

# Starting Small:

Factors that May Impact Development of Young Children  
Born Extremely Preterm or with Extremely Low Birth Weight

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No disclosures

# Learning objectives

- Participants will be able to explain adjusted age and its role in evaluating development and planning appropriate interventions.
- Participants will identify medical factors that may impact development of children born extremely preterm and/ or with extremely low birth weight.
- Participants will identify services and interventions that may be indicated to support the development of children born extremely preterm and/ or with extremely low birth weight.

# Terminology (and preterm-inology)

- Term = 40 weeks' gestation (37-42 weeks)
- Preterm or premature: born before 37 **completed** weeks' gestation
- Extremely preterm or extremely premature: born before 28 completed weeks' gestation

|                           |                    |
|---------------------------|--------------------|
| <b>Late preterm</b>       | <b>34-36 weeks</b> |
| <b>Moderately preterm</b> | <b>32-33 weeks</b> |
| <b>Very preterm</b>       | <b>28-31 weeks</b> |

- NICU: Neonatal Intensive Care Unit

# Terminology

- Extremely low birth weight (ELBW):  
    <1,000 grams (2 lb, 3 oz)
- Very low birth weight (VLBW):  
    <1,500 grams (3 lb, 5 oz)
- Low birth weight (LBW):  
    <2,500 grams (5 lb, 8 oz)



# Terminology

## **Chronological age:**

- Age according to date of birth.

## **Adjusted age:**

- How old a preterm child would be if carried to term. Also, “corrected age.”

- Adjusted age
  - Use until 2 years.
  - Use for
    - Growth
    - Developmental milestones
  - Do NOT use for
    - Immunization schedule

# To calculate adjusted age

- 1. Determine the number of weeks premature:** Subtract the baby's gestational age at birth from 40 weeks.

**Formula:**

$$40 \text{ weeks} - [\text{Gestational age at birth in weeks}] = [\text{Number of weeks premature}]$$

**Example:** A baby born at 26 weeks was **40 – 26 = 14 weeks premature**.

- 2. Calculate the adjusted age:** Subtract the number of weeks premature from the baby's chronological age (actual age since birth).

**Formula:**

$$[\text{Chronological age in weeks}] - [\text{Number of weeks premature}] = [\text{Adjusted age in weeks}]$$

**Example:** A baby born at 26 weeks is now 4 months (17 weeks) old.

|                            |       |                      |        |                     |
|----------------------------|-------|----------------------|--------|---------------------|
| <b>Actual age in weeks</b> | minus | <b>Weeks preterm</b> | equals | <b>Adjusted age</b> |
| 17 weeks                   | -     | 14 weeks             | =      | 3 weeks             |

# To calculate adjusted age OR Use an online calculator:

[neonatal.rti.org/index.cfm?fuseaction=AdjustedAgeCalculator.main](https://neonatal.rti.org/index.cfm?fuseaction=AdjustedAgeCalculator.main)

The screenshot shows the NICHD Neonatal Research Network Web-Based Adjusted Age Calculator. The page has a blue header with the logo and navigation links: HOME, ABOUT, NETWORK CENTERS, STUDIES, PUBLICATIONS, TOOLS, DATA REQUESTS, OPPORTUNITIES, LINKS, and MEMBER LOGIN. The main content area is titled "NICHD Neonatal Research Network Web-Based Adjusted Age Calculator" and contains a form with the following fields and instructions:

|   |   |  |
|---|---|--|
| Date of Birth:                            | <input type="text" value="mm/dd/yyyy"/>                                       | Enter the Child's Birth Date (mm/dd/yyyy).                       |
| Developmental Test Date:                  | <input type="text" value="mm/dd/yyyy"/>                                       | Enter the Developmental Test Visit Date (mm/dd/yyyy).            |
| Gestational Age Weeks:                    | <input type="text" value="In Weeks"/>   | Enter the Estimated Gestational Age at Birth (in Weeks) (18-40). |
| Gestational Age Days:                     | <input type="text" value="In Days"/>  | Enter the Estimated Gestational Age at Birth (in Days) (0-6).    |
|   | <input type="button" value="Calculate"/> <input type="button" value="Clear"/> | Click on the "Calculate" button.                                 |
| Adjusted Age for Developmental Test Date: | <input type="text"/>  |  |
| Chronological Age:                        | <input type="text"/>  |  |
| 18-Month Adjusted Age Date:               | <input type="text"/>  |  |
| 22.5-Month Adjusted Age Date:             | <input type="text"/>  |  |
| 22-Month Adjusted Age Date:               | <input type="text"/>  |  |
| 26.5-Month Adjusted Age Date:             | <input type="text"/>  |  |

