

Preterm Birth in Kentucky: A Public Health Challenge

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American Public Health Association Meeting

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Kentucky Department for Public Health

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The Problem of Prematurity

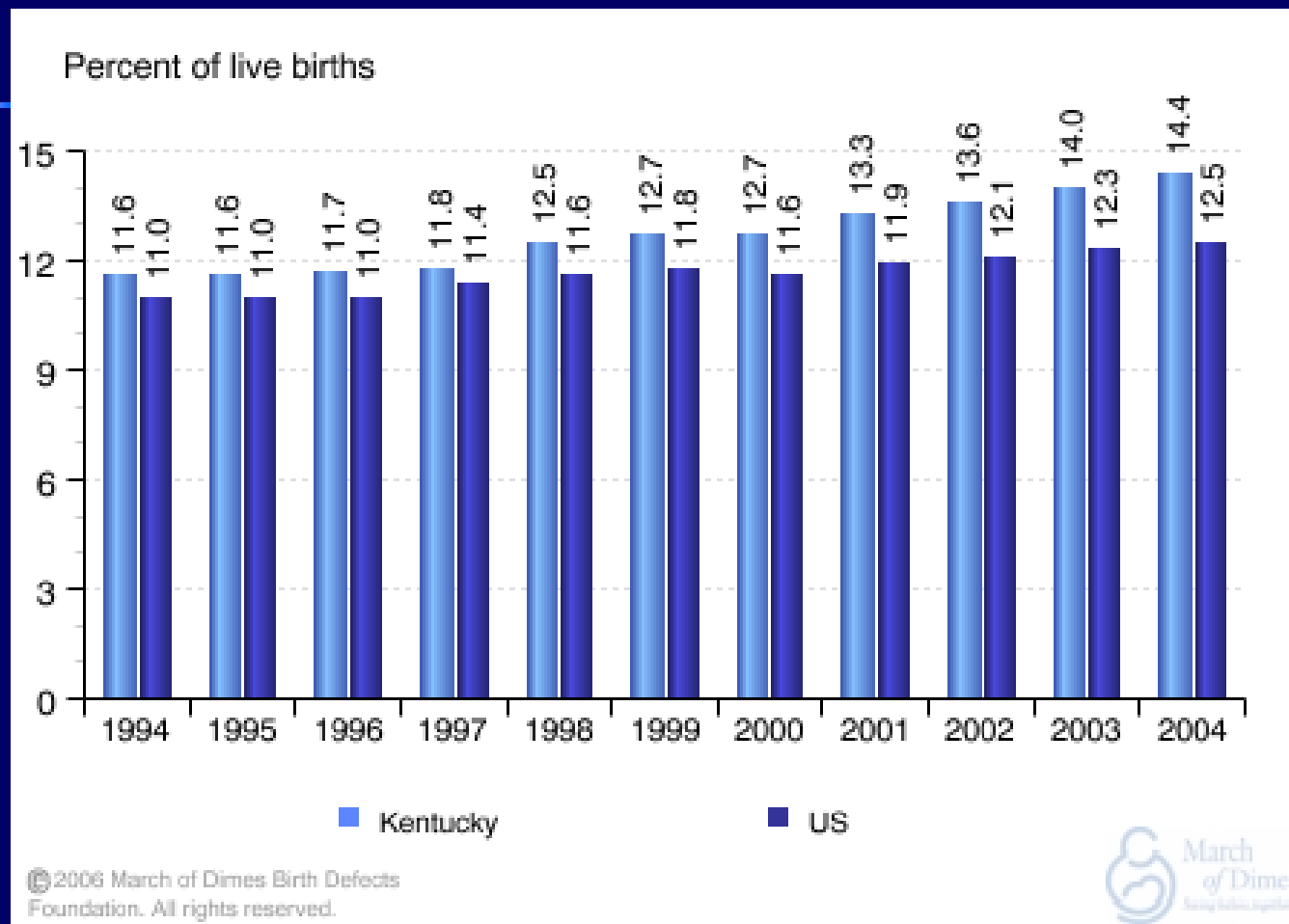
- Prematurity is the number one killer of newborn infants
- One in four premature infants may suffer lifelong disability or impairment
 - Cerebral Palsy, Mental Retardation, Neurologic Defects, Developmental Delay, Impaired Vision, Asthma

Preterm Infants

- Preterm birth:
 - <37 completed weeks
- Late preterm (near-term):
 - 34-36 weeks
- Very preterm:
 - <32 weeks



