

Children's Stress Levels: An Evaluation Tool to Determine Program Quality

Andrew Guilfoyle, Ph.D.,

Margaret Sims, Ph.D.,

Trevor Parry, D.P.H., D.C.H., F.R.A.C.M.A., F.R.A.C.P.

Abstract

Ideal programme evaluations track the impact of interventions on children's outcomes over a period of years. But longitudinal studies are expensive, results can take a life time to generate, and links between inputs (experiences in the early years) and outcomes (child development, adult success) tend to be identified at the macro-level, so it is impossible to identify micro-inputs and associate these with particular outcomes. Recently, the role of stress and the HPA axis in shaping outcomes have been significant players in a growing understanding of how children's interactions with their environments shape long-term outcomes. Studies with both animals and children indicate that dysregulation of the HPA axis is linked to caregiving and the types of environmental stimuli experienced by infants in the early years of life. Child day care, although often necessary, can also be risky. Patterns of cortisol elevation across the day are commonly found in studies of children's day care. This study examines children's cortisol patterns across the children's days in care, to see if and how they are related to child care quality. Results demonstrate that salivary cortisol levels can be used as an indicator of the quality of child care programmes. They provide an immediate measure of the impact of the child care environment on children. From this immediate impact we can infer longer term outcomes if such exposure is also long term.

Introduction

It is important to better understand both how to evaluate children's stress levels and the impact of the quality of day care on children's stress levels. Optimally, studies of these subjects would use methods that are cost-effective and relatively convenient. In this paper we present data obtained about just such a cost-effective, convenient way to evaluate the quality of day care and its

impact on children's stress levels, from a study conducted recently in several day care programs serving three- to six-year-olds in an Australian city.

Background

Ideal program evaluations track the impact of interventions on children's outcomes over a period of years. Interventions such as the Perry High/Scope and the Abecedarian programs have demonstrated life-changing effects over many years and are regarded internationally as providing the best evidence for the effectiveness of early intervention. Both these studies ably demonstrated the link between children's early experiences and long-term outcomes on a range of social indicators, such as employability, income earning, involvement in the welfare and criminal justice systems, and physical and mental health (Ramey et al., 2000; Schweinhart, Montie, Xiang, Barnett, and Nores, 2005).

There have been a small number of effective longitudinal studies following the development of children through early life and into adulthood. The Otago study in New Zealand is one example, and much new knowledge has been gained from this in-depth study of children across the life span. For example, new insights as to the role of both genetics and environment in shaping outcomes have arisen from analysis of the link between the promoter region of the serotonin transporter (5-HTT) gene and depression (Caspi et al., 2003). The Australian government has recognized the importance of obtaining longitudinal data on children in order to track outcomes and plan effective social policy, and thus the government funded Growing up Australia (<http://www.aifs.gov.au/growingup/home.html>).

Longitudinal studies are expensive. Results can take a lifetime to generate, limiting the timeliness of evidence for professionals who must plan services to address current and urgent priorities. In addition, links between inputs (experiences in the early years) and outcomes (child development, adult success) tend to be identified at the macro level; it is impossible to identify micro-inputs and associate these with particular outcomes. For example, both the High Scope/Perry Preschool Programme and the Abecedarian study demonstrated that quality preschool attendance is somehow linked to decreased welfare dependency in adulthood, but neither was able to identify which components of the program were specifically effective or what the mechanisms were. Until recently, researchers have not been able to provide such information. However, recent collaborations, linking health and medical researchers with social scientists, have created new opportunities for increased understanding.

As an alternative to traditional longitudinal designs, in the past 15 years a number of studies have focused on exploring the ways in which experiences in the world around children affect their biology and thus influence long-term developmental outcomes (Sims, 2002). The cortisol story, and the role of stress and the HPA axis in shaping outcomes (Dickerson and Kemeny, 2004) have been significant in this growing understanding.

Cortisol is one of the hormones used by the body to react to stress. Its role is to provide additional energy to fuel the biological stress coping mechanisms (such as additional vigilance and raised levels of awareness and activity). In adults, cortisol production follows a circadian rhythm, with a peak in the morning associated with waking and a nadir at night associated with sleeping (Adam, 2003). In regular circumstances, it is expected that infants will establish this diurnal rhythm in cortisol levels (de Weerth, Zijl, and Buitelaar, 2003) and learn to regulate their cortisol reactions so that transitory peaks (resulting from

instinctive responses to triggers such as fear, uncertainty, and anxiety) are quickly reduced to basal levels.

