a range of undesirable outcomes. Researchers such as Belsky (2001) argue that group care for children thus negatively affects parent-child relationships and, in more recent research, that child care has a negative impact on children's behavior (Belsky, Vandell, Burchinal, Clarke-Stewart, McCartney, & Owen, 2007). At a societal level, policies such as government funding for child care and family initiatives such as paid parental leave arise out of prevailing beliefs about who should care for young children. Child care has traditionally been significantly underfunded and undervalued because of the tensions evident in the parental care/alternative care debates (Sims, 2007). Many politicians, of course, live and operate in private worlds where their own children are cared for in the home by the politicians' partners, and thus espouse a worldview that accepts such arrangements as the norm.

Despite this, there are times when child care is considered desirable. The Australian federal government, which funds child care as an employment support program, has held this position for some years. However, the benefits arising out of employment for women still do not outweigh or muffle the negative public discourse concerning the "selfish" and "unmotherly" women who choose to use these services; they are seen by many as pursuing their own employment aims at the expense of their children's need for mothering. Consequently, child care is often portrayed in the media as dangerous for children, and a plethora of popular books and magazines constantly warn parents of the risks of placing their children in child care. Child care is also frequently portrayed as a symptom of the decay of the family—a tool supporting the selfish aims of mothers at the expense of children. Research identifying negative outcomes of child care is constantly highlighted and publicized, whereas that identifying beneficial aspects of child care is ignored or overlooked.

American research in particular has shown that children in child-care centers typically demonstrate elevated cortisol levels compared with children in their home environments (Dettling, Gunnar, & Donzella, 1999; Tout, De Haan, Campbell, & Gunnar, 1998; Wataamura, Donzella, Alwin, & Gunnar, 2003). To counter this, there is research suggesting that it is the quality of the early childhood environments, rather than type of environments per se, that is important (Dettling, Parker, Lane, Sebanc, & Gunnar, 2000; Sims, Guilfoyle, & Parry, 2005, 2006). This research suggests that children in poor-quality care centers tend to respond with increases in cortisol levels across the day, whereas children in high-quality care centers are observed to have decreases in cortisol across the day.

Cortisol reactions are affected by all the environments in which children live (Meyerkort et al., 2004). It is clear that primary familial factors have more impact on long-term outcomes for children than does child care, and this is made clear by the extensive National Institute of Child Health and Human Development (NICHD) longitudinal study in America (Belsky et al., 2007; National Institute of Child Health and Human Development, NIH, & DHHS, 2006; NICHD Early Child Care Research Network, 2006; Vandell, 2001). It is also possible that the children's cortisol response while in child care is related to their home environments rather than the quality of the child-care program.

Any interaction between the child-care and family environments is complex. It will include basic parent-child relationships, for example; in this regard, the child care may provide sanctuary from or support of ongoing family life stressors or home-based maltreatment, abuse, or neglect. More specific mediating factors, such as how the parents help the child to respond to stress (e.g., building resilience), might in turn affect the cortisol response to the day care program. How parents handle the separation between home and care is another very important factor. This can



depend on family structures, supports, the number of parents in the household, and the nature of parental paid employment, among other things. Broader factors include how and why a parent chooses a poor-quality child-care program rather than a high-quality program. If the family lives in a region or poor community with few resources, a poor program may be the only one available. It is also possible that parents with poor parenting skills, other stressors, and inadequate resources may not have the skills to choose a high-quality program; in contrast, parents with better self-esteem, more maturity, better parenting skills, and/or more resources may select the higher-quality program from the choices available.

In this paper we do not delve into these interacting complexities. Given the powerful influences of the home and all other environments, it is important to note that in this research design we are not interested in assessing external factors and how they affect child-care stress. We did not assess children's cortisol responses in the home, nor did we test those of their parents. Although we note the need to consider all ecosystems (Guilfoyle, Banham, Cavazzi, & Napolitana-Lincoln, 2011; Ungar, Brown, Liebenberg, Cheung, & Levine 2008), we should not neglect a focus on what happens within micro systems.

