Psychological and Neuroendocrinological Sequelae of Early Social Deprivation in Institutionalized Children in Romania

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ETHICAL FRAMEWORK FOR RESEARCH ON SEVERELY DISADVANTAGED CHILDREN

The situation of infants and children living in state-operated residential institutions in Romania provides a setting in which the consequences of severe social deprivation can be examined. These children experience a form of custodial care in which their medical and nutritional needs are met, but their social and psychological needs are not. The tens of thousands of infants and children from birth to age 3 living in the institutions known as *Leagane* (meaning cradles) are but the leading edge of the hundreds of thousands of children spending much or all of their lives in institutional care. This high prevalence of institutional care for children peaked in the two decades prior to 1990, during the political era of Nicolae Ceausescu. His social and economic policies forced families to bear more children than they wanted or could afford, resulting in around 2% of the population being cared for by the state until they reached the age of 18. Over the 5 years since the fall of Ceausescu's regime, the economic and social instability (resulting from an uncertain transition to a market economy and democratic political rule) has not produced the expected reduction in the rate of admission of infants and children to these institutions.[1]

Romania is not unique among industrialized countries in employing institutional remedies for children affected by complex societal problems. We believe it is scientifically and ethically imperative to analyze the developmental deficits of such children within the context of the social and material resources available to them and their families, that is, not to decouple the social cause from the developmental consequences. We hold that the empirical validity of developmental studies of socially and economically disadvantaged children is threatened when any child is examined in isolation from their immediate social context and those societal factors that have an impact on their families and communities. Study of the deficits or capacities of the decontextualized child can lead to invalid attributions of intrinsic causation within the child (e.g., genes for temperament, IQ) rather than to those sequences of regulatory

events that have given rise to the child's phenotypic features. It is this perspective, one that combines ethical and social imperatives with scientific investigation, that provides the rationale for this study.

Studying children in a situation of extreme deprivation provokes such a strong response that pursuing an ethical voice to govern one's work would seem crucial. We intend to go beyond the guidelines required by human studies procedures in the United States and become advocates for these children at the same time that we assess the consequences of their living conditions.[2] In approaching the Romanian situation, the ethical framework that we used to guide this work is the UN Convention on the Rights of the Child (CRC). This was based on its broad coverage of both the needs and capacities of children and youth and the near universal acceptance of its principles.[3] The CRC introduces a level of ethical analysis that legitimately takes children's issues beyond the family into the international political arena, with the awareness that "it is children who pay the heaviest price for our short-sighted economic policies, our political blunders, and our wars."[4]

Children's rights can be characterized in three broad categories: (1) survival (right to basic needs such as shelter, nutrition, and access to medical services); (2) care/protection (right to education, play, culture, leisure, religion, and protection from exploitation, and (3) participation (right to voice, to association, and to information). As a legal document, the intent is that these rights would be specified in national legislation, but as principles for developmental research, clinical medicine, and public health, these rights can be thought of as a framework to guide research, treatment, and services for children without the need for legal sanctions. Of all the categories of rights, participation rights are the most controversial and to us the most important, as they view the child as a citizen. The democratization of children does not separate the child and his/her family, but specifies the rights of families "to provide direction in a manner consistent with the evolving capacities of the child." For young children, caretaker/community participation is critical, as are the developing capacities of the child to initiate and have an opinion in the growth of biological and psychological competence.

EPIGENETIC FACTORS IN BRAIN DEVELOPMENT, DAMAGE, AND SENSORY DEPRIVATION

The demonstration of a direct relation between the tactile modality and social deprivation was established in the laboratory of Harry Harlow where it was shown that tactile contact was a stronger determinant of attachment to a surrogate mother than feeding and that tactile (but not visual or auditory) deprivation was a critical determinant of the autistic-like behavioral syndrome that resulted from early social deprivation.[5] These studies were continued by Mason[6] and many others, including one of the authors.[7]