Search “adjusted age calculator,” and select this one:



Neonatal Research Network

<https://neonatal.rti.org/fuseaction=AdjustedAgeCalculator>

# Risks to development

| Maternal health   | Conception & pregnancy  | Birth  | Neonatal period   | Home environment   |
|---|---|--|---|--|
| Nutritional status<br>Substance abuse<br>Diabetes<br>Hypertension<br>Chronic disease<br>Age | <b>Maternal health factors, PLUS</b><br>Smoking<br>Infection<br>Trauma<br>Placenta problems<br>Premature labor<br>Multiple gestation<br>Prenatal care<br>Genetics | Hypoxia<br>Anoxia<br>Low APGARs (perinatal depression)<br>Trauma<br>Infection<br>Low birth weight<br>Prematurity | Intraventricular hemorrhage (IVH)<br>Periventricular leukomalacia (PVL)<br>Infection<br>Prolonged ventilator support<br>Hypothyroxinemia<br>Seizures<br>Necrotizing enterocolitis (NEC)<br>Hyperbilirubinemia | Nutrition<br>Nurturance<br>Safety<br>Sleep<br>Maternal depression<br>Maternal education<br>Maternal age<br>Poverty<br>Marital status |

# Risks to development

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| Nutritional status<br>Substance abuse<br>Diabetes<br>Hypertension<br>Chronic disease<br>Age | <b>Maternal health factors, PLUS</b><br>Smoking<br>Infection<br>Trauma<br>Placenta problems<br>Premature labor<br>Multiple gestation<br>Prenatal care<br>Genetics | Hypoxia<br>Anoxia<br>Low APGARs (perinatal depression)<br>Trauma<br>Infection<br>Low birth weight<br>Prematurity | Intraventricular hemorrhage (IVH)<br>Periventricular leukomalacia (PVL)<br>Infection<br>Prolonged ventilator support<br>Hypothyroxinemia<br>Seizures<br>Necrotizing enterocolitis (NEC)<br>Hyperbilirubinemia | Nutrition<br>Nurturance<br>Safety<br>Sleep<br>Maternal depression<br>Maternal education<br>Maternal age<br>Poverty<br>Marital status |

**Birth**

Hypoxia  
Anoxia  
Low APGARs  
(perinatal depression)  
Trauma  
Infection  
Low birth weight  
Prematurity

# Risks to development

- Hypoxia, Anoxia, Low Apgar scores: Resuscitation at birth

## Apgar Scoring System

| Indicator |                                  | 0 Points     | 1 Point                         | 2 Points                       |
|-----------|----------------------------------|--------------|---------------------------------|--------------------------------|
| <b>A</b>  | Activity<br>(muscle tone)        | Absent       | Flexed limbs                    | Active                         |
| <b>P</b>  | Pulse                            | Absent       | < 100 BPM                       | > 100 BPM                      |
| <b>G</b>  | Grimace<br>(reflex irritability) | Floppy       | Minimal response to stimulation | Prompt response to stimulation |
| <b>A</b>  | Appearance<br>(skin color)       | Blue<br>Pale | Pink body<br>Blue extremities   | Pink                           |
| <b>R</b>  | Respiration                      | Absent       | Slow and irregular              | Vigorous cry                   |

Virginia Apgar



en.wikipedia.org/wiki/Virginia\_Apgar

**Birth**

Hypoxia

Anoxia

Low APGARs  
(perinatal  
depression)

Trauma

Infection

Low birth  
weight

Prematurity

# Risks to development

- Trauma: Head injury, shoulder dystocia
- Infection: Contracted during pregnancy or at delivery