How stress is managed in the child-care setting, even by little ones, is important. Not all stress is bad, and some is necessary for learning and even survival. However, young children in child care have not had much chance to develop stress management strategies, and thus are particularly susceptible to the impact of stress through cortisol activation (Charmandari et al., 2005). Hence, it is interesting to investigate, in a broad sense—taking as givens the absolute levels of stress children have upon arrival at a child-care facility and the stress management strategies they have already learned—whether stress levels are being maintained, increased, or mitigated, and whether stress is being “managed” by the qualities of the micro child-care environment.

Our question is primary: We are interested in what happens to children's stress within quality child care. Thus, we ask, regardless of external stressors and causes: Are established patterns of cortisol responsivity associated with the level of quality of the child-care environment? Our study focuses on the cortisol changes that occur within each child when he or she is in child care. Children's absolute starting and ending levels of cortisol were not our concern. These factors were controlled for in our design by categorizing children based on their patterns of cortisol responsivity (not “levels” of cortisol per se). The baseline or behavioral anchor for each child's shift was the child's morning cortisol level within the child-care environment. Because of the known and unknown environmental stressors discussed earlier (including, perhaps, just the very thought of attending the child-care facility), some children arrive at child care with high or low serum cortisol levels. For some, these will stay at the same level throughout the day, whereas for others they will shift up or down during the day. We aimed to observe each child's typical responsivity pattern over three days and identify how the common patterns were associated with the quality of their child-care environment to address the following research question: *What are the associations between different patterns of cortisol responsivity and the quality of the child care attended?*

## Design

Our research is an example of applied research in natural settings which was sensitive to participants on two levels. First, it required assessment of each child-care center's quality, which we accomplished using a standardized accreditation tool. Second, it required collection of salivary cortisol samples from children over three consecutive days. We could not force centers into participating in this type of research, nor did we want to. Furthermore, a random selection of the national population of centers was not ideal, as most child-care

centers in Australia are classified as offering high- or medium-quality services. It was important for statistical validity that we include a comparable range of low-quality centers. The design was therefore quasi-experimental (Cook & Campbell, 1979) and we purposively approached child-care centers across a metropolitan city in Australia using a maximum variation technique (Liamputtong, 2009). Drawing from our experiences with center activities in this city while undertaking our own previous professional practice visits, we mapped all centers based on their status as community or private; their geographical location; and their potential for low-, medium-, or high-quality care. We then systematically approached all low-quality private and community centers in each location. When we exhausted our pool of potentially low-quality centers, we then approached corresponding numbers of potentially medium- and high-quality care centers (matched to the low-quality candidates on their status as private/public and their location).

## Methods

### Sample Centers

Sixty-three child-care groups within a range of centers agreed to participate. Ultimately, only one of the noncommunity (private) bodies we approached approved the participation of any of their centers; thus, only one private center participated. Therefore, the sample consists almost exclusively of community-based child-care centers. We assessed this final sample against national averages to determine its representativeness in terms of a range of different levels of quality (see Table 1). Our sample shows that our maximum variation technique worked. We successfully included more centers rated low quality on several dimensions than the national average.

To determine if the centers provided a sample that was representative of 3- to 6-year-old children in child care nationally,

*Cortisol Changes and the Quality of Child Care in Australian Preschool and Kindergarten Children* we used the most recently available data from the Australian Bureau of Statistics (Australian Bureau of Statistics, 2003) in a series of comparisons. Our sample was found to be similar to the Australian distribution for family structure (in Australia as a whole, 80.4% of children are from two-parent families, and in this study 79.8% were from two-parent families). Compared to all Australian families, families in this study were more likely to come from both lower and higher income groups and thus less likely to be in middle income levels. (In Australia as a whole, 33.2% of families have an income under \$41,000. Income categories used in this study were slightly different: 39% had an income under \$40,000. In Australia as a whole, 22.8% of families have an income over \$73,000 and in this study 33.3% had an income over \$80,000.) This probably reflects the priority of access to child care in Australia: families in which parents are working or training for work, or which have identified needs for parental relief, have priority for child-care places.