For the last two decades an important goal of neurophysiological studies of somatic sensory cortex has been to establish cerebral localization of tactile discrimination capacity in primates and to gain an understanding of the role of the tactile system in the development and maintenance of tactile capacity and social behavior.[8] Components of this research program have included studies of the neural and behav-

ioral effects of localized surgical lesions of somatic sensory area of the cerebral neocortex in fetal, infant and juvenile, and adult primates,[9] along with studies of prenatal and early postnatal tactile deprivation (produced by reversible peripheral nerve crush). Unlike research in the visual system in which early deprivation results in enduring modifications of cortical circuitry, these studies of fetal and neonatal macaques with primary somatic sensory cortex (SI) lesions demonstrated a remarkable level of tactile sparing/recovery, and SI topography is not permanently altered after months of perinatal sensory deprivation (studies in progress). Based on anatomic studies in other modalities and other studies of early thalamocortical projections to SI and secondary somatic sensory cortex (SII), this lack of persisting deficits after SI or SII lesions may be due to the stabilization of early exuberant and normally transient pathways.[10] Similarly, months of tactile deprivation in fetal and neonatal macaques have resulted in no permanent cortical changes or lasting sensory deficits. The results of this body of work, much of which has been conducted in the laboratory of the first author, suggest that early tactile deprivation does not work at the level of cortical processing of sensory input. It is in response to the more recently developing work on stress hormone regulation by the hypothalamic-pituitary-adrenal (HPA) system that we aim to better understand how neurodevelopmental events might explain the profound and enduring behavioral consequences of early tactile deprivation in human and nonhuman primates.

NEUROENDOCRINOLOGY OF STRESS, COGNITIVE DEVELOPMENT, AND GROWTH

The proposed studies were conceived from the finding in the HPA system that early tactile deprivation reduced the number of the stress hormone or glucocorticoid (GC) receptor binding sites in the hippocampus and frontal cortex, but not in the hypothalamus, pituitary, septum, or amygdala.[11] A working model of molecular events involved in the upregulation of GC receptors by touch begins with an increase in plasma thyroid levels, leading to an increase in serotonin (5-HT) turnover, followed by increases in cAMP and activation of cycle nucleotide-dependent protein kinases. A transcription factor (AP2) is activated in this cascade in hippocampal neurons within minutes of handling/touch, and the promoter region of the human GC receptor gene has numerous binding sites for AP2, all making a strong case for the role of touch in GC receptor gene regulation.[12] Downregulation of GC receptors in nonhandled rodents results in a compromised negative feedback loop along the HPA axis and chronically elevated levels of circulating GC due to poor reactivity control.[13] Tactile experience beyond the preweaning period in touch-deprived rodents does not compensate for early deprivation, indicating a critical period for this effect.[14] Further studies in these rodents demonstrate that the same hippocampal neurons (CA3 and CA1 pyramidal cells) that characteristically contain GC receptors degenerate prematurely as a consequence of persistently elevated stress hormone levels,[15–17] resulting in forms of memory loss associated with hippocampal damage.[18] The molecular and cellular mechanisms by which these high GC concentrations threaten hippocampal neurons are not ones of direct toxicity but rather of indirect endangerment to make the neurons more vulnerable to any coincident insult (i.e., hypoxia-ischemia, epileptic seizures,

hypoglycemia, toxicity, and trauma). Glucocorticoids inhibit glucose utilization in hippocampal neurons, inducing an energetic vulnerability that in combination with activation of an excitatory animo acid/calcium cascade stimulated by the coincidental insult can lead to cell death.[19]