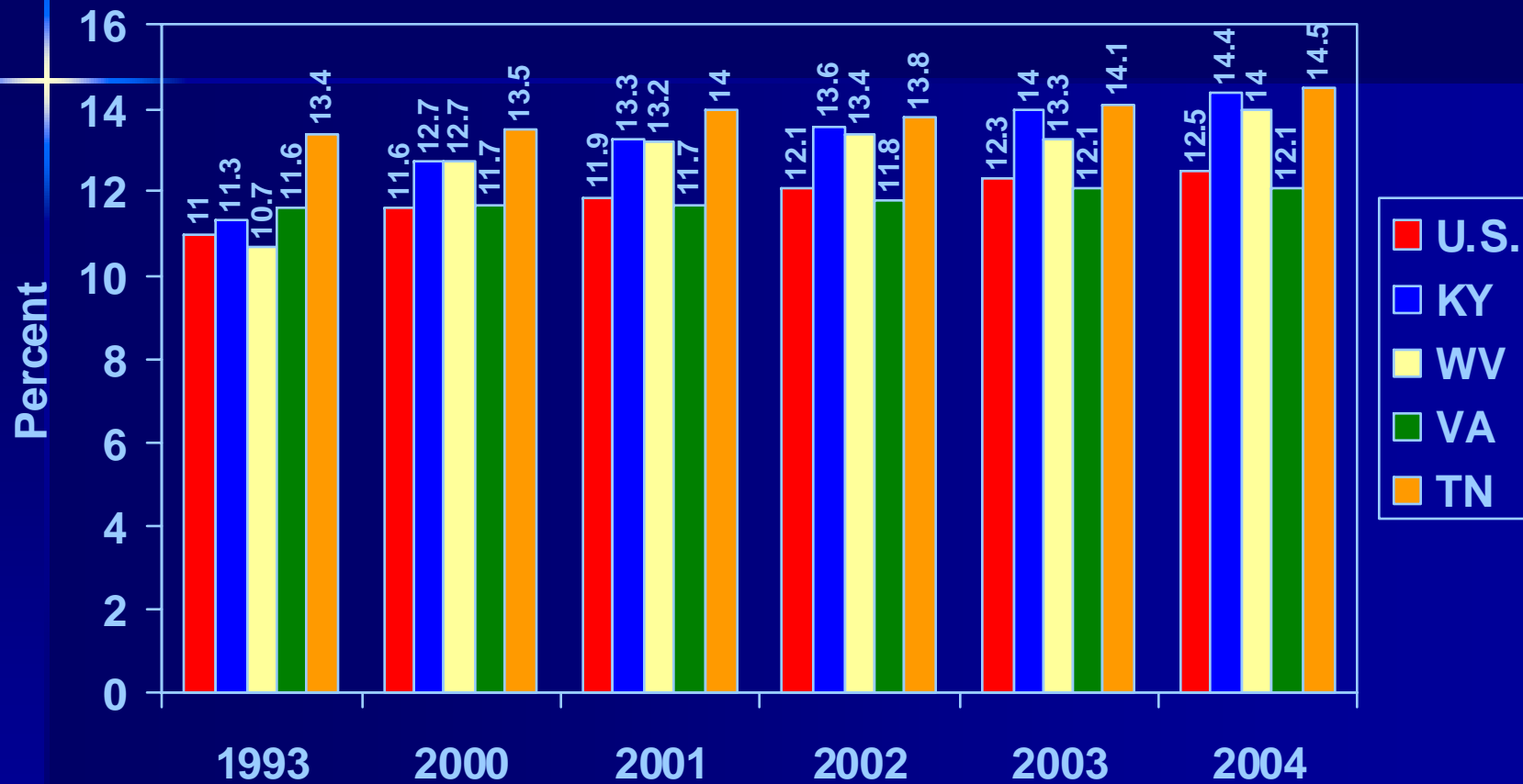
Percent of Live Births that were Preterm*; Kentucky and U.S., 1994-2004



*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

Data Source: March of Dimes Peristats

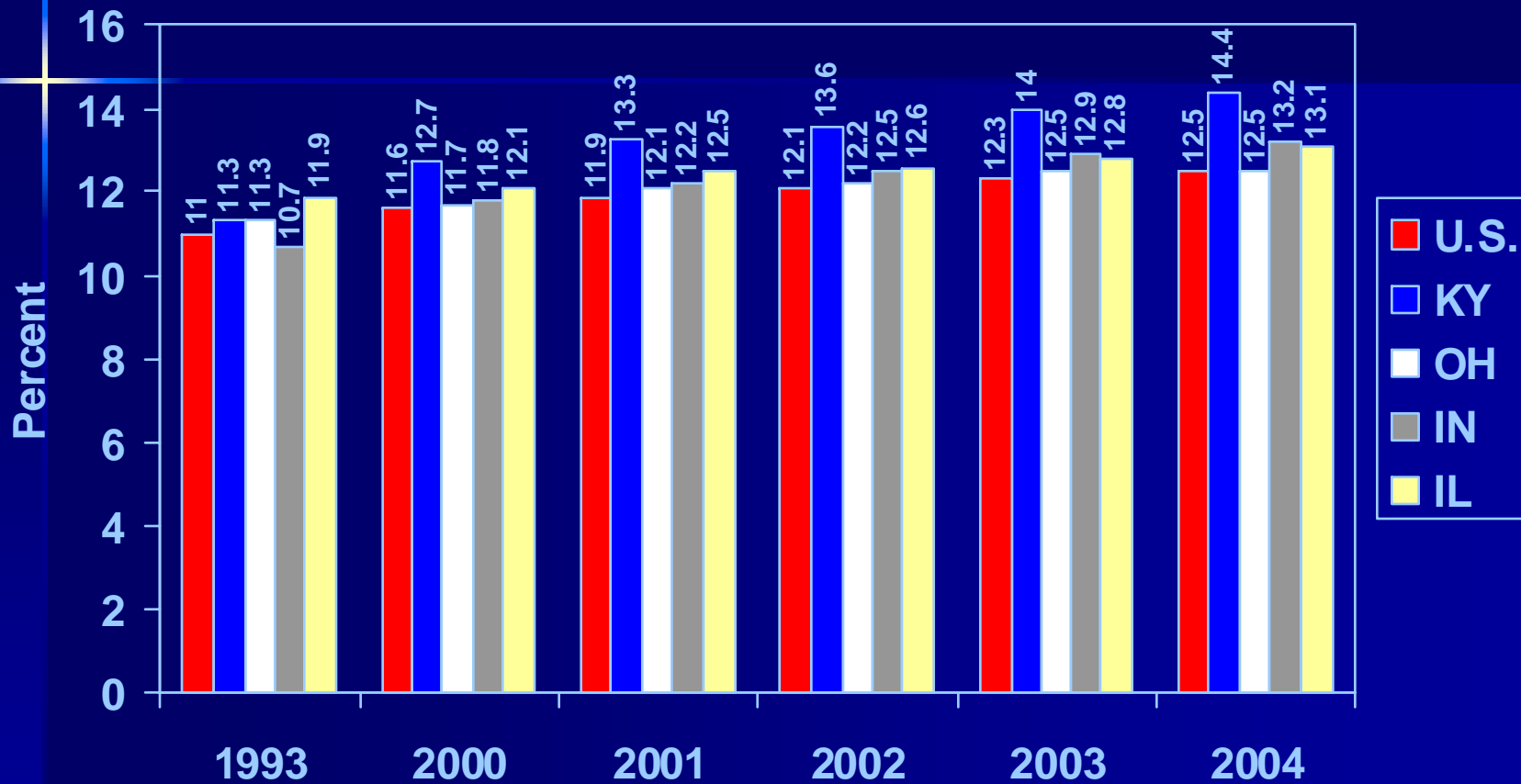
Percent of Live Births that were Preterm* Among Southern Contiguous States; 1993, & 2000-2004