Although these transitory peaks are thought to enable humans to increase alertness in order to deal with a stressful situation (Keenan, Grace, and Gunthorpe, 2003), chronic activation of the HPA system is known to have much more negative long-term outcomes in the areas of health and other variables that can be linked to increased child welfare support. Chronically high levels of cortisol are associated with:

- hypertensive illnesses (such as heart attacks and strokes);
- other health concerns, such as diabetes, chronic fatigue syndrome, and severe rheumatoid arthritis;
- mental health problems, such as depression, internalization problems, extreme behavioral inhibition, obsessive-compulsive disorder, panic disorder, and withdrawal;
- memory problems;
- poor school performance;
- cognitive impairments; and
- anti-social behavior and delinquency.

Likewise, chronically low activation of the HPA system is linked with:

- anxious and withdrawn behaviors and other behavior problems;
- depression and posttraumatic stress disorder;
- excessive immune responsivity;
- premenstrual tension syndrome;
- rheumatoid arthritis and chronic fatigue syndrome (Adam, 2003; Yashmin, Karten, and Cameron, 2005).

Gunnar and Vazquez (2001) suggested that hypercortisolism may be associated with an active coping response to stress and hypocortisolism with a passive coping style; however, it is not clear what causes these different cortisol responses, although a number of pathways have been explored.

Hypercortisolism is defined as chronically high levels of basal cortisol and/or the inability to quickly reduce cortisol levels once triggered by transitory stress-provoking stimuli. *Hypocortisolism* is characterized by chronically low levels of basal cortisol and/or the inability to elevate cortisol despite being triggered by stress-provoking stimuli (Luecken and Lemery, 2004). In addition to differences in coping style, it appears that differential patterns of cortisol responsivity might be linked to the nature of the chronic stress to which children are exposed, the external resources available to assist the child to cope (for example, the ability of adults involved with the child to provide some form of buffering; Gunnar, Sebanc, Tout, Donzella, and Dulmen, 2003), and to characteristics within the child himself or herself (e.g., temperament, executive function, self-regulation; van Bakel and Riksen-Walraven, 2004).

Studies with both animals and children indicate that dysregulation of the HPA axis is linked to caregiving and the types of environmental stimuli experienced by infants in the early years of life (Gunnar and Cheatham, 2003). Rat pups that experience sensitive caregiving (expressed by maternal licking) were more likely to have lower cortisol levels (Liu, Caldji, Sharma, Plotsky, and Meaney, 2000) than rat pups that are separated from their caregivers at an early age. The latter group demonstrate atypical cortisol responsivity (Meaney, 2001).

In humans, Gunnar and others (e.g., Gunnar, Bruce, and Hickman, 2001; Larson, White, Cochran, Donzella, and Gunnar, 1998) have shown that children who receive sensitive caregiving in the first three months of life show a decline in cortisol responsivity over this time. Children who are securely

attached to their caregivers demonstrate transitory peaks when stressed, but their cortisol levels quickly return to baseline. In contrast, cortisol levels of infants who have insecure attachments remain at high levels for much longer periods of time (Gunnar, Brodersen, Nachmias, Buss, and Rigatuso, 1996). Children who receive sensitive and responsive caregiving are more likely to demonstrate lower levels of cortisol than children who are left on their own to manage stress-inducing situations. These patterns of reactivity appear even when caregivers are instructed to respond to signs of distress (Gunnar, Larson, Hertsgaard, Harris, and Brodersen, 1992), demonstrating that cortisol responses are not always detectable by overt behavior (Smider et al., 2002).

A number of studies have investigated cortisol levels in children who are exposed to various degrees of risk. For example, children in stepparent and foster families are found to have higher cortisol levels than children living with their biological parents. Of stepchildren and biological children within a single household, stepchildren were found to have higher cortisol levels (Flinn and England, 1995). Maltreated children living in foster homes, where foster parents were involved in an early intervention program, demonstrated changes in cortisol patterns in the direction of more "normal" daily trajectories (Fisher, Gunnar, Chamberlain, and Reid, 2000). Children of mothers with diagnosed panic disorder were found to have elevated cortisol levels (Warren et al., 2003). Children who had spent at least eight months in a Romanian orphanage demonstrated higher cortisol levels 6.5 years after adoption than did children who were adopted earlier (Gunnar, Morison, Chisholm, and Schuder, 2001). Children growing up in poverty are exposed to numerous risk factors (including high levels of family conflict, harsh parenting, less parental supervision, and physical danger from family and/or community violence; Sims, 2002), and thus are more likely to demonstrate atypical cortisol reactivity (Blair, Granger, and Razza, 2005). Infants of mothers who experienced

posttraumatic stress disorder (PTSD) as a result of the collapse of the World Trade Center on September 11, 2001 were found to have lower than usual levels of cortisol, particularly if the pregnancy was in the third trimester at the time of the PTSD (Yehuda et al., 2005).