ASSESSMENT OF STRESS HORMONE AND PHYSICAL AND PSYCHOLOGICAL DEVELOPMENT IN 2–3-YEAR-OLD CHILDREN IN *LEAGANE*

In the wake of Ceausescu's assassination in December 1989, images of the severe deprivation experienced by generations of institutionalized infants and children in Romania were shocking. The revelation that infants could be so grossly neglected seemed unfathomable, given the knowledge accumulated over the last century on the detrimental consequences of institutional rearing on both physical growth and psychological development. The muteness, blank facial expressions, social withdrawal, and bizarre stereotypic movements of these infants bore a strong resemblance to the behavior of socially deprived macaques and chimpanzees. Most of the children living since birth in these *Leagane* had experienced severe tactile/social deprivation due to the high child:caretaker ratios and custodial rearing practices. In looking for a population of children in whom to examine stress and HPA system regulation, we discovered an early enrichment program in Iasi, Romania, organized by an American psychologist, Joseph Sparling.[20] In this program, two groups of 2-9-month-old infants were randomly assigned to either a social/educational enrichment condition with a child:caretaker ration of 4 : 1 or left in the standard depriving condition with a child:caretaker ratio of 20 : 1. Our familiarity with recent research in neuroendocrinology showing the effects of touch (or handling) on brain and cognitive development led us to think that examination of HPA system regulation in these infants was an appropriate condition in which to evaluate the rehabilitative potential of this intervention. The results of laboratory studies in rodents point to the importance of tactile/social stimulation during the preweaning period on the development of HPA regulation.[21]

In the 9-month period necessary to obtain funding for this study, this intervention program lost its support. Thus, after a 13-month period of enrichment, children in the intervention group were once again living in the depriving conditions. The children in the intervention group had shown significantly accelerated physical growth and mental/motor development compared to the control group during the enrichment period, but they were no longer superior to the control children in either growth or performance 5–6 months after the program ended (as measured on the Denver Development Screening Test). Measures of weight and height, head, triceps and chest circumference, and mental and motor performance (using the Bayley Scales of Infant Development) revealed that the intervention group had lost the advantage obtained from the previous enrichment experience. At this same time, we measured cortisol (using a noninvasive method of obtaining samples of saliva[22]) to determine its level, diurnal variation, and its reactivity to a stressful event. Salivary samples were taken prior to meals on two consecutive days: at 8 AM, noon and 7 PM on Day 1 and again at 8 AM and noon, and at three closely spaced intervals in the afternoon (5 PM, 6:30 PM, and 7 PM) on Day 2. The afternoon period corresponded to intervals

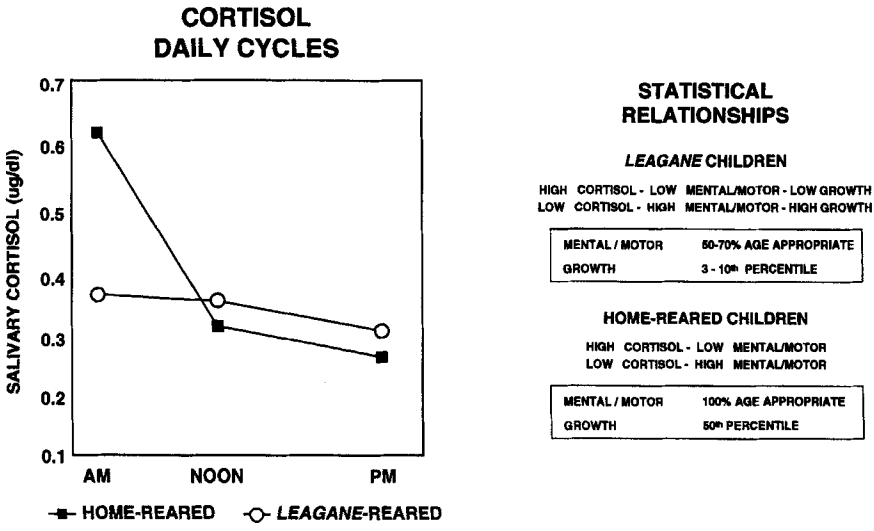

FIGURE 1. Home-reared and *Leagane* children 2 years of age.

before and 15 and 45 minutes after a physical examination, which was introduced as a mild stressor. The AM cortisol levels in the institutionalized *Leagane* children were significantly lower than those in home-reared Romanian children of the same age (FIG. 1) and remained elevated at noon and PM compared to those of the children at home. When the two *Leagane* groups are examined separately (FIG. 2), the control