*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

Data Source: March of Dimes Peristats

Percent of Live Births that were Preterm* Among Northern Contiguous States; 1993, & 2000-2004

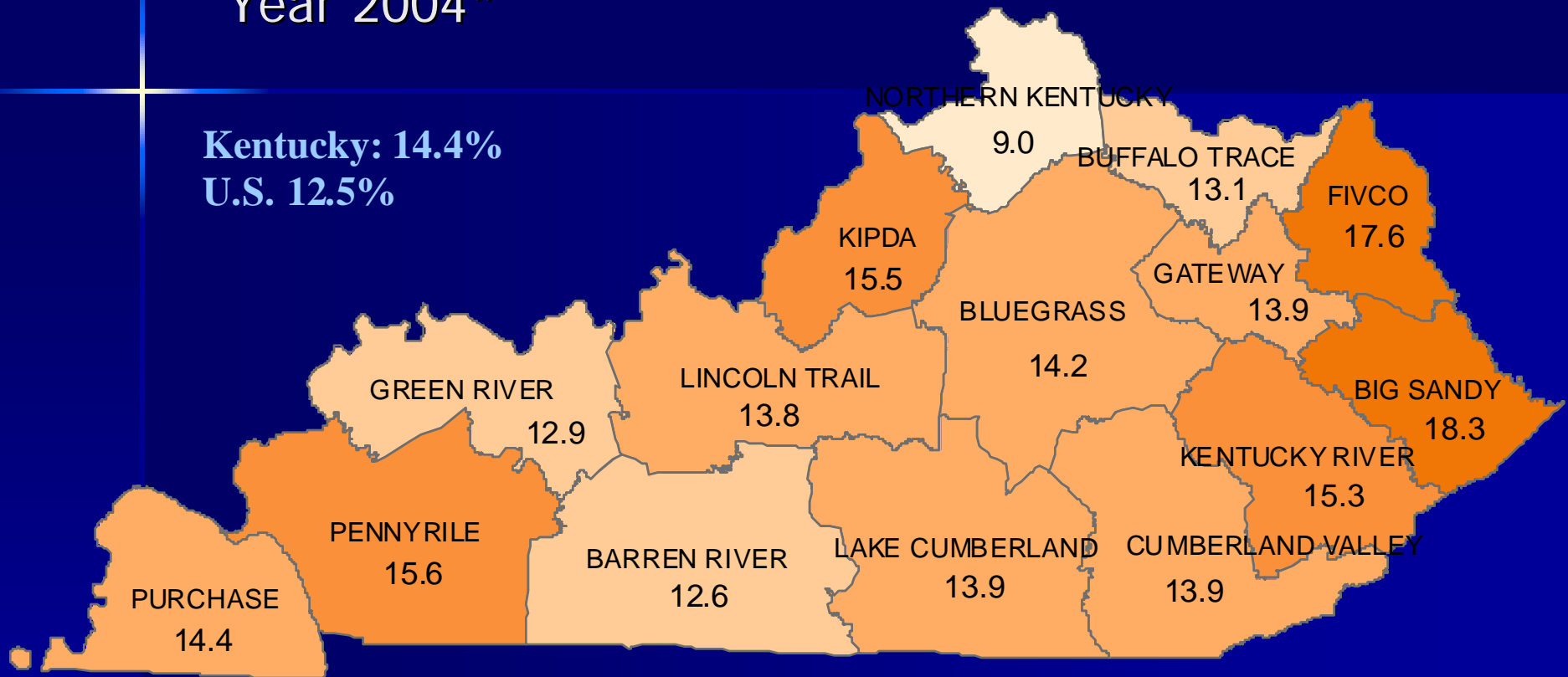


*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

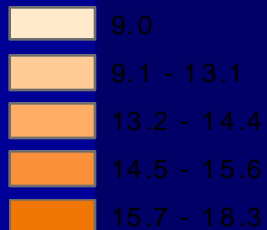
Data Source: March of Dimes Peristats

Percent of Live Births to Kentucky Residents that were Preterm** by Area Development District; Year 2004*

Kentucky: 14.4%
U.S. 12.5%



Percentage



*2004 data is preliminary and numbers could change

**Preterm birth is defined as any live birth occurring before 37 completed weeks gestation

Note: Area Development District is based on the Mother's county of residence at time of birth

Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 2004

Selected Categories of Risk for Preterm Birth

- History of Preterm Birth
- Medical Complications/Pre-existing conditions
- Unintended pregnancy
- Extremes of Maternal Age
- Maternal Race
- Multiple Gestations
- C-section delivery
- Gestational age 34, 35,36 weeks