**T Toxoplasmosis**

**O Other:** Syphilis, Parvovirus B19, Varicella (chickenpox)

**R Rubella**

**C Cytomegalovirus (CMV)**

**H Herpes simplex virus**

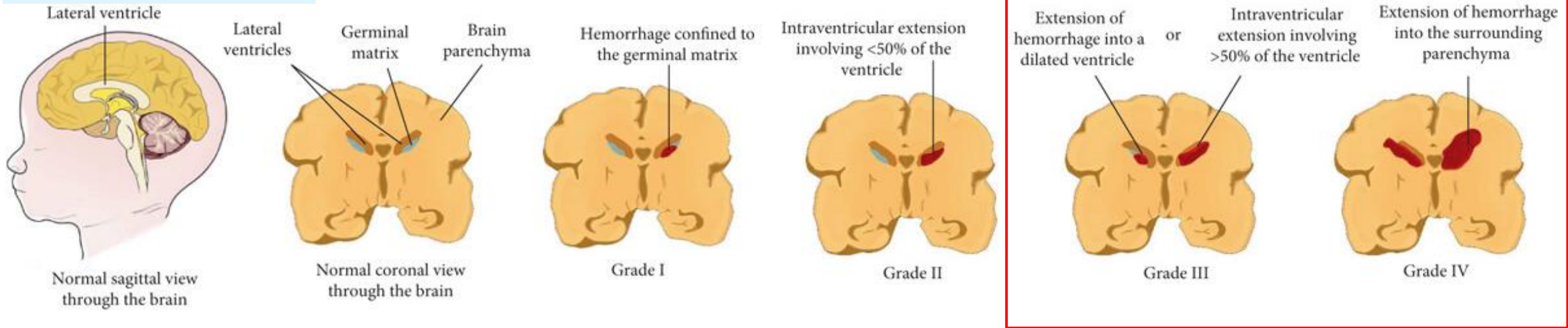
- Lower birth weight → Higher risk of developmental delays
- Shorter length of gestation (more premature) → Higher risk of developmental delays

**Neonatal period**

# Risks to development

Intraventricular hemorrhage (IVH)  
Periventricular leukomalacia (PVL)

- Intraventricular hemorrhage (IVH)
- Periventricular leukomalacia (PVL)



# Risks to development

## Neonatal period

Intraventricular hemorrhage (IVH)  
Periventricular leukomalacia (PVL)  
Infection  
Prolonged ventilator support  
Hypothyroxinemia  
Seizures  
Necrotizing enterocolitis (NEC)  
Hyperbilirubinemia

- Infection: Sepsis, CNS infections, respiratory infections, *et al.*, acquired in NICU
- Support for breathing

**Ventilator**

**NIPPV/ CPAP**

**Supplemental O<sub>2</sub>  
(nasal canula)**

**Room air**

# Risks to development

## Neonatal period

Intraventricular hemorrhage (IVH)  
Periventricular leukomalacia (PVL)  
Infection  
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Hyperbilirubinemia

## Congenital hypothyroidism

- Part of newborn screening.
- If untreated, may lead to
  - Cognitive impairment
  - Fine motor delay
  - Delayed gross motor skills
  - Language delay
  - Attention difficulties

## Seizures

- Often due to an underlying problem affecting the brain:
  - Hypoxic-ischemic encephalopathy (HIE)
  - Stroke
  - Structural brain abnormality
  - Infection
  - Metabolic disorder
  - Genetic cause

## Neonatal period

Intraventricular hemorrhage (IVH)  
Periventricular leukomalacia (PVL)  
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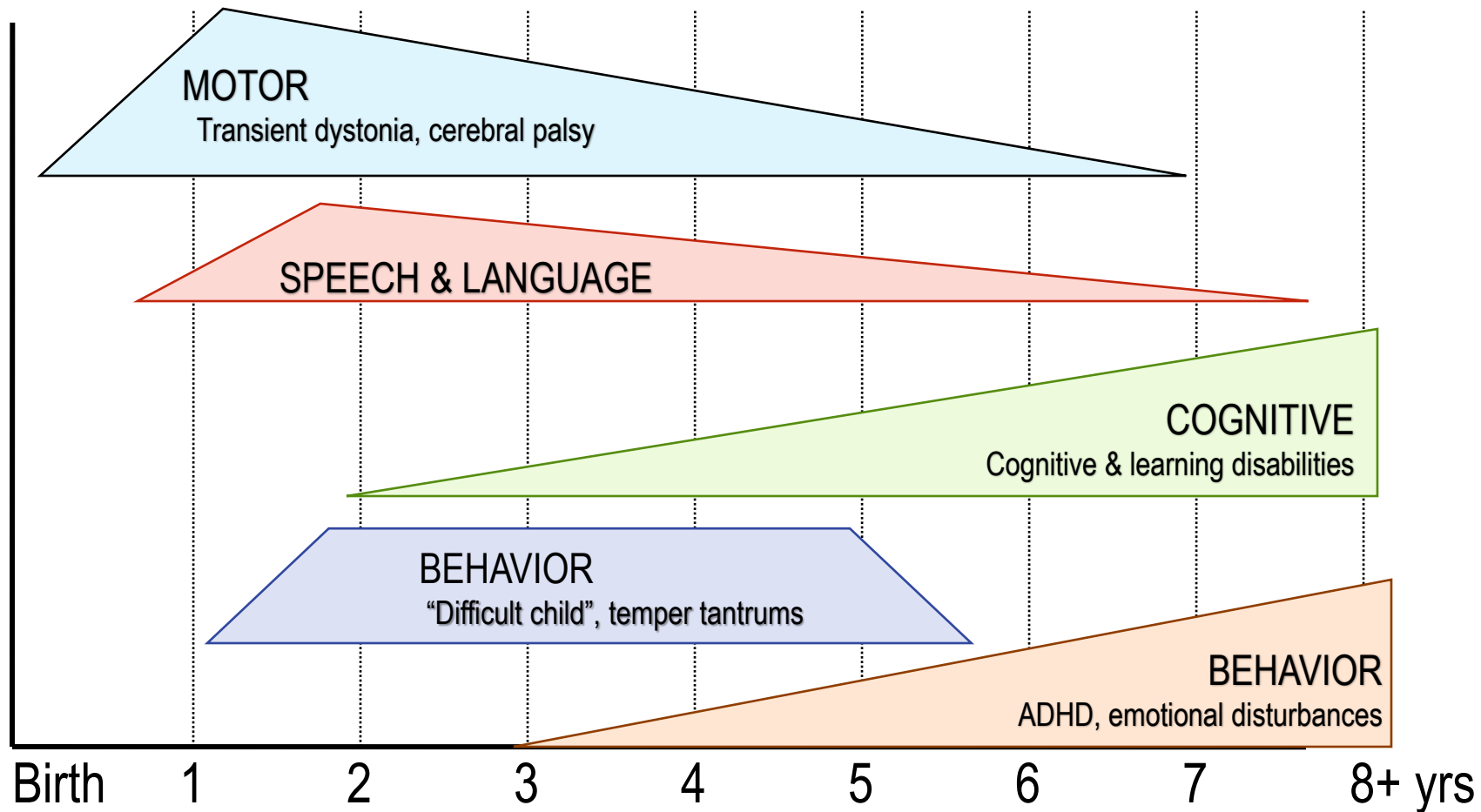
# Risks to development

