

# Prenatal Issues on Development

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- Why should we be concerned about pre-natal issues?
- What prenatal conditions impact development?
- What can we do we identify areas of developmental concern?
- What resources are available?

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## MATERNAL DRUG USE AND INFANT DEVELOPMENT

### Multiple Influences on Children's Development

- Biological and environmental factors interact over time and influence development
- Prenatal substance exposure is one influence on children's development
- Other factors can mitigate or amplify the effects of exposure

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MATERNAL DRUG USE AND INFANT DEVELOPMENT

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**Major Influences Impacting Child Development**

- Quality of prenatal environment
- Child's constitutional makeup
- Parenting
- Social factors

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•What prenatal conditions should concern us the most?

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**Teratogens**

- Agents and conditions, including viruses, drugs, chemicals, stressors, and malnutrition, which can impair prenatal development and lead to birth defects or even death.
- Behavioral teratogens are related to chronic stress, exposure to violence, chaotic or unstable caregiving.
- **Examples of Teratogens:**
  - Environmental Toxins – PCBs, Pesticides, Lead, Mercury
  - Maternal illness, such as *HIV, AIDS, or Rubella*
  - Certain prescription medications
  - Recreational Drugs
  - Environmental stress related to poverty, exposure to violence.

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MATERNAL DRUG USE AND INFANT DEVELOPMENT

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**Common Substances**

- Cigarettes
- Alcohol
- Marijuana
- Cocaine
- Heroin

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PRENATAL DEVELOPMENT

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**Maternal Stress**




Photo: Marilyn Noh

- Includes physiological stress response
- When stress levels are too high for too long or too frequent, risk increases for:
  - Premature birth, low birth weight, and miscarriage
  - Smaller infant head size, mental and motor delays, and greater irritability

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**Adverse Childhood Events**

ACE study: (Anda & Felitti, 1998)

- Demonstrated a link between adverse childhood experiences and lifelong health and quality of life
  - 6 or more ACES = 20 years less in life expectancy
- Looked at: childhood abuse, neglect, and household challenges

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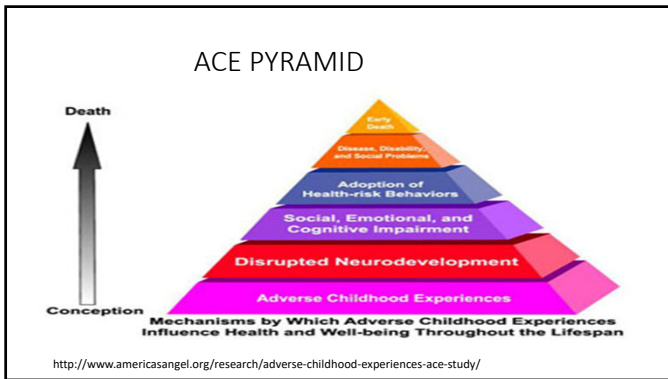
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**Poverty in Nebraska**

- 2014 Kids Count Report in Nebraska - nearly 41% of Nebraska children are growing up in low-income families. A disproportionate number of these children are minorities.
  - 10.7 percent of Caucasian children 17 & younger live in poverty;
  - 44.9 percent for African American children;
  - 42.2 percent for Native Americans;
  - 31.9 percent for Hispanic children.
- The vast majority have parents working 2 or more jobs and earning less than they need to survive.
- Overall, 8% of Nebraskans work multiple jobs, the fifth-highest rate in the nation.

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*How does a child make it through this?*

- ❖ By building resilience
- ❖ Working with the family system
- ❖ Working with multiple caregivers and providers, all of whom are “going to bat” for the child
- ❖ Stability, routines, predictable occupations
- ❖ Helping the brain build a new roadmap

(Van der Kolk, 2014; Koomar, 2009; Perry, 2006)

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•How do we identify problems early?