Maternal Risk Factors Associated with Preterm Birth in Kentucky, 2004 *

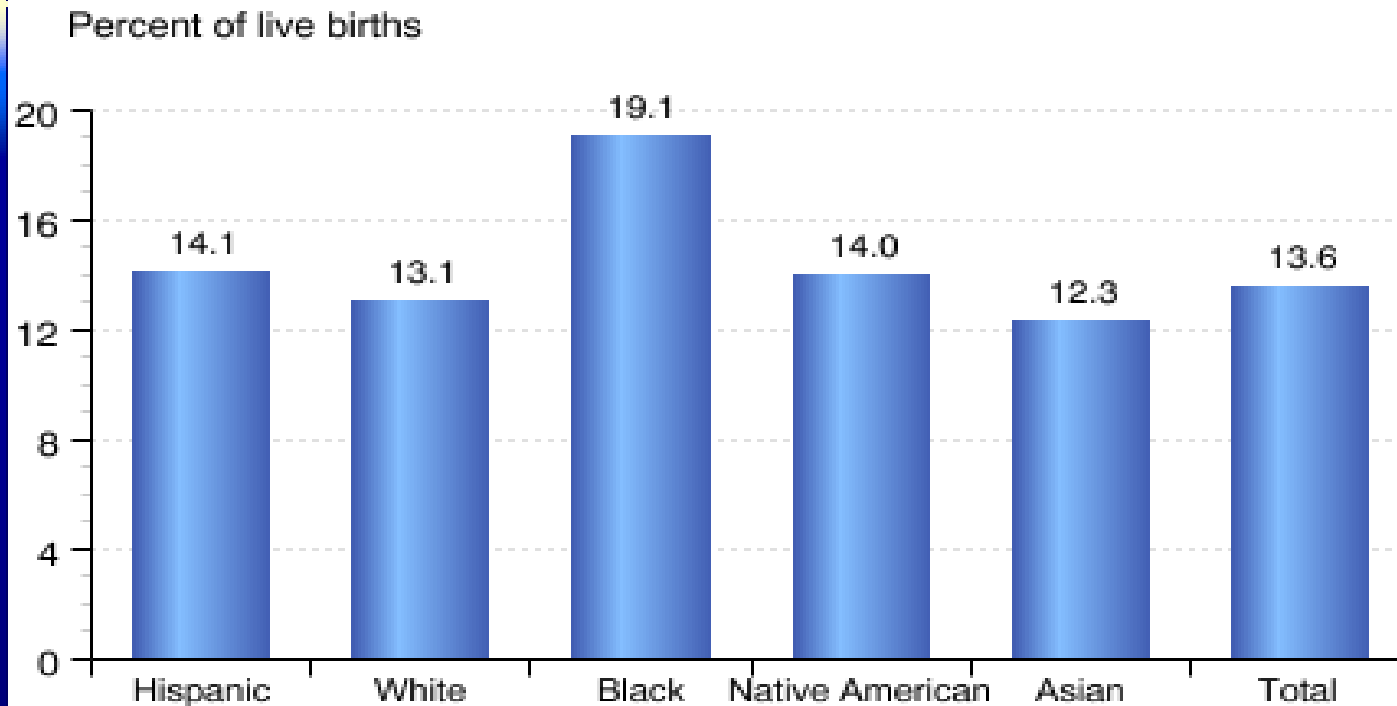
Risk Factor	Odds Ratio	Confidence Limits	P-Value
Previous Preterm Birth	3.58	(3.24, 3.95)	<0.0001
Diabetes	1.60	(1.47, 1.75)	<0.0001
Smoker	1.16	(1.11, 1.22)	<0.0001
Overweight (BMI 25.0-29.9)	0.89	(0.84, 0.95)	<0.0001
Obese (BMI \geq 30)	0.93	(0.88, 0.98)	0.0079

*2004 data is preliminary and numbers could change

Note: p-value <0.05 is significant; diabetes include pre-existing as well as gestational cases; smoker includes those who smoked three months prior to pregnancy or anytime during pregnancy

Stepwise Logistic Regression Analysis was used to determine associations; Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 2004

Percent of Live Births that were Preterm by Ethnicity/Race; Kentucky, 2001-2003

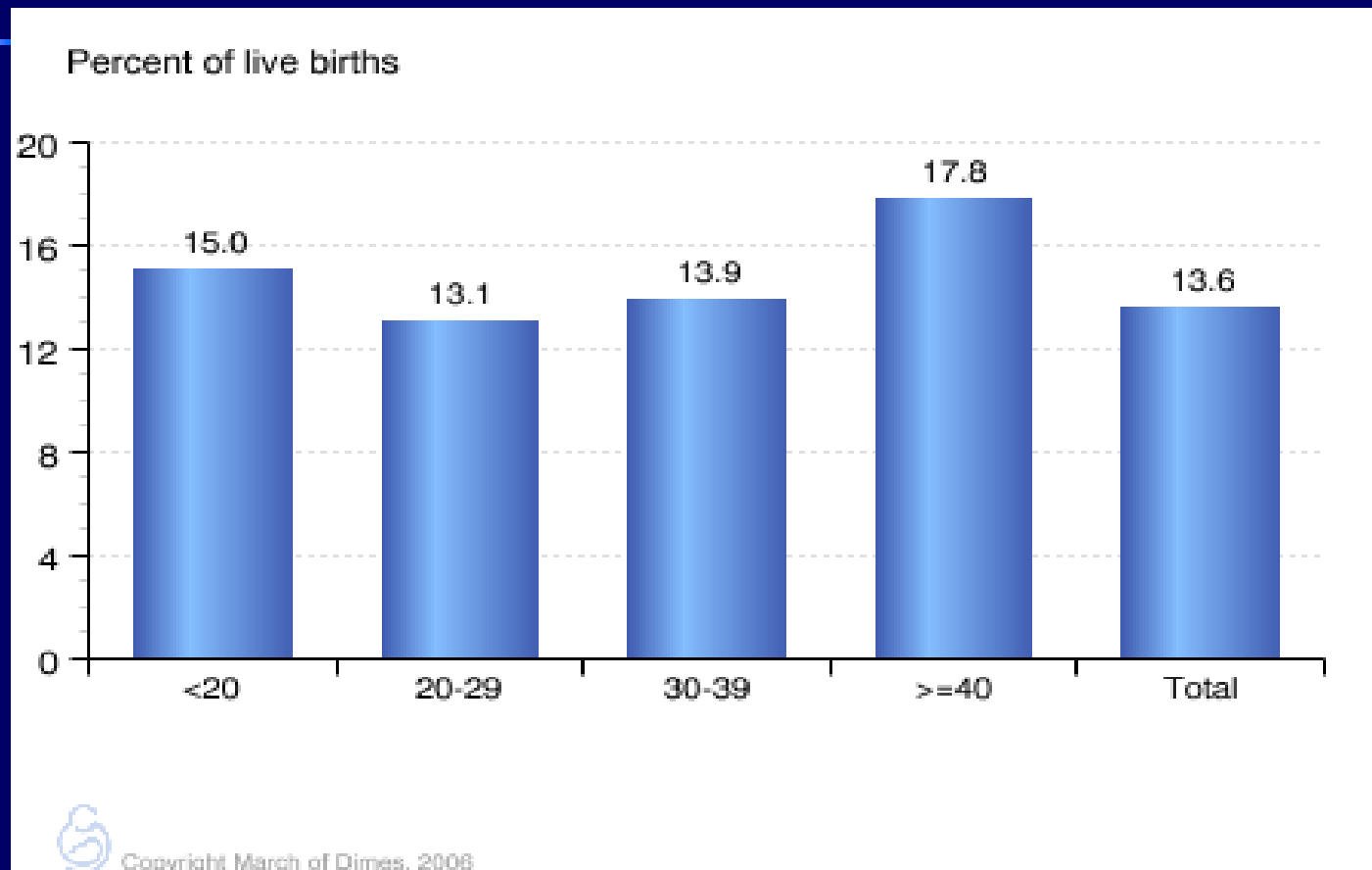


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*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