### Children

Once permission was gained from a center, families using the center were approached, through the center. Criteria for selection of children were:

1. Attendance of at least three days a week between immediately before morning tea to immediately before afternoon tea. Note that these times vary depending on which room children were in, what time the children arrived, and so on. Morning tea is usually any time between 9:30 and 10:30 a.m. and afternoon tea anytime between 1:00 and 2:00 p.m. Collection over three days enabled averaging of biomarker data; this was important so that we could minimize any "one-off" stress anomalies and establish a consistent pattern (Dettling et al., 1999; Tout et al., 1998). Most children in Australia attend child care part-time, with 69.6% using child care for less than three days per week (Australian Bureau of Statistics, 2003). Thus, although it added reliability; the three-

day collection limited the numbers of children qualifying to participate in the study. This reduced the overall sample size and limits the generalizability of the sample to children who are using child care extensively (i.e., three or more days per week). This “three days per week” sample provided a valid test of associations between experiences of child care and stress.

2. Permission was gained from parents/guardians, and indirectly from the children; the latter was judged by the child’s willingness to participate in saliva collection. No pressure or coercion was applied to any child who was not comfortable with saliva collection, and a small proportion of children (11.7%) did not give a full set of saliva samples because of this. In the 3- to 6-year group, 117 children had complete datasets to use in the analyses; 41% were female and 59% were male.

The subject of this paper is the 3- and 6-year group (referred to as *kindergarten or preschool age* by the child-care sector in Australia). Though age was partly controlled by restricting our sample to these kindergarten-aged (3 to 6 years) children, we ran a check on whether there were differences in cortisol reactions across the 3- to 6-year age group (using the children’s age as a within-sample covariant). We found that age was a not significant contributor to cortisol reactions in this sample ( $F(1, 70) = 2.63, p = .109$ ) and thus we could treat the sample as a single group in our formal analysis.

### Quality Improvement and Accreditation System

We attended each center that agreed to participate and made observations using a standardized tool, so as to independently classify the center as high, medium, or low quality as defined in this section. Australia uses a federal Quality Improvement and Accreditation System (QIAS) to assess child care quality. This system establishes principles for high-

Cortisol Changes and the Quality of Child Care in Australian Preschool and Kindergarten Children quality center-based care child-care practice, and sets out accompanying standards and performance indicators for assessing practice against the standards (National Childcare Accreditation Council, 2001a, 2001b). Federally trained moderators and validators ensure consistency in rating across the country. The QIAS is designed to operate as a support and practical tool for enhancing performance; thus, centers commonly identify specific principles as targets for improvement efforts. The validity of the QIAS scale is supported by its national application. Its reliability is assessed by consistency of evaluators’ ratings (which we found were 100% concordant).

The QIAS rating was applied in a manner consonant with its standard application in two ways. First, the QIAS is a rating of the entire center, so the ratings obtained for the center as a whole can be applied to consideration of effects of quality on any subgroup. Thus, it was appropriate for us to apply the rating to a subgroup of children: namely, only 3- to 6-year-old children within the center. We restricted the sample to these children because we were interested in effects on this young age group, which is frequently in child care (at less than 3 years of age, the typical diurnal cortisol patterns are not established). Second, in the standard QIAS application each of the relevant principles is defined and evaluated separately. It is not a psychometric research instrument and neither validity nor reliability is contingent on application as a whole set. Thus, use of a subset of the QIAS quality indicators is valid, as each principle can be considered separately. Indeed, by selecting a relevant set of indicators for a specific research purpose, rather than using all of them, we improve the current ecological validity of the measures (Huck, Cormier, & Bounds, 1974). We therefore chose a subset of the QIAS principles to measure quality in this study because the principles represent the immediate experiences of each individual child within the group at the center. The principles chosen included those related