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**BUILDING THE BRAIN**

**Brain Development in the Prenatal Period**

- Begins with the formation of the neural tube
- Ends looking much like an adult's brain

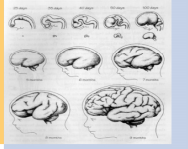


Illustration: Tom Prentiss, from W.M. Cowan, 1979, Scientific American

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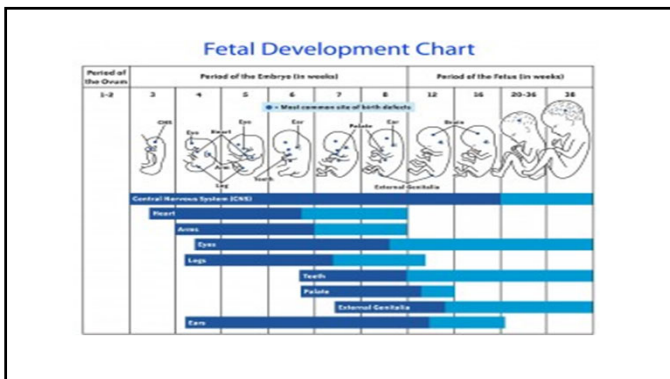
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PRENATAL DEVELOPMENT

### Sensory System Development

TOUCH TASTE AND SMELL	VESTIBULAR HEARING	VISION
FIRST TRIMESTER	SECOND TRIMESTER	THIRD TRIMESTER

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PRENATAL DEVELOPMENT

### Touch



- Begins at 7½ weeks
- Fetus experiences constant touch and containment
- Prenatal touch important to growth and development

Photo: Lennart Nilsson/Albert Brantzen Fotog

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PRENATAL DEVELOPMENT

### Smell



- Amniotic fluid contains many different smells, some from what mother has recently eaten
- Newborn recognizes and prefers smells from in utero

Photo: Lennart Nilsson/Albert Brantzen Fotog

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PRENATAL DEVELOPMENT

### Taste



- Taste buds at 11–13 weeks, sense of taste soon after
- Amniotic fluid contains many different tastes, some from what mother has recently eaten
- Newborn recognizes and prefers tastes from in utero

Photo: Lennart Nilsson/Albert Bonstein Fotog

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PRENATAL DEVELOPMENT

### Hearing



- Begins around 21 weeks
- Background noise in womb equivalent to volume of vacuum cleaner
- Fetus hears sounds from outside womb, although dampened
- Mother's voice most salient

Photo: Lennart Nilsson/Albert Bonstein Fotog

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PRENATAL DEVELOPMENT

### Sense of Movement and Position



- Vestibular system begins to function at 14 weeks
- Fetus experiences own movements and movements of mother
- Vestibular experience is important to development

Photo: Lennart Nilsson/Albert Bonstein Fotog

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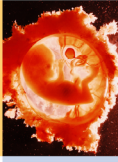
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PRENATAL DEVELOPMENT

### Fetal Movement



- Early movements are sudden and uncoordinated
- As higher brain structures develop, movements can be inhibited and become more coordinated (Hofer, 1981)

Photo: Lennart Nilsson/Albert Bonstein Fotlag

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PRENATAL DEVELOPMENT

### Behavioral Organization

- Amount and pattern of fetal activity are related to amount of infant crying and patterns of infant behavior (DiPietro et al., 1996; DiPietro, Bornstein, et al., 2002; St. James-Roberts & Menon-Johansson, 1999).

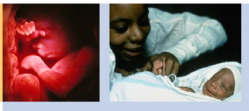


Photo: Lennart Nilsson/Albert Bonstein Fotlag, Polyneph film

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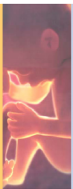
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PRENATAL DEVELOPMENT

### Sleep/Wake States



- State organization emerges at 24 weeks with separation of quiet and active states
- Most of the time, fetus is in active sleep
- Later in pregnancy, quiet sleep increases and a quiet alert state emerges (Hofer, 1981)

Image: Ytaira, 2002

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NEUROBEHAVIORAL OBSERVATION

### Calm Alert State



■ A calm alert state is critical for social interaction, learning, and development

