

The Influence of Stress on Developmental Outcomes in the National Children's Study

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Introduction

Stress is defined as a feeling of distress experienced when demand exceeds an individual's ability to control what is happening in his/her life. Stress has consequences for physical health, primarily when it is chronic, not acute.

The role of stress will be examined in the National Children's Study using a **Multi-Level Interactive Model** that examines the role of the individual, family, neighborhood, school, and community.



Several *white papers on psychiatric, neuropsychological, social/emotional, and motor development*, as well as *workshops on maternal stress and pregnancy, and on gene/environment interactions in the control of behavior* serve as input to the protocol in this area for the National Children's Study. The reports from these can be found on the Study Web site: www.nationalchildrensstudy.gov

Impact of Stress on Health and Development

Stress interacts with health and development in 3 major ways:

1. As an independent predictor of health and development
2. Through interactions with other environmental exposures
3. Through gene-environment interactions

The major health outcomes of concern are:

- Psychiatric and mental health
- Cognitive
- Neurobehavioral
- Social/emotional health and development

1. Independent Predictors of Health and Development

- **Neighborhood and community** characteristics as predictors of behavioral outcomes (e.g., violence)
- **Media exposure** as a predictor of cognitive development and sensitivity to violence
- **Racism** stress can be a predictor of preterm birth
- **Family resources and process** as predictors of school performance and social behaviors
- **Psychosocial stress** during pregnancy as a predictor of birth weight and outcomes, difficult behavior at 3–8 months

2. Interactions with Other Environmental Exposures

Example: Animal research indicates that maternal stress modulates the effects of maternal lead exposure in offspring.

Effects differ by gender: neither lead alone nor stress alone raised corticosterone in female offspring but the combination of stress and lead did. Neurohormones (dopamine, DOPAC, etc.) were higher in females than in males (Cory-Slechta et al., 2004).

Social/Emotional Health and Development Examinations in the National Children's Study

Areas of investigation

- Social competence
- Attachment
- School readiness
- Emotional competence
- Temperament/personality
- Aggression



3. Gene/Environment Interactions

Example: Serotonin transporter gene (rh5-HTTLPR - macaque)

Genes contain "promotor" regions that influence gene expression by turning "off" or "on" and by "up" and "down" regulation. One such example is a receptor in the promotor region of the serotonin gene for stress hormones (a glucocorticoid response element).

Example: Epigenetics (Methylation, acetylation)

One and the same allelic variant can be expressed completely differently depending on the surrounding biological environment, which is influenced by psychosocial (e.g., stress hormones) and other factors (e.g., nutrients).

Genotype is not the sole determinant of function.

Example: Schizophrenia

Although a strong genetic etiology for schizophrenia is now generally accepted (e.g., COMT, DISC1, GABAA, chromosome 22q multimer, etc.), adoption studies with children of schizophrenic mothers indicate that family environment modulates risk of schizophrenia in offspring (Tienair et al., 2004).

Risk of schizophrenia is also increased by famine (St. Clair et al., 2005) and prenatal infection (Rapoport et al., 2005).

Example: Parenting Style Alters Gene Expression

In rats, licking and grooming of infants permanently alters behavioral (fearfulness) and neuroendocrine stress-reactivity (Caldji, 2000). In monkeys, cross-fostering of "high-reactive" monkeys to nurturant mothers creates behaviorally precocious offspring (Suomi, 1997).

Summary

Exposures: Psychosocial and behavioral factors interact with each other and with other environmental and genetic/biological factors to influence health and behavioral outcomes from molecular to systemic levels.

Outcomes: The psychosocial outcomes in this study are complex behaviors that will be investigated from a perspective of multiple influences which vary in importance by developmental stage.

Mechanisms: Mechanisms for these behaviors will be examined from molecular to systemic levels.