**Table 1 QIAS Principles and Levels of Quality Nationally and in This Study**

Principle number	% nationally —high quality	% (& n) this study— high quality	% nationally — satisfactory	% (& n) this study— satisfactory	% nationally—unsatisfactory	% (& n) this study—unsatisfactory
<b>Quality Area 1: Relationships with children</b> <i>2 of 2 principles used in this study</i>						
1.1: Staff create a happy, engaging atmosphere and interact with children in a warm and friendly way	93	57 (36)	6	38 (24)	< 1	5 (3)
1.2: Staff guide children’s behavior in a positive way	82	57 (36)	15	38 (24)	3	5 (3)
<b>Quality Area 2: Respect for children</b> <i>3 of 4 principles used in this study</i>						
2.1: Staff initiate and maintain communication with children, and their communication conveys respect and promotes equity	84	57 (36)	14	38 (24)	2	5 (3)
2.2: Staff respect the diverse abilities and the social and cultural backgrounds of all children and accommodate the individual needs of each child	81	37 (23)	15	38 (24)	4	25 (16)
2.3: Staff treat children equitably	81	41 (26)	15	33 (21)	< 1	25 (16)
<b>Quality Area 3: Partnerships with families</b> <i>1 of 3 principles used in this study</i>						
3.1: Staff and families use effective spoken and written communication to exchange information about individual children and about the center	74	49 (31)	24	51 (32)	2	0
<b>Quality Area 4: Staff interactions</b> <i>1 of 1 principles used in this study</i>						
4.1: Staff communicate effectively with each other and function well as a team	83	48 (30)	17	52 (33)	< 1	0
<b>Quality Area 5: Planning and evaluation</b> <i>2 of 4 principles used in this study</i>						
5.1: Programs reflect a clear statement of center philosophy and a related set of broad center goals	64	38 (24)	25	33 (21)	10	29 (18)
5.3: Programs cater to the needs, interests, and abilities of all children in ways that assist children to be successful learners	78	62 (39)	17	27 (17)	5	11 (7)
<b>Quality Area 6: Learning and development</b> <i>1 of 6 principles used in this study</i>						
6.1: Programs encourage children to make choices and take on new challenges	81	48 (30)	16	41 (26)	3	11 (7)
<b>Quality Area 7: Protective care</b> <i>3 of 4 principles used in this study</i>						
7.2: Staff supervise children at all times	79	44 (28)	17	51 (32)	4	5 (3)
7.3: Toileting and nappy [diaper] changing procedures are positive experiences and meet each child’s individual needs	74	38 (24)	25	57 (36)	1	5 (3)
7.4: Staff ensure that children are dressed appropriately for indoor and outdoor play and that rest/sleep time and dressing procedures encourage self-help and meet individual needs for safety, rest, and comfort	76	52 (33)	14	40 (25)	10	8 (5)
<b>Quality Area 8: Health</b> <i>No principles of 4 used in this study</i>						
<b>Quality Area 9: Safety</b> <i>No principles of 3 used in this study</i>						
<b>Quality Area 10: Managing to support quality</b> <i>1 principle of 4 used in this study</i>						
10.2: Staffing policies and practices facilitate continuity of care for each child	85	46 (29)	15	54 (34)	< 1	0



to relationships between caregiver and child, respect for children, partnership with parents, planning and evaluation, staff interactions, learning and development, and protective care (see Table 1).

We took written observations of practice in each group and used those observations to rate the center on each of the principles. We used a 3-point scale: unsatisfactory, satisfactory, and high quality. (Note that we were rating groups within a center, as we chose principles related to group operations rather than whole-center operations, whereas the national system rates the center as a whole.) The written observations for 4 of the 16 centers (12 groups total, as each center had 3 groups) were then provided (anonymously) to a federally trained evaluator who used the observations to assess the 4 centers across the same QIAS principles. This independent classification yielded 100% concordance with our own classifications.

## Cortisol

The ease of collection of salivary cortisol (Gunnar & White, 2001) has made it very popular as a biomarker of activation of the HPA axis (Gerra et al., 2001). In this study, we decided to collect saliva samples twice a day (before morning and afternoon tea time) over three days (Dettling et al., 1999; Tout et al., 1998) in order to balance respondent load for children, cost of laboratory analysis, and the need for valid cortisol results. Saliva was collected using the approach recommended by Gunnar and White (2001). This involved washing the child's mouth with water, then asking the child to chew on a small eye spear (a small swab fixed on the end of a stick). This was held by an adult so the child could not accidentally swallow the collection tool. The eye spear was immediately stored in a sterile test tube and frozen, and was later sent to a commercial laboratory for analysis. The laboratory used the Coat-A-Count cortisol kit and a radioimmunoassay procedure to analyze the samples.

## Cortisol change

We were interested in cortisol changes from morning to afternoon and categorized children according to four potential shifts. For each child, we determined the difference between the morning and afternoon levels on each day. Based on previous work, a change in cortisol level of 0.94 nmol/L up or down was used as our point to classify children into four categories of consistent cortisol reaction.