- Necrotizing enterocolitis (NEC)
  - Mechanisms: systemic inflammation, surgery/ anesthesia, sepsis/ bacteremia
  - Higher risk for cerebral palsy, cognitive impairment, vision impairment, hearing impairment
- Hyperbilirubinemia (jaundice)
  - Associated with cerebral palsy (dyskinetic), hearing impairment, intellectual disability, speech-language impairments, autism spectrum disorder, ADHD

# Other considerations

- Surgeries in NICU or after discharge
- Hydrocephalus
  - Ventricular shunt
- Craniofacial anomalies:
  - Cleft lip/ palate
  - Ear malformations
  - Eye malformations
- Limb anomalies
  - Club foot (talipes equinovarus)
  - Missing extremities or parts of extremities
- Myelomeningocele (spina bifida)
- Genetic syndrome
- Congenital heart disease
  - With or without surgical intervention
- Retinopathy of prematurity (ROP)
- Possible cortical vision impairment (CVI)
- Hearing impairment
  - Most are at risk, even with normal newborn hearing screen.
- Medical equipment
- Psychosocial

# Timing of developmental impacts



# Potential areas of need

| If medical history includes this,             | Consider whether interventions are needed for these issues. |                                   |
|---|---|-----------------------------------|
| Hypoxia, anoxia, perinatal depression         | Gross motor   | Receptive language                |
| Trauma: head injury                           | Fine motor  | Expressive language               |
| IVH/ PVL                                      | Vision  | Speech                            |
| TORCH infection                               | Hearing   | Feeding                           |
| CNS infection (meningitis, encephalitis)      | Parent training   | Social skills                     |
| Seizures                                      | Cognition   | Activities of daily living (ADLs) |
| Respiratory infection (especially if hypoxic) |   |                                   |
| Prolonged ventilator use                      |   |                                   |

- Anything that affects oxygen levels can affect the brain.
- Anything that affects the brain may potentially impact all areas. Particular outcomes depend on the parts of the brain affected. However, the developing brain is very plastic, and brain imaging does not tell the whole story.

# Potential areas of need

| If medical history includes this, | Consider whether interventions are needed for these issues. |                                      |   |                                  |
|-----------------------------------|---|--------------------------------------|---|----------------------------------|
| Trauma: should dystocia           | Gross motor   | Fine motor                           | Parent training                                     |                                  |
| Congenital hypothyroidism         | Gross motor<br>Fine motor                                   | Cognition<br>Parent training         | Receptive language<br>Expressive language           | ADLs                             |
| Necrotizing enterocolitis         | Gross motor<br>Fine motor<br>Cognition                      | Parent training<br>Vision<br>Hearing | Receptive language<br>Expressive language           | Speech<br>ADLs                   |
| Hyperbilirubinemia                | Gross motor<br>Fine motor<br>Cognition                      | Parent training<br>Hearing           | Receptive language<br>Expressive language<br>Speech | Feeding<br>Social skills<br>ADLs |