Photo: University of Illinois Extension

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NEUROBEHAVIORAL OBSERVATION

### Self-Regulation



Self-regulation is the ability to manage physiology, arousal, emotion, attention, and behavior appropriately for a task or situation

Photo: Rebecca Klein

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### Neuronal Group Selection Theory (NGST)

Hadders-Algra, 2018

- 2 Phases of motor development: Primary & Secondary
- Primary Phase: Development starts with primary variability wherein the nervous system generates a wealth of self-generated afferent information to shape the developing brain. Prepares the nervous system for the accurate and integrated use of afferent perceptual information to adapt motor behavior in a later phase. The spontaneous motor behavior assists in the "fine-tuning" of the somatosensory cortex.
- Secondary Phase: The nervous system uses the afferent information produced by behavior and experience for selection of the motor behavior which best fits the situation. The selection process is based on active trial and error experiences and involves multimodal information, that is, joint information from multiple sensory systems.

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### Motor learning & selection

Hadders-Algra, 2018

- Especially effective when the infant engages in play with others.
- Infant learns from their own trial & error attempts and from the actions performed by others due to the neural mirroring mechanisms.  
(Wentz et al., 2009)
- Infants profit especially from the observation of others' actions when the infant and partner are involved in mutual imitational play.

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### Organization of Motor Control

- Selection of the most efficient (adaptive) motor strategy.
- By 18 months all basic motor functions have reached the first stages of secondary variability.
- Takes until late adolescence before the secondary neural repertoire has obtained its adult configuration due to the long lasting developmental processes in the brain (dendritic refinement, myelination, extensive synapse re-arrangement) that allow for increasingly complex movement sequences.

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### Attachment

- The enduring emotional bond characterized by a tendency to seek and maintain proximity to a specific figure(s) particularly when under stress.
- Longitudinal Studies: Security of attachment during infancy is linked to the young child's developing capacity for self-regulation, reciprocity and collaborative social interactions.

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Neuroception Stephen Porges, PhD

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Goodness of Fit

- Focus on problems and strengths in the relationship between caregiver and child.

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SENSORY PROCESSING

**Sensory Processing Problems**



- Impair children's ability to learn and to form relationships with others
- Everyday activities are challenging or stressful
- May lead to delays in fine and gross motor skills, language, balance, and visual-spatial skills

Photo: Jeffrey Puffin

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SENSORY PROCESSING

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**Sensory Modulation**

Ability to appropriately respond to sensory input rather than over- or underreacting

<p>LOW SENSORY THRESHOLD</p> <ul style="list-style-type: none"> <li>■ Takes little input to activate the nervous system</li> <li>■ Hyperreactive—may overreact</li> </ul> <p>(Williamson &amp; Anzalone, 2001)</p>	<p>HIGH SENSORY THRESHOLD</p> <ul style="list-style-type: none"> <li>■ Takes a lot of input to activate the nervous system</li> <li>■ Hyporeactive—may underreact</li> </ul>
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**DC:0-5**  
**Sensory Processing Disorders**

- Over-Responsivity Disorder
- Under-Responsivity Disorder
- Other Sensory Processing Disorder
  
- Crosswalks – DSM-5: Other Specified Neurodevelopmental Disorder.  
 ICD-10: Other Disorders of Psychological Development (F88)

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**Sleep**

- Sleep disturbances in children with neurodevelopmental disabilities are extremely common and often a source of stress for the families. The types of sleep disorders are varied and are not generally unique to these populations. However, the prevalence of sleep issues is considerably higher. (Mindel, 2010)

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### Identification of Sleep Disorders

• Key Screening Questions:

- Does your child have any problems at bedtime?
- Does your child have problems falling asleep?
- Does your child wake up during the night?
- Does your child snore or have any problems breathing during the night?
- Does your child have any unusual behaviors during the night?
- Does your child need assistance to wake up in the morning?
- Does your child seem sleepy or overtired during the day?