Child care is thought to be a potentially risky context for children: They must separate from their parents each day in order to attend, and have to learn to interact with peers, who may not have sufficient social skills for comfortable interaction (Sims, 2003). Patterns of cortisol elevation across the day are commonly reported in child care studies (e.g., Watamura, Donzella, Alwin, and Gunnar, 2003). Evidence clearly demonstrates that children who receive high-quality child care are likely to demonstrate either smaller increases or actual decreases in cortisol levels across the day—but this is not the case in lower-quality care settings (Sims, Guilfoyle, and Parry, 2005). Although many studies have focused on global measures of quality, in our research we aim to explore more refined and child-centered dimensions of quality.

Although international trends vary, in the Australian context at least, the 2002 ABS child care survey (Australian Bureau of Statistics, 2003) indicated that approximately a third of all Australian children under one year of age experience some form of nonparental care on a regular basis. A fifth of these children are in grandparent care (see Goodfellow and Laverty, 2003, for Australian research on grandcaring), and a smaller number are in family day care or long day care. By the time children are four years of age, 88% are in some form of nonparental care, with nearly 60% of this number using grandparent care either as the only form of nonparental care or in combination with other forms of care. Long day care is used by nearly a quarter of all four-year-olds in Australia and family day care by a smaller number.

Australia is experiencing an increasing demand for child care venues; as growing numbers of women participate in the

workforce, the numbers of children in care will continue to rise. Fifty percent of women with partners are in the workforce by the time their youngest child is two years of age. However, more than half of these are likely to be in part-time work, mainly because of their child care responsibilities (House of Representatives Standing Committee on Family and Human Services, 2006). More women would choose to work (13%) if child care were available; this would increase female workforce participation rates by a further 2.3% to 68.5%. The link between women's employment rates and availability of appropriate child care is very strong: across 20 OECD countries, 40% of the variation in female employment is explained by the use of formal child care alone. Thus, the availability and quality of day care influences the short and long-term well-being of children and their parents, and also the nature of the workforce available to countries.

This study examines children's cortisol patterns across the child care day spectrum, with the aim of identifying their responses to different levels and dimensions of child care quality.

Methodology

Participants

Child care centers in one city were approached to participate in the study. The data in this report come from 16 centers, all of which are community-based with one small private center the only exception. Data collection is ongoing. In each center, families of all children who attended for a minimum of three days a week were approached to participate. As 69.6% of Australian children are likely to attend child care for less than three days a week (Australian Bureau of Statistics, 2003), this limited qualifying numbers. However, the necessity to collect data over a period of days made this requirement important. This paper reports on data collected from 117 children aged three to six years. Data on infants and toddlers are reported in other papers (e.g., Sims, Guilfoyle, and Parry, 2006a).

Measures

Child Care Quality

Child care quality was measured using the national Australian Quality Improvement and Accreditation System (QIAS) (National Childcare Accreditation Council, 2001a, 2001b). This identifies 35 principles of quality service delivery. Each principle has performance indicators identifying practice at unsatisfactory, satisfactory, and high-quality levels. The system is used nationally to accredit child care centers, and there are nationally trained validators and moderators who examine evidence produced by centers to determine the accreditation outcome. For this study, 14 principles were selected (see Table 1) that best reflected the day-to-day experiences of children within the group where they spent their time (i.e., principles were chosen to reflect experiences within the child's group rather than procedures operating at center level). Written observations were taken within each group over a period of 5 to 10 days, depending on the number of children in the group participating in the study. These written observations were used to obtain a rating for each of the principles chosen. A sample of 25% of observations was given to a nationally trained validator to check the accuracy of the ratings. There was 100% concordance in these ratings. (See Table 1 next page.)

Stress levels

Salivary cortisol is used as an indicator of children's stress levels. Saliva samples were taken before morning tea and before afternoon tea over three days. Twice a day is the minimum recommended collection interval to identify changes in salivary cortisol over time (Gunnar and White, 2001). Average morning and afternoon levels were calculated from the three days of measurement (Dettling, Gunnar, and Donzella, 1999; Tout, De Haan, Campbell, and Gunnar, 1998). Saliva was collected following the recommendations of Gunnar and White.