Data Source: March of Dimes Peristats

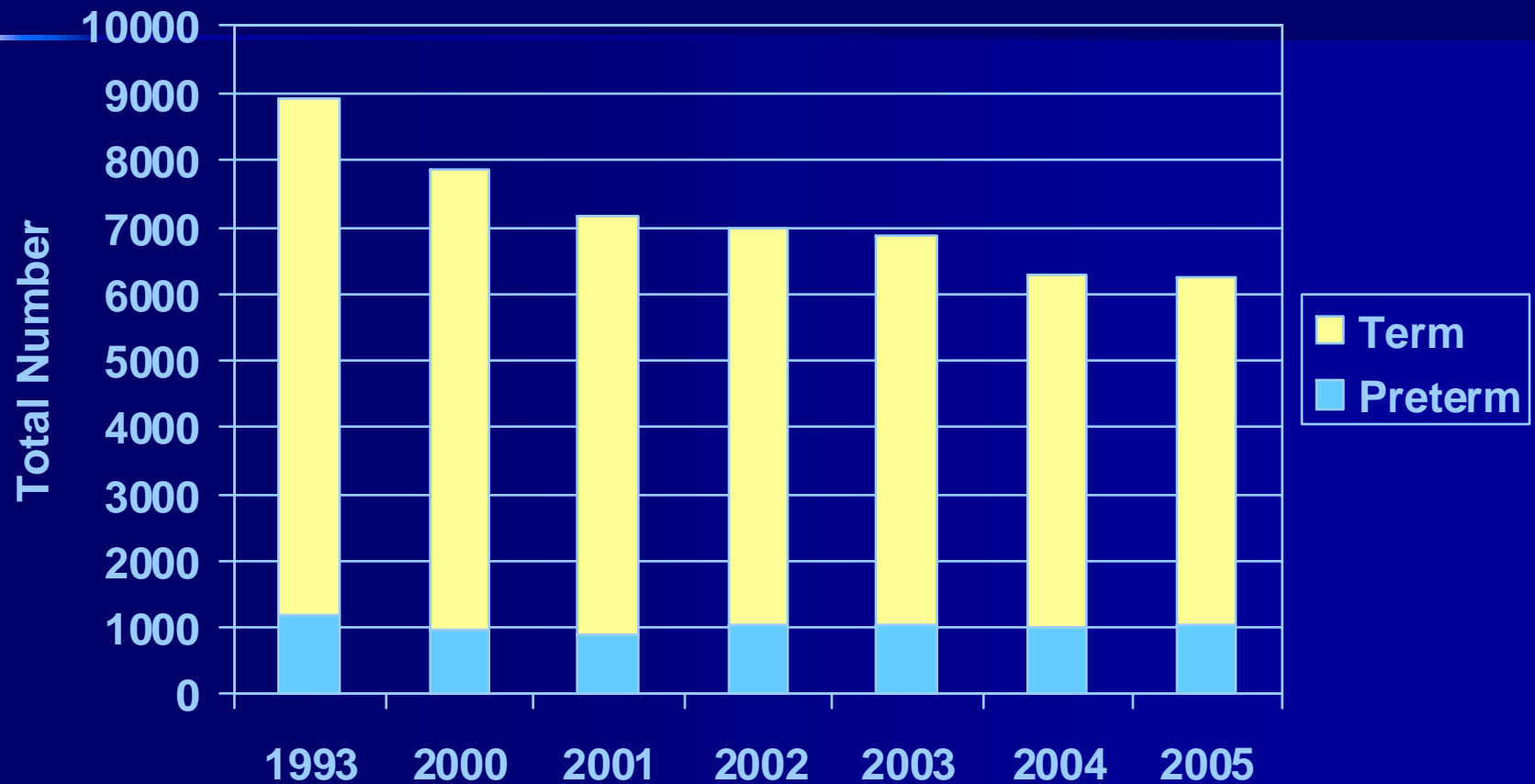
Rate of Preterm* Birth by Maternal Age; Kentucky, 2001-2003



