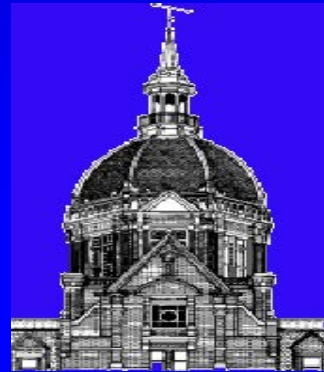


Development and Follow-Up of Premature and Low Birthweight Infants



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Objectives

- To describe the range of health and neurodevelopmental outcomes for extremely preterm infants
- To describe rates of health problems and Neurodevelopmental Disabilities by birthweight and gestational age groups
- To discuss important risk factors for major Neurodevelopmental Disabilities in preterm infants
- To discuss implications of these findings for our health care systems

The population of preterm infants is a heterogeneous one, with a wide range of etiologies, complications and outcomes.

Criteria for Determining Preterm Outcomes

- Birthweight
- Gestational Age
- *Maturity*

Birthweight (BW) Categories

LBW <2500 gms (5 lbs 8oz) Low Birthweight

VLBW <1500 gms (3 lbs 5oz) Very Low BW

ELBW <1000 gms (2 lbs 3oz) Extremely Low BW

ILBW <750 gms (1 lb 10oz) Incredibly Low BW
<600 gms (1 lb 5oz)
<500 gms (1 lb 2 oz)

Survival at the Limit of Viability by BW

BW Category	NICU Survival
600-699 gms	26%-61%
500-599 gms	1%-38%
<500 gms	0-18%

Survival at the Limit of Viability by GA

GA Category	Survival from L&D	Survival from NICU
25 wks	9%-79%	9%-82%
24 wks	9%-56%	9%-62%
23 wks	0-34%	0-55%
<23 wks	0-2%	0-18%

Limit of Viability: GA and BW at which 50% survive, by Race

	Time period	White	Afr-Am	Difference
GA	1975-79	26.8	25.2	1.6wks
	1990-94	24.5	23.9	0.5wks
BW	1975-79	1025	928	97gms
	1990-94	696	673	23gms

Chronic Lung Disease (CLD)

- Defined by the infant's need for support ($O_2 >28$ days, >36 wks PMA)
- Associated with infections, CNS injury, ROP, poor nutrition, inadequate growth
- Prolonged length of hospital stay
- Rehospitalizations and surgeries
- Associated with language delay, minor neuromotor dysfunction, cerebral palsy and low IQ

Nutrition & Growth in LBW Children

- Difficult to feed sick preterm children
- Some preterm and LBW children had IUGR
- Controversy re: optimal feeding regimen
- Poor nutrition affects growth, development & immunity
- Fetal origins of adult diseases
 - Relationship between BW and adult hypertension, diabetes, heart disease and kidney disease
 - Related to IUGR, not prematurity
 - Related to childhood growth: highest risk w/obesity

Neurodevelopmental Disabilities

- Major Disability
 - Cerebral Palsy
 - Mental Retardation
- Sensory Impairment
 - Hearing Impairment
 - Visual Impairment
- School and Behavior Problems
 - Learning Disability
 - Attention Deficit Hyperactivity Disorder
 - Minor Neuromotor Dysfunction
 - Sensorimotor Inefficiencies

Cerebral Palsy in Children by BW

BW Category	CP Prevalence
>2500 gms	0.4-1.3/1000
1500-2499 gms	9-12/1000
<1500 gms	40-130/1000
<1000 gms	110-150/1000
<750-800 gms	100-190/1000
<500 gms	460/1000

Cerebral Palsy in Preterm Infants

The most common type of CP in preterm infants is Spastic Diplegia, and it tends to be mild. Many clinicians and outcomes researchers now make a distinction between Mild CP and Disabling CP.

Minor Neuromotor Dysfunction

- Mild abnormalities on neurodevelopmental exam
- No or mild motor delay
- Frequently known as “clumsy child” or toe walker
- Frequently have sensorimotor inefficiencies
- May have oromotor dysfunction
- Hand preference demonstrated early or late
- Fine motor dysfunction frequent (70% ELBW)
- Frequent in children w/CLD, often with tremors

Cognition in Preterm Children

- Preterm children have a normal range of IQs.
- Meta-analyses have found mean IQ for LBW children 5-10 points lower than NBW controls.
- More preterm children with MR and borderline IQ.
- IQ scores are inversely related to BW.
- SES has less of an effect on IQs of ELBW children.
- The older the child, the more accurate the assessment.

Cognition in Preterm Children

- Preterms may have initial expressive language delay, but receptive language is usually normal.
- Later, vocabulary may be normal but difficulty with syntax, abstract verbal skills & verb production.
- Preterm children frequently have visual-perceptual and visual-motor integrative problems.
- IQ scores are an average, and reliance on IQs as an outcome may mask more subtle deficits.

Disability in Preterm Infants: Summary of Recent Literature

	CP	MR	HL	VI	LD
VLBW	5-14%	4-8%	0.1-5%	0.1-5%	10-48%
ELBW	8-11%	6-14%	6-7%	4-12%	23-52%
ILBW	3-14%	3-28%	1-5%	5-13%	27-45%

In comparison with FT controls, VLBW children with normal IQs:

- have a higher incidence of language delay,
- have more visual-perceptual problems,
- have more difficulty with reading, and
- require more special education.

Learning Disability in Preterm Children

- Preterm children with normal IQs often have difficulties with attention, executive function, memory, spatial skills and fine motor function.
- Rates of LD are independent of IQ scores.
- Many preterm children have better verbal cognitive skills than non-verbal abilities.
- Environment has a moderating effect on LD.