Procedure

Once permission was granted by the center coordinator and staff, information was sent home to parents through the center. It was necessary to obtain permission from parents of all children in a group, even when a child was not a target (participating) child, because observations for quality assessment could have involved any child in the group. Where a parent withheld permission, if it was possible to collect data on days when their child was not present, this was undertaken. If exclusion of the child was *not* possible, the group was not included in the study.

A research assistant (a trained caregiver) spent between 5 and 10 days at each center collecting saliva samples and taking written observations. It was not possible to collect full data sets for all children whose parents had given permission. Sometimes this was because children did not attend the center on the days they were expected, and other times it was because children did not want to participate in saliva collection. Children were never pressured to do so. Table 2 shows the numbers of children who were finally included in the analyses. For several of the principles, numbers in the unsatisfactory quality level were too small, and thus this level of quality was excluded in these cases.

Analyses

We began by examining cortisol data for normality: variance-covariance matrices and equality of error variances were also examined. Natural log transformations were applied to facilitate normality. A full explanation of the data screening is provided in Sims, Guilfoyle and Parry (2006b), or can be obtained from the authors.

Following this we undertook split-plot analyses of variance for each principle, to examine the impact of the levels of quality on changes in cortisol levels across the day. For the majority of the principles, there were insufficient children in groups rated unsatisfactory to include this quality level in

Table 1 Principles Selected to Measure Day Care Quality

Principle number	Descriptor
	<i>Quality Area 1: Relationships with children</i> 2 of 2 principles used in this study
1.1	Staff create a happy, engaging atmosphere and interact with children in a warm and friendly way
1.2	Staff guide children's behavior in a positive way
	<i>Quality Area 2: Respect for children</i> 3 of 4 principles used in this study
2.1	Staff initiate and maintain communication with children, and their communication conveys respect and promotes equity
2.2	Staff respect the diverse abilities and the social and cultural backgrounds of all children and accommodate the individual needs of each child
2.3	Staff treat children equitably
	<i>Quality Area 3: Partnerships with families</i> 1 of 3 principles used in this study
3.1	Staff and families use effective spoken and written communication to exchange information about individual children and about the center
	<i>Quality Area 4: Staff interactions</i> 1 of 1 principles used in this study
4.1	Staff communicate effectively with each other and function well as a team
	<i>Quality Area 5: Planning and evaluation</i> 2 of 4 principles used in this study
5.1	Programs reflect a clear statement of center philosophy and a related set of broad center goals
5.3	Programs cater to the needs, interests, and abilities of all children in ways that assist children to be successful learners
	<i>Quality Area 6: Learning and development</i> 1 of 6 principles used in this study
6.1	Programs encourage children to make choices and take on new challenges
	<i>Quality Area 7: Protective care</i> 3 of 4 principles used in this study
7.2	Staff supervise children at all times
7.3	Toileting and diaper-changing procedures are positive experiences and meet each child's individual needs
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
	<i>Quality Area 8: Health</i> No principles of 4 used in this study
	<i>Quality Area 9: Safety</i> No principles of 3 used in this study
	<i>Quality Area 10: Managing to support quality</i> 1 principle of 4 used in this study
10.2	Staffing policies and practices facilitate continuity of care for each child

Table 2 Numbers of Children with Complete Data Sets

Principle	N of children in high-quality groups	N of children in satisfactory-quality groups	N of children in unsatisfactory groups	Total N of children with complete data sets for analysis
1.1	39	25	3	67
1.2	40	24	3	67
2.1	39	25	3	67
2.2	26	26	15	67
2.3	29	23	15	67
3.1	35	32	0	67
4.1	33	34	0	67
5.1	28	22	17	67
5.3	42	17	8	67
6.1	32	27	8	67
7.2	32	32	3	67
7.3	28	36	3	67
7.4	36	26	3	65
10.2	33	34	0	67

the analyses (see Table 2); thus, unsatisfactory was included in analyses only for Principles 2.1, 2.3, and 5.1, and in the overall quality rating. The overall quality rating was calculated by summing the results for each of the principles.

Results

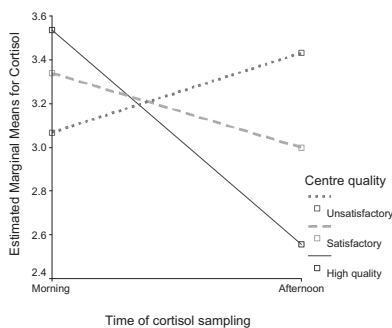
Overall quality

There is a significant interaction effect between time and comparison center, $F[1, 60] = 3.94, p < .05$ (see Figure 1). Children in high-quality centers demonstrated a decline

in cortisol levels across the day, whereas children in low-quality centers showed an increase.