*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

Data Source: March of Dimes Peristats

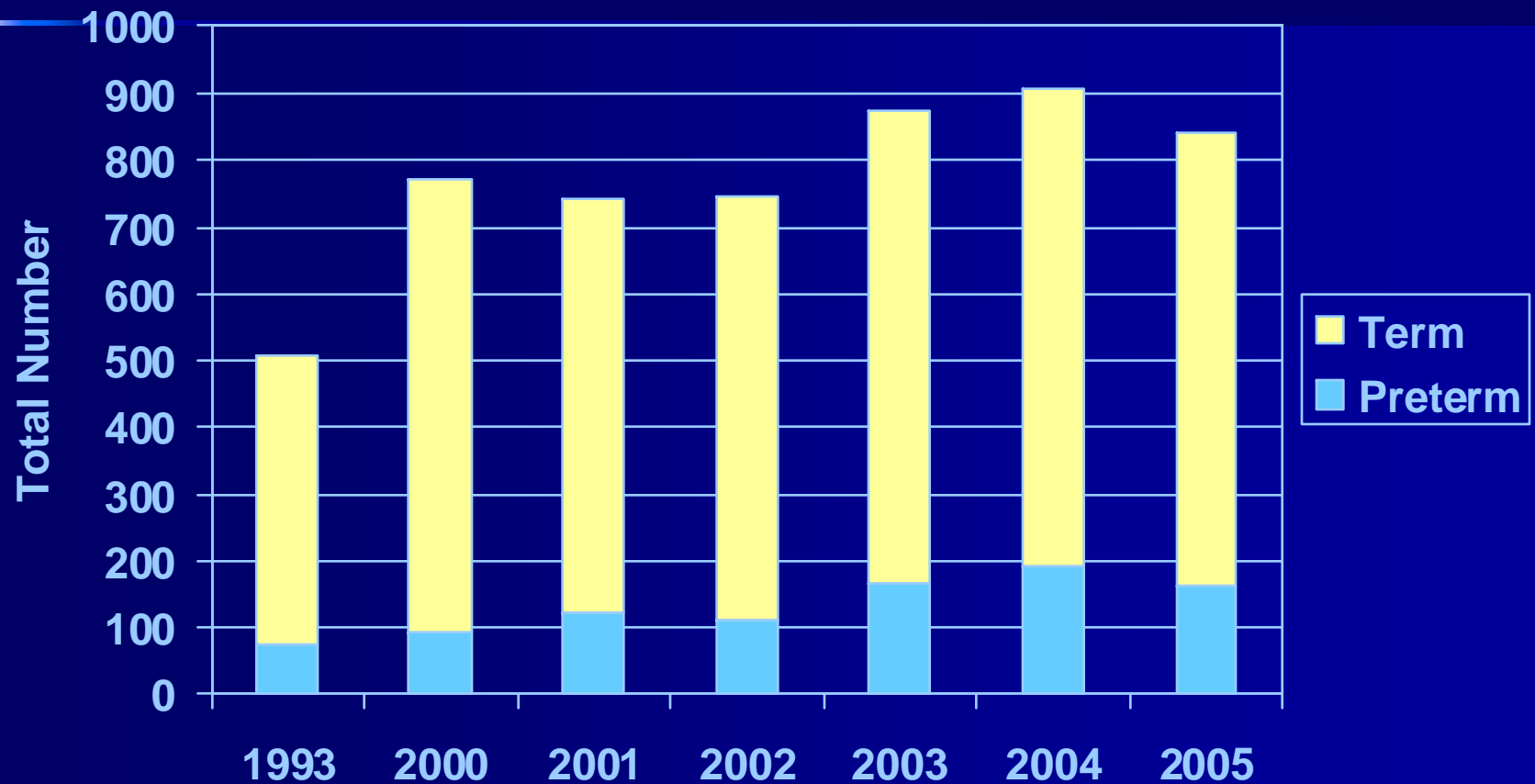
KY Births to Teen Mothers [Women ≤ 20 Years of Age] Term and Preterm Births



*2005 data is preliminary and numbers could change

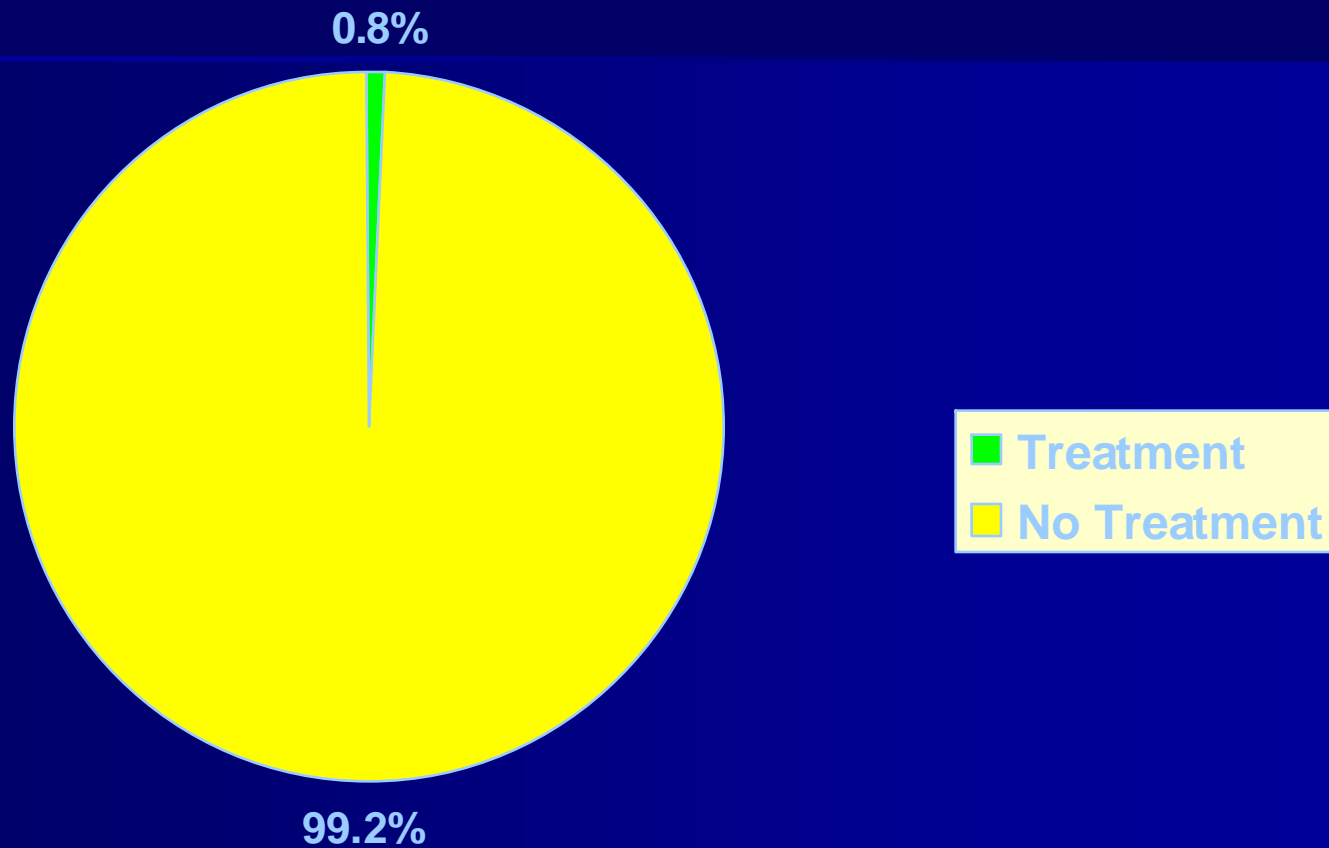
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 1993, & 2000-2005