Learning Disability in Preterm Children

- Visual-perceptual and fine motor difficulties can make writing a major problem for preterm children.
- Males have 2.5-5 X greater risk of LD than females.
- Efficiency becomes a problem by middle school.
- The likelihood of LD increases with age:
 - 31%-48% at 4 years in ELBW children
 - 25%-71% at 6 years in ELBW children
 - 74%-86% at 8 years in ELBW children

Behavior Problems in Preterm Children

- Behavioral and social problems much more difficult to measure.
- Symptoms of ADHD 2.6-6X more frequent in VLBW and ELBW children.
- Conduct disorders, shyness, unassertiveness and withdrawn behavior are common in preterms.
- Impact of cognitive, motor and social skills deficits on self-esteem and peer relationships.

“By school age, many prematurely born children may exhibit subtle problems that are often difficult to define clinically, but which are likely to adversely affect their ability to cope with the demands of life both at school and at home.”

F. C. Bennett, 1988

Survival Without Disability at the Lower Limit of Viability

GA	Without Major Disability	Without Any Disability
25 wks	31%-56%	23%
24 wks	13%-42%	12%
23 wks	6%-7%	5%
22 wks	0-0.7%	0?

Diagnosis of Neonates

- It is virtually impossible to diagnose any of the neurodevelopmental disabilities in the neonatal period.
- It is possible to select a group of neonates who are at high risk for ND disabilities.
- These infants require comprehensive neurodevelopmental followup and, as needed, early intervention.

Perinatal/Neonatal Risk Factors

- Risk means an increased likelihood of disability.
- Not everyone who is at risk develops disability.
- Many who developed disability had NO risk factors.
- Statistical associations between risk factors and neurodevelopmental outcome do not imply causation.
- Risk factors vary in the strength of their association with disability: some carry a higher risk than others.
- Multiple risk factors have at least an additive effect.
- Biological vs. environmental risk

Perinatal/Neonatal Risk Factors

- Background characteristics: SES
- Obstetric/Prenatal: L&D complications, Maternal Illness, Maternal Ingestions, Congenital Infections, Chorio
- Physical characteristics: Prematurity, IUGR, Anomalies
- Condition at birth: Perinatal asphyxia/depression, Apgars
- Neonatal complications: Chronic lung disease, Seizures, Infection (Sepsis, Meningitis)
- Measures of CNS Structure and Function: Neuroimaging, Neurodevelopmental Examination

Most drugs used in the
NICU have NOT been
studied in newborn,
premature or LBW infants.

Quality of Life: Whose Point of View?

ELBW adolescents rated their own functional level more favorably than their health care providers and parents rated their functional level.

Health in Premature and LBW Children

- The most common health sequelae is lung disease: asthma/reactive airway disease, frequent colds or pneumonia, rehospitalizations.
- Nutrition and growth is often a concern, both in terms of poor growth and overweight.
- The impact of improved survival of premature and LBW children on rates of adult hypertension, diabetes and heart, kidney and lung disease is unknown.

Disability in Preterm Children

- The majority of preterm and LBW children do not have major disability (CP or MR).
- The more immature the infant, the higher the risk of major disability and sensory impairment.
- Cause, severity and timing of IUGR influences risk of disability.
- The best predictors of ND outcome are signs of CNS injury.
- Many children have multiple risk factors.
- Risk does not mean cause: is it the condition, associated factors or how we treat it? (few neonatal drug studies)

Preterm infants have a higher incidence of Learning Disabilities, Attention Deficit Hyperactivity Disorder, Minor Neuromotor Dysfunction and Sensorimotor Inefficiencies than term children. These milder manifestation of CNS dysfunction can have a profound influence on the child's school performance, behavior, peer relationships and self-esteem.

Risk Factors for Disability

- In an environment of limited resources, risk factors can help focus ND F/U & early intervention efforts.
- High risk infants require careful, focused ND F/U w/appropriate referral for early intervention services.
- Many insurers will not authorize ND F/U visits for infants with risk factors, who do not (yet) have a diagnosis of disability.
- Many child health care providers do not have the training or resources to follow development in high risk NICU infants or to counsel parents.

Limitations of Early Intervention

- Lack of efficacy (and safety) data
- Those who provide the services are often also doing the evaluations: no objective measures
- Early intervention services should be individualized and focused
- EI providers are generally not prepared to make or discuss diagnoses or to counsel parents about what to expect in the future
- Infants w/mild delays often receive short term interventions – no continuity with LD services
- Interventions can improve cognitive and functional abilities, but they must be ongoing (or effects are lost).

Family Support

- Evidence strongly suggests a positive influence of enriched environment on cognitive development.
- Maternal depression is common (occurs in 1/3), and more frequent with multiples.
- Maternal mental health impacts child development.
- Many mothers are unable to get insurance coverage for mental health services.
- Many obstetricians treat maternal depression, but there is no provision for long term support.

System Problems or Obstacles

- More resources go into saving sicker and more immature infants, with fewer resources available for ND F/U, early intervention and parent support services
- Frequent problems with cooperation among & communication between health, education and social service agencies
- Limited mental health services for parents or children
- Early intervention services do not seamlessly transition to services at preschool and school age
- Current educational approach sets these children up for failure
- No provisions for longterm F/U (through childhood to adulthood).

Research Needed

- NICU studies:
 - Neuroprotection strategies
 - Better treatments of lung disease
 - Relationships between nutrition, growth and development
- Evaluation of current and all new NICU treatments for impact on neurodevelopmental outcome
- Better prediction of neurodevelopmental outcome
 - Greater accuracy and prediction of type & severity of disability
 - Consider costs (look beyond high-tech, high-cost neuroimaging)
 - Use them to study neonatal drugs & early intervention strategies
- Support for long term F/U studies through childhood into adulthood