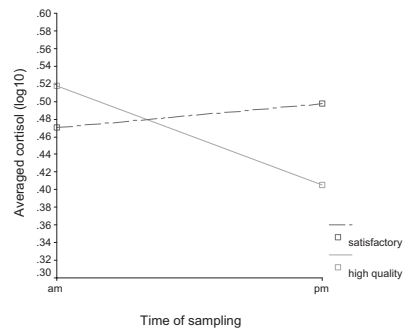
For both the principles in Area 1 (relationships with children), significant differences were found between cortisol patterns and quality level (Principle 1.1 $F[1,58] = 7.19, p = .010$; and Principle 1.2 $F[1,35] = 11.60, p = .002$). Figure 2 illustrates this pattern for Principle 1.1. Children in high-quality centers show a decline in cortisol across the day, whereas those in satisfactory centers show little change.

Figure 1: Cortisol Patterns for Overall Quality Ratings



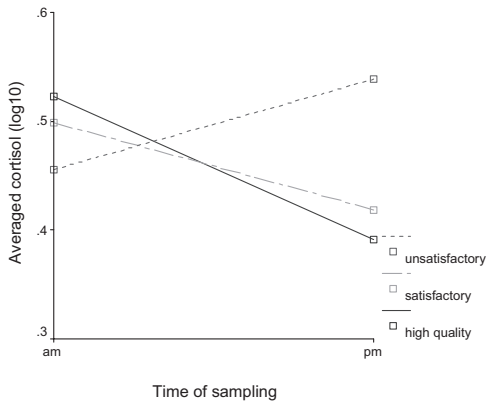
Quality as relationships—Quality Areas 1, 2, 3, 4 and 10

Figure 2: Cortisol patterns for Principle 1.1: Relationship dimension of quality

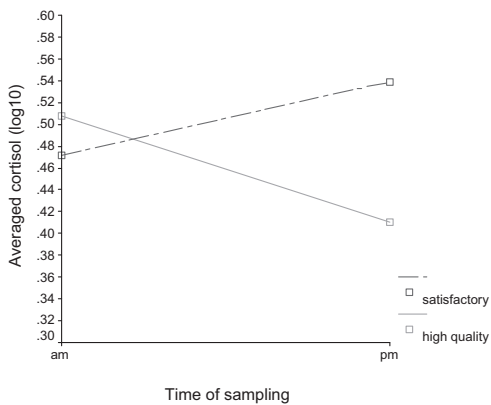


Quality Area 2 (respect for children) is also a component of relationships.

**Figure 6: Cortisol Patterns for Principle 5.1:
Quality Area Planning and Evaluation**

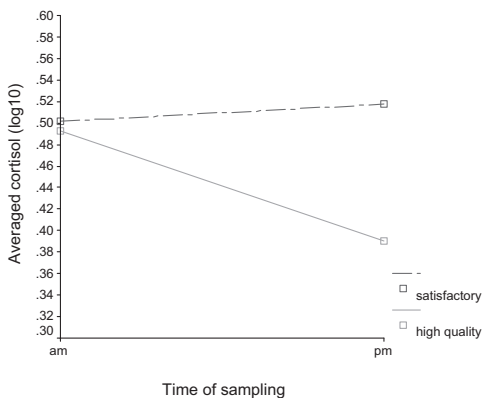


**Figure 7: Cortisol patterns for Principle 5.3:
Quality Area Planning and Evaluation**



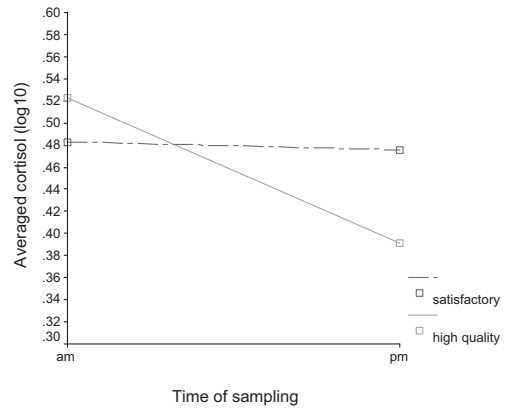
A significant difference was also found in the area of learning and development (Principle 6.1 $F[1,54] = 4.69, p = 0.035$), where children from high-quality and satisfactory programs show different cortisol patterns (see Figure 8).