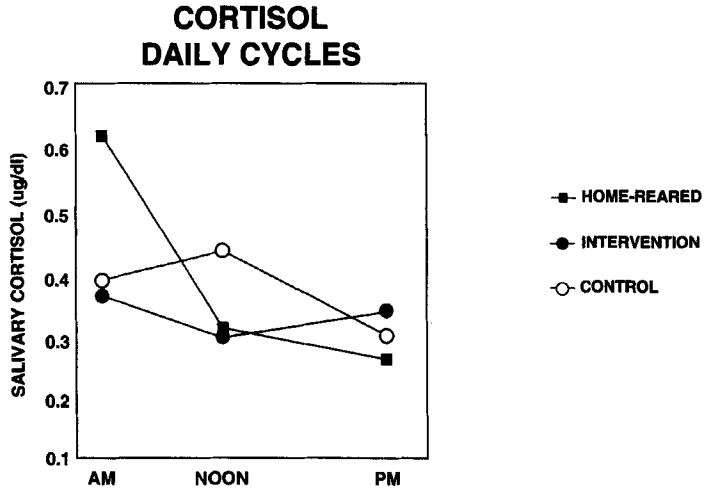

FIGURE 2. Home-reared, intervention, and control *Leagane* children 2 years of age.

group levels can be seen to rise significantly at noon (compared to the intervention group levels). Significant correlations were obtained between levels of cortisol for certain times of day and performance on Denver Tests and Bayley Scales, as well as with physical measures for the *Leagane* children. As a group, the *Leagane* children were strikingly below the Bayley norms and growth norms for their age. Correlations between cortisol and the mental and motor scales of the Bayley (but not with physical growth) were also found for the home-reared children. These children were similar to US children in their psychological performance and physical growth. We have obtained additional measurements from the *Leagane* children as they have moved to pre-school institutions, along with measures of family-reared 2- and 3-year-old children at home and in day-care settings, which we expect to give us insight into the separate contributions of early experience and current context in the regulation of diurnal variation in cortisol secretion and its relationship to mental and motor performance.

Although the rodent studies described above indicate the presence of a critical period for touch to regulate the negative feedback system for glucocorticoids, this intervention program (average age of enrollment at 6 months) may have begun relatively late to confer a significant advantage on development of the HPA system. Studies of the development of stress regulation in normal infants describe a single diurnal pattern emerging at about 12 weeks of age[24] and modulation of stress reactivity occurring at about 4–6 months of age.[25]

STRESS HORMONE AND PSYCHIATRIC AND MEMORY DISORDERS

This study in psychosocially deprived and stressed young children not only carries implications for deficient learning and memory, but also may convey a lifelong vulnerability to certain psychiatric disorders. The results of this research will be compared to clinical studies of psychiatric conditions in adults that reveal similar factors of HPA dysregulation, hippocampal degeneration, and declarative memory loss. A particularly dramatic and paradoxical relationship exists in posttraumatic stress disorder. Patients with this disorder typically have low cortisol levels compared to those of normal individuals or those with other psychiatric diagnoses. One explanation for this phenomenon is that higher levels of the HPA axis (hypothalamus and pituitary) become hypersensitive to circulating levels of cortisol, leading to enhanced negative feedback, thereby inhibiting CRH and ACTH synthesis and/or release responsible for GC secretion in the adrenal gland.[25] The most profound similarity with the work in rodents is the finding of significant hippocampal shrinkage on magnetic resonance imaging (MRI) in patients with posttraumatic stress disorder.[26] The presence of shrinkage is strongly associated with declarative memory deficits, but not other cognitive tasks that are typically spared in patients with temporal lobe amnesia. Both MRI changes in hippocampal volume and verbal memory loss have been associated with the degree of cortisol elevation in Cushing's disease in adults.[27] Elevated endogenous levels of cortisol associated with memory impairment are seen in depressed adults and adolescents,[28] and elevated levels of exogenous glucocorticoids administered for control of asthma have been shown to produce memory deficits and other cognitive changes in children.[29,30]

FUTURE DIRECTIONS

These studies promise to advance the understanding of social factors in the development of HPA regulation in the first few years of life and the impact of this regulation on cognitive, emotional and social development. Although the tragic circumstances of the tens of thousands of infants subjected to profound social deprivation in Romania presents an extreme example, the more normative situation of daily or weekly care facilities in that country suggests wider implications of these findings. We find it remarkable that the categories of rights (survival, care/protection, and participation) that identify both needs and capacities of children, when threatened, are among the most potent activators of the stress hormone system. In the complex and dynamic ecological system in which the child develops, rights can be realized (or violated) by the caretaker and child's access to resources and by their combined capacities to avoid or prevent threats to well-being. Chronic violation of these rights potentially has an impact on life-long HPA regulation and thereby can impair many important biological and psychological functions.