KY Births to Older Mothers [≥ 40 Years of Age] Term and Preterm Births



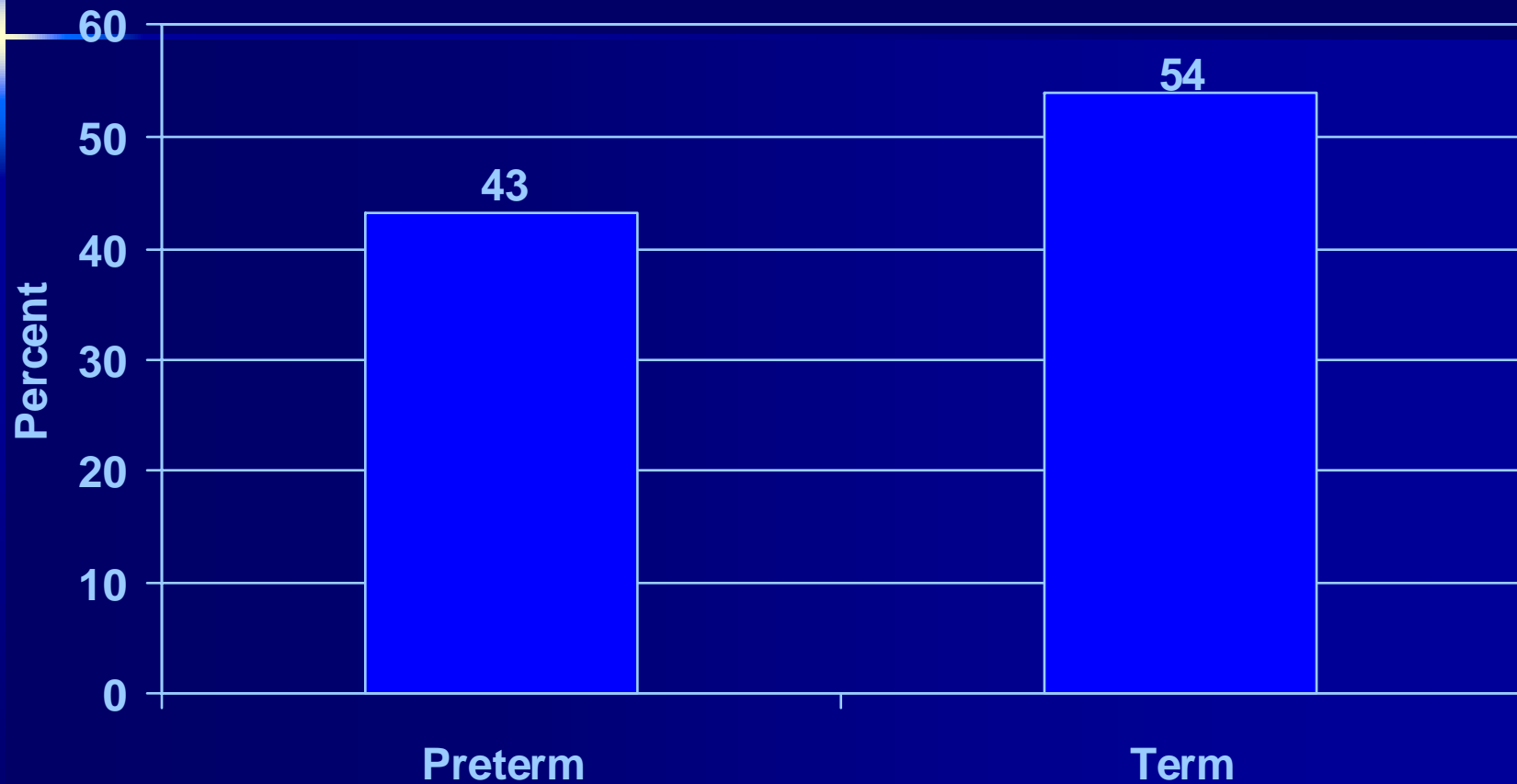
*2005 data is preliminary and numbers could change
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 1993, & 2000-2005

Percent of Live Births Resulting from Infertility Treatment; Kentucky, 2005*



*2005 data is preliminary and numbers could change
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 2005