**Figure 8: Cortisol patterns for Principle 6.1:
Quality Area Learning and Development**



Two of the three principles in the area of protective care showed significant differences between children in satisfactory and high-quality centers (Principle 7.2 $F[1,58] = 4.69, p = 0.035$; and Principle 7.3 $F[1,58] = 5.46, p = 0.023$). See Figure 9.

**Figure 9: Cortisol patterns for Principle 7.3:
Quality Area Protective Care**



Discussion

It is clear that children's stress reactions (measured through salivary cortisol) can be used to distinguish between different quality levels of service delivery in child care. In some areas there is a clear differentiation between children's reactions to satisfactory and high-quality programs, whereas in others the difference is clear between unsatisfactory, satisfactory, and high-quality. This is most probably a reflection of the performance indicators used to identify these categories. However, what the results do suggest is that the performance indicators for a number of the quality variables, particularly those associated with relationships, should be modified. Satisfactory performance under Principles 1.1, 1.2, 2.1, 3.1, 4.1, 5.3, 6.1, 7.2, and 10.2 shows children's cortisol levels that either remain unchanged or increase across the day. Centers can be accredited at this level of performance, but we believe this is not acceptable, particularly as long-term chronic stress is linked to a range of undesirable outcomes for children, as discussed earlier.

This research demonstrates that salivary cortisol levels can be used as an indicator of the quality of child care programs. They provide an immediate measure of the impact of the child care environment on children. From this immediate impact, we can infer longer-term outcomes if such exposure is also long-term. Children attending centers over a period of some years, who finish the day more stressed than they should be, are those most likely to experience undesirable long-term outcomes. If that chronic stress is also experienced in the home environment, these children are likely to establish an atypical circadian rhythm that they will carry into adulthood, affecting their long-

term physical and mental health, well-being, and overall functioning. However, the relative importance of home and out-of-home experiences has yet to be clearly established, although research indicates that the home influences are likely to be much more significant (e.g., NICHD Early Child Care Research Network, 2005). The question then becomes the extent to which high-quality child care programs (or other forms of child care) can mediate home influences and the extent to which low-quality child care experiences can exacerbate them. This question will be explored in further papers arising out of this research project.

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Andrew Guilfoyle, Ph.D., is a senior Research Consultant with the Faculty of Business and Law at Edith Cowan University in Perth, Western Australia. He has won large scale grants and conducts national research examining his focus on quality of life and community well being, particularly for at risk groups including Indigenous Australians, children, youth and the elderly. Recent projects include; Towards a National Indigenous Child Care Plan; Building Resilience against Suicide in the Southwest of Australia; Measuring Youth Participation, National Scoping Study.

Margaret Sims, Ph.D., is an Associate Professor at Edith Cowan University in Perth, Western Australia, where she co-ordinates the community work degree programmes. She has an interest in quality community-based services for children and family, and this includes a long-time involvement in child care services. Her work using cortisol as a biomarker of stress for children in child care has been published widely (see <http://www.ecu.edu.au/ses/iccs/cware/cfs/index.html>; <<https://staffmail.ecu.edu.au/exchweb/bin/redir.asp?URL=http://www.ecu.edu.au/ses/iccs/cware/cfs/index.html>>) and was used as the basis of a documentary screened nationally in Australia in 2006 ("Life at One" see <http://abc.net.au/tv/life/> <<https://staffmail.ecu.edu.au/exchweb/bin/redir.asp?URL=http://abc.net.au/tv/life/>>). The documentary was nominated for a Logie - the national Australian TV awards. She has extensive community work experience in a range of services including early intervention, family support and community living support for people with disabilities.

Trevor Parry, D.P.H., D.C.H., F.R.A.C.M.A., F.R.A.C.P., is a developmental pediatrician and Associate Clinical Professor, School of Paediatrics and Child Health, University of Western Australia. He is a graduate of the West Australian Medical School and following time in Fiji and Sarawak undertook postgraduate studies in the United Kingdom in Public Health, Child Health and Developmental Paediatrics. He is a past Vice-President of the former Australian College of Paediatricians, an Emeritus Consultant at Princess Margaret Hospital, a Member of the National Board of NIFTEY (the National Investment for the Early Years) and founder and Chair of its State Branch. He has been much involved in medical education as well as public education with particular reference to parenting, child development and the importance of the early years.