Group 1: Children who showed a consistent decrease in cortisol levels. Any children exhibiting a decrease between morning and afternoon above the criterion level of 0.94 nmol/L for at least two of the three consecutive days of testing were labelled "down" ( $n = 33$ ; 31%).

Group 2: Children who showed an increase in cortisol levels. Any children exhibiting increases between morning and afternoon above the criterion level for at least two test days were labelled "up" ( $n = 17$ ; 16%).

Group 3: Children whose cortisol levels did not change. Any children demonstrating no change between morning and afternoon greater than the criterion level for at least two test days were labelled "flat" ( $n = 32$ ; 30%).

Group 4: Children with fluctuating increase, decrease, or no change. These were effectively a control group of children who did not consistently show any of the three previous patterns and were thus labelled "mixed" ( $n = 24$ ; 23%).

The division into these groups meant that each category had a different number of children. When this happens, it important check whether the spread of scores within each group is similar to the spread within the other groups. If so, a statistical test of difference between the groups is reliable. We performed a Levene's test of error matrices, which showed that the spread of scores in each group was comparable; thus, we could reliably compare the four groups ( $F(3, 102) = .931, p = .429$ ).



## Findings

We compared the center quality scores for children in each of the four listed groups using ANOVA ( $F(3, 102) = 2.84, p = .041$ ) and a follow-up analysis to find which groups differed most using Tukey's honestly significant difference (HSD). It showed that one significant difference occurred. Children in the cortisol down category were associated with high-quality centers (mean quality score = 35.60) more than cortisol up children (mean quality score = 29.95) ( $p = .025$ ). This difference is illustrated in Figure 1.

Follow-up analyses repeated the ANOVA and follow-up test on each quality indicator separately to identify which quality indicators were associated with cortisol reactions. Significant results are identified in Tables 2 and 3. Table 4 treats each quality indicator separately.

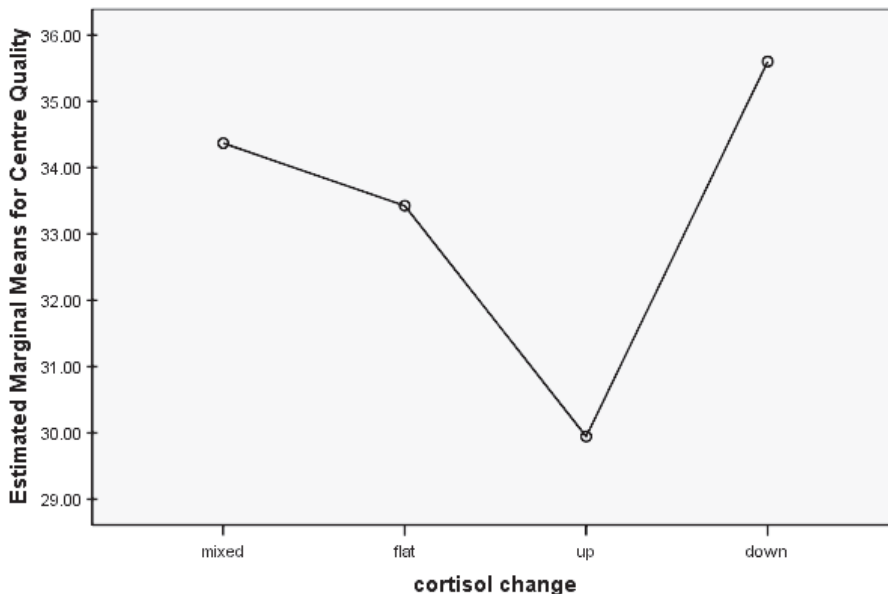
## Discussion

This study supports the work of Dettling et al. (2000) and Sims, Guilfoyle,

*Cortisol Changes and the Quality of Child Care in Australian Preschool and Kindergarten Children and Parry (2005, 2006)*. It demonstrates that high-quality child care, as measured by a set of principles representing the immediate experiences of each individual child within the group at the center and related to relationships between caregiver and child, can be associated with beneficial cortisol changes. Children who show a consistent decrease in cortisol response across the day are attending high-quality programs. Poor-quality child care is associated with cortisol changes that are not good for children; that is, increased cortisol responses across the day were associated with low-quality care. The results are further validated by the fact that children who demonstrated a flat cortisol trajectory, wherein their stress remained relatively unchanged across the child-care day, attended centers where the quality score was approximately midway between the scores of the high- and low-quality centers.