Caution is required in any simple interpretation of these results, as the HPA system is responsive to a wide range of social and nonsocial influences. At least two strong motivations exist to continue the studies so far initiated in the *Leagane* children. The first is to examine in greater detail the situational specificity of the high levels we have so far discovered and to look for changes in HPA activity that might be attributable to changes in caretaking arrangements as children move into different family and educational environments. The other reason is to provide assistance in the massive effort to steer that society in the direction of either drastically improving or altogether eliminating these institutions.

Improving these institutions, as many administrators are striving to accomplish, must be predicated on the assumption that the political and economic climate that characterizes this transitional society will continue to strain the resources of families to care for their children with the ugly consequence that the number of abandoned children will not significantly decrease. Eliminating the *Leagane,* certainly the more desirable alternative, is predicated on a societal determination to find other solutions to care for abandoned infants (e.g., adoption, foster care, and group homes) and to drastically improve the support for families, so that surrendering one's child to the state becomes neither desirable nor necessary.

If our initial findings hold, suggesting that ordinary day care can be particularly stressful for preschool children, then improving the quality of these environments should also be vigorously pursued. The implications for the cognitive and social development of future generations of adults in this society are potentially serious when one considers that most Romanian children spend significant amounts of time in some form of institutional setting. At the same time that we pursue our scientific study of HPA regulation in Romania, we are interested in the applications of this study to other populations of children. One group is represented by Romanian children who have been adopted by caring and relatively affluent families outside of Romania. The results of at least one published account measuring the social adjustment of such a group indicate lasting social deficits (mainly in the form of indiscriminate friendliness) in children who were adopted after spending 9 months or more in a Romanian institution.[31] Another group in whom we are interested are infants and

preschool children attending day care of varying quality in the United States. To date, standards for determining what is quality day care remain crude and very poorly regulated. For the most part, standards for licensure are based on structural criteria such as child/staff ratio, caretaker training, and the types of play and educational materials available. From our perspective, quality should be judged primarily on the basis of social relationships, degree of control and predictability experienced by the child, and the level of consistency in expectations and practices shared by different adults in the child's home and school environments. These are attributes that come close to our concept of rights, such that their absence constitutes a violation of needs (and frustration of capacities) required for satisfactory psychological development. As we observed in the *Leagane* of Romania, adequate physical care can be provided, child/staff ratios can even appear appropriate, yet the subjective level of stress experienced by the child is high, as reflected in diurnal patterns of cortisol secretion.

In light of the evidence from studies of social deprivation in animals and humans of the harmful effects on brain functions of high levels of glucocorticoids in early development, we are reviewing the human literature on the constraints that seem to operate in limiting the degree to which recovery from the effects of profound social deprivation are possible.[32] Although this undoubtedly has implications for the nature of affiliative relations in Romanian society, we are increasingly concerned about the consequences of the growing numbers of children under age 5 who live in poverty in this country (a rate that has increased from 15% to 26% over the last 20 years).[33] When this reality is coupled with the increasing rates of maternal employment, which is the objective of "workfare," and the insufficient supply of satisfactory child care arrangements, the enduring negative effects on child well-being for a large segment of American society should be appreciated. These conditions constitute a warning that child rights are being violated. In not more than one context have we witnessed a call for a return to orphanages in this country.[34] Our work is to complete the construction of a framework that consolidates science and ethics in such a way that prevents our public policy from returning to the use of institutional solutions for children and families for complex social and economic deprivations that have their origins in national and global policies.

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