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#### MATERNAL DRUG USE AND INFANT DEVELOPMENT

### Alcohol Use During Pregnancy

#### Effects on fetal and child health and development

- Not a linear model predicted by dosage or timing alone
- Effects range from subtle changes in IQ to profound mental retardation
- Increased risk for:
  - Fetal growth retardation
  - Birth defects of major organ systems
  - Abnormal brain growth, structure, and functioning (CDC, 2003; Claren et al., 1978; Coles et al., 1991)

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#### BUILDING THE BRAIN

### Dysmigration of Neurons: Fetal Alcohol Syndrome

- Alcohol during the first and second trimesters affect migrating neurons, so that they do not arrange in appropriate layers, but instead migrate haphazardly
- This can result in cognitive deficits, learning disabilities, and behavior problems



Photo: Strengath, 1997

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### Fetal Alcohol Spectrum Disorder (FASD)

- Broad term that describes a range of morphological anomalies and cognitive-behavioral deficits seen in children with prenatal alcohol exposure.
- At one end of the spectrum are severely affected children who show a characteristic cluster of malformations called Fetal Alcohol Syndrome.
  - Dysmorphic facial features including all of the following: small palpebral fissures at or below 10th %ile, smooth philtrum, thin vermilion border. Requires diagnosis by a clinical dysmorphologist.



- Majority of children on the spectrum show only some or none of the morphological anomalies, yet display significant cognitive and behavioral problems.

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### Alcohol Related Neurodevelopmental Disorder

- ARND is term used to describe the continuum of non-dysmorphic complex neurodevelopmental problems that are seen in the absence of clinically discernable morphological anomalies.

• **Accounts for 75 to 80 % of patients.**

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#### Cocaine Use During Pregnancy

##### Effects on fetal and child health and development

- Associated with:
  - "Stress behaviors" in infants (restlessness, irritability, high muscle tone, tremors, and abnormal reflexes)
  - Impairment in neonatal habituation, attentional and arousal regulation, reactivity to novelty, and recognition memory
  - Different brain activity patterns in area of the brain involved in controlling impulses and attention (Dixon et al., 1990; Mayes & Bornstein, 1995; Smith et al., 2001)

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MATERNAL DRUG USE AND INFANT DEVELOPMENT

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**Opiate Use During Pregnancy**

Effects on fetal and child health and development

- Results in:
  - Decreased nutrition to fetus
  - Altered fetal brain wave patterns
  - Depressed fetal breathing activity
  - Irregular blood sugar levels
  - Increased risk of stillbirths and fetal distress

(AADAC, 2002)

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**Protective Factors -**

- Findings from studies of resilience in prenatally exposed children have suggested the following protective factors:
  - Appropriate diagnosis of child and family problems.
  - Nonjudgmental attitudes on the part of professionals.
  - Realistic expectations for child and parent.
  - Early success at improving infant self-regulation and mutual regulation between the caregiver and the prenatally affected child.
  - Specialized support for parents and professionals working with children who are prenatally exposed, such as training on fetal alcohol/drug effects.

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MATERNAL DRUG USE AND INFANT DEVELOPMENT

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**Risk and Protective Factors**

- Protective factors can help reduce the impact of prenatal exposure
- An accumulation of other risk factors can exacerbate the influence of prenatal exposure

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What can we do?

- Multi-disciplinary assessments: Get to know pediatric specialists from multiple disciplines in your area including mental health therapists, developmental pediatricians, occupational therapists, speech therapists and physical therapists.
- Early dyadic therapies such as Child-Parent Psychotherapy (CPP) and Parent-Child Interactive Therapy (PCIT).

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NE Resource Project for Vulnerable Young Children

- [www.nebraskababies.com](http://www.nebraskababies.com)
- Provides a list of trained Child-Parent Psychotherapy (CPP) providers across the state. Many providers are also trained in Parent-Child Interactive Therapy (PCIT) and other evidence based practices for young children and families.

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Teratogens

- Organization of Teratology Information Specialists.  
[www.mohtertobaby.org](http://www.mohtertobaby.org)

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National Alliance for Drug Endangered Children

- Established in 2000.
- Authored the national protocol for medical evaluation of children found in drug labs.
- Provides fact sheet
- [www.nationaldec.org](http://www.nationaldec.org)

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