We found, notwithstanding causes of external stressors, that children's stress responses are (concomitantly, perhaps)

**Figure 1**  
**Mean Center Quality across Categories of Cortisol Change**



**Table 2 Principles Reaching Significance**

Quality Principle	
2.2	Respect for children: respecting social, cultural, and individual needs
2.3	Respect for children: treat equally
3.1	Partnerships with families: communication with parents
5.1	Planning & evaluation: programs follow center philosophy
7.2	Protective care: supervise children at all times
7.3	Protective care: toileting and nappy (diaper) changing are individualized

**Table 3 Significant Individual Quality Indicators**

Quality Principle	<i>df</i>	<i>F</i>	<i>p</i>	Tukey's*
2.2	3, 102	3.608	.016	.008
2.3	3, 102	4.020	.010	.005
3.1	3,102	3.629	.015	.016
5.1	3,102	4.374	.006	.003
7.2	3,102	3.952	.010	.007
7.3	3,102	3.802	.012	.003

\* In each case, Tukey's HSD showed a significant contrast between cortisol up and cortisol down only.

**Table 4 Means and Standard Error for Each Significant Individual Quality Indicator**

Quality Principle	Cortisol Change	Cortisol			
		down	up	flat	mixed
2.2	Mean	2.46	1.81	2.19	2.25
	Std. error	.12	.16	.12	.14
2.3	Mean	2.49	1.81	2.19	2.33
	Std. error	.117	.163	.119	.137
3.1	Mean	2.74	2.34	2.52	2.47
	Std. error	.08	.11	.08	.09
5.1	Mean	2.42	1.65	2.19	2.17
	Std. error	.12	.17	.13	.15
7.2	Mean	2.61	2.08	2.33	2.44
	Std. error	.09	.13	.09	.11
7.3	Mean	2.58	2.07	2.37	2.36
	Std. error	.11	.15	.11	.13

vulnerable to the quality of their child-care environments. The child-care quality principles that were significantly associated with beneficial cortisol trajectories were those of demonstrating respect for children, their social and cultural backgrounds and their individuality; those associated with parent partnerships; those specifying levels of supervision; and those concerned with offering a program that is linked to the center philosophy. All of these principles are important components contributing to the development of secure attachments and strong relationships (see Sims & Hutchins, 2011, for a discussion of the strategies used to foster secure attachments). The relationship dimension of quality is important, as secure attachments are known to moderate the stress response (Gunnar et al., 2001; McCain et al., 2007), and thus influence long-term outcomes.

By focusing on associations between discrete care environments and children's stress, we are making the point that it is essential to avoid fixating analyses on debates such as whether parental or alternative care is "best." Our results also show that we should not become overly concerned with teasing out individual stressors. The reality for many parents is that they will need to use some form of child care other than a stay-at-home parent. The issue for many children, then, is less one of parental versus outside child care, and more one of needing quality in both types of care. This being the case, as care service providers, we need to focus our energies on ensuring the quality of the child-care program.

Within the limitations of our study, including its self-selecting participation and associational rather than causal basis and a controlled sample of 3- to 6-year-olds in care for three days per week, our conclusions in principle should transfer beyond child care. They can lend weight to broader research conducted by those concerned with young children's welfare. Our results suggest that the mediating quality of the micro environments that

Cortisol Changes and the Quality of Child Care in Australian Preschool and Kindergarten Children children experience during their early years are important. Caring relationships matter, whether the care is parental, provided through a child-care center, or within institutional or residential welfare-based care (in the context of foster care, adoption, parental imprisonment, or providing child protection from maltreatment, abuse, or neglect). Creating the conditions for high-quality, secure relationships between caregivers and children in a micro care setting can add something to the optimal developmental context for children. Failing to create such relationships, however, can increase or ignore stress and thus, by default, perpetuate any stressors the child is experiencing outside of the care environment.

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