Percent of Infertility Births by Preterm Status; Kentucky, 2005**

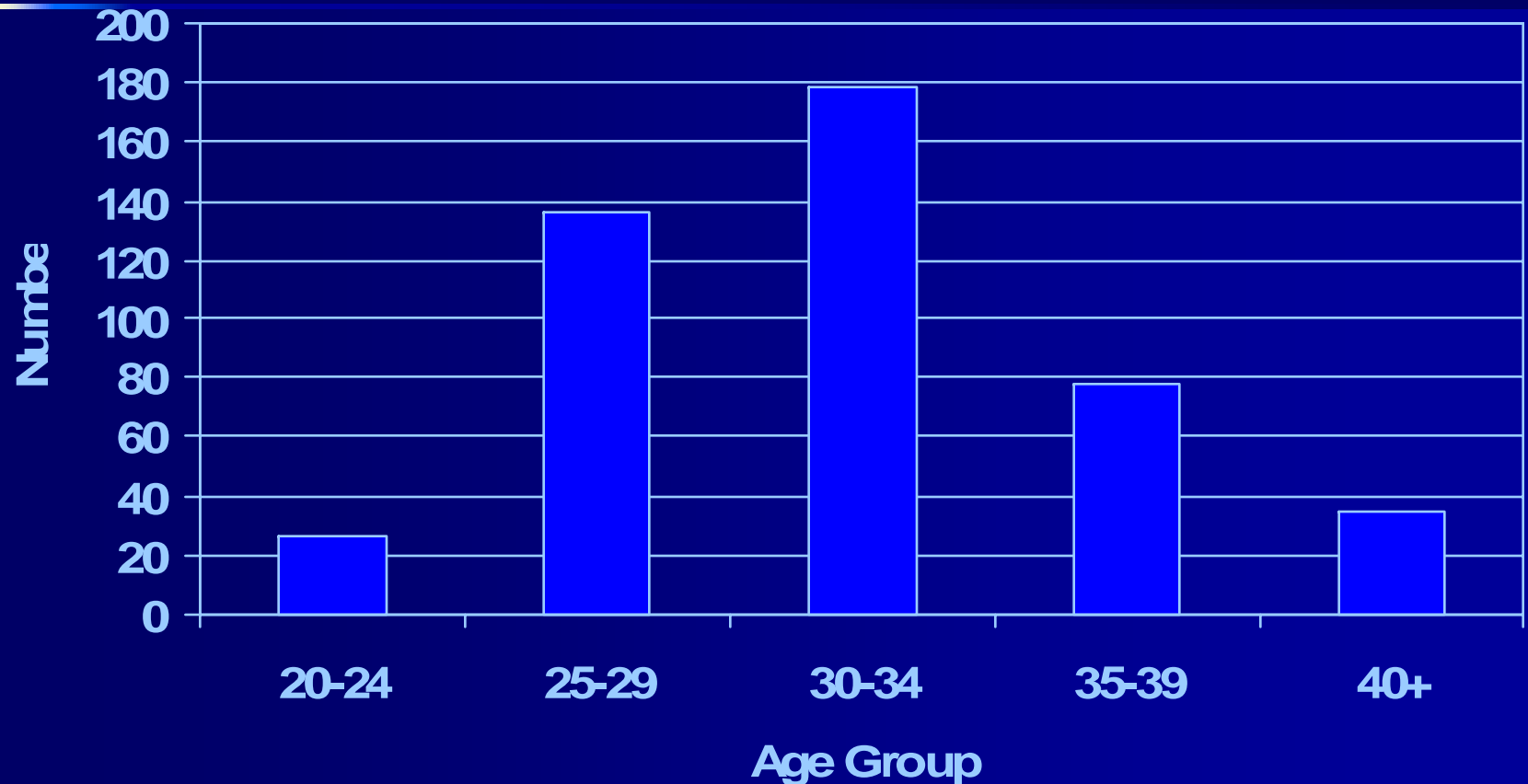


*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

**2005 data is preliminary and numbers could change

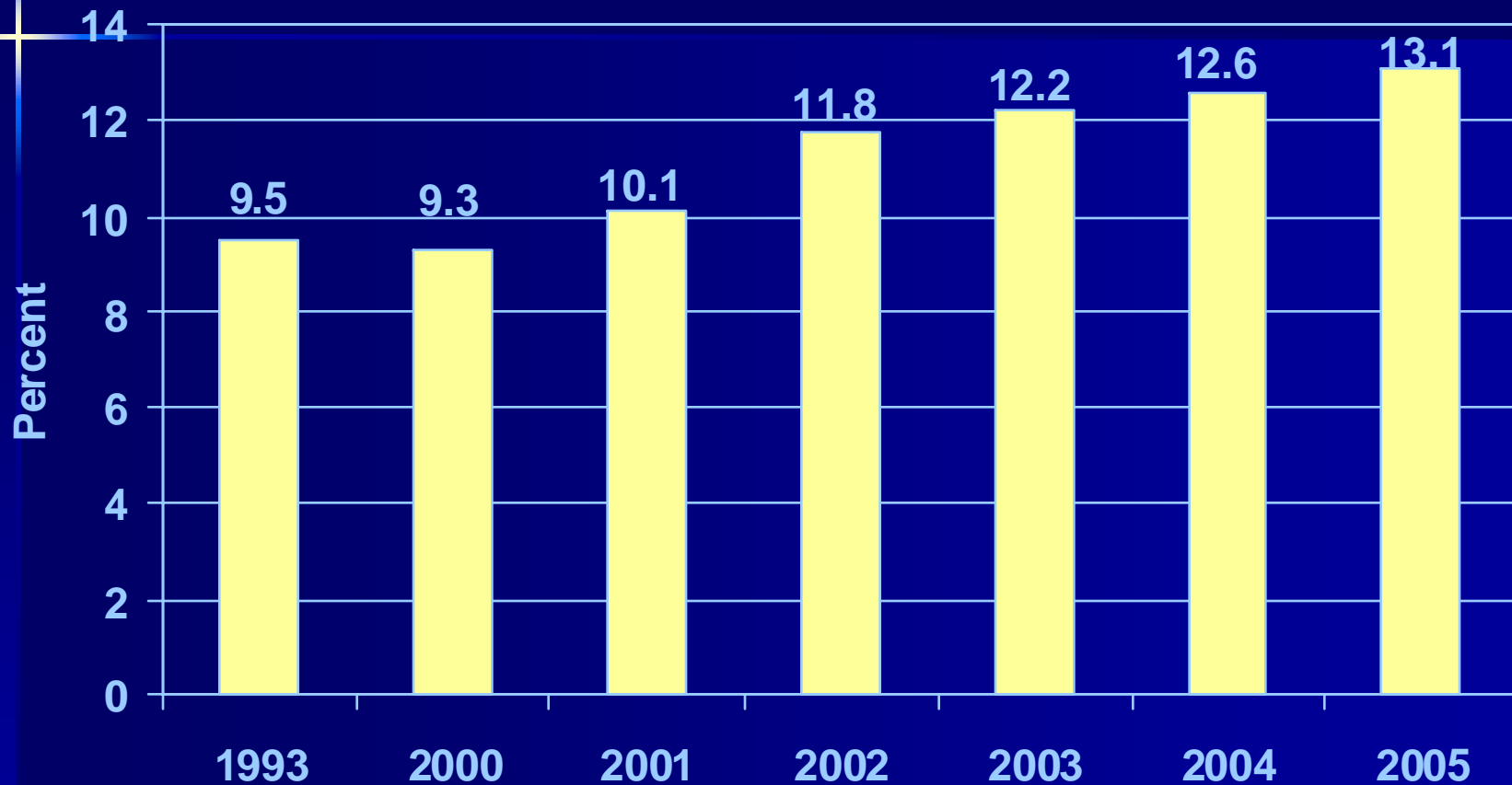
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 2005

Births that Resulted from Infertility Treatment by Maternal Age Groups; Kentucky, 2005*



*2005 data is preliminary and numbers could change
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 2005

Singleton Live Births that were Preterm* in Kentucky 1993, & 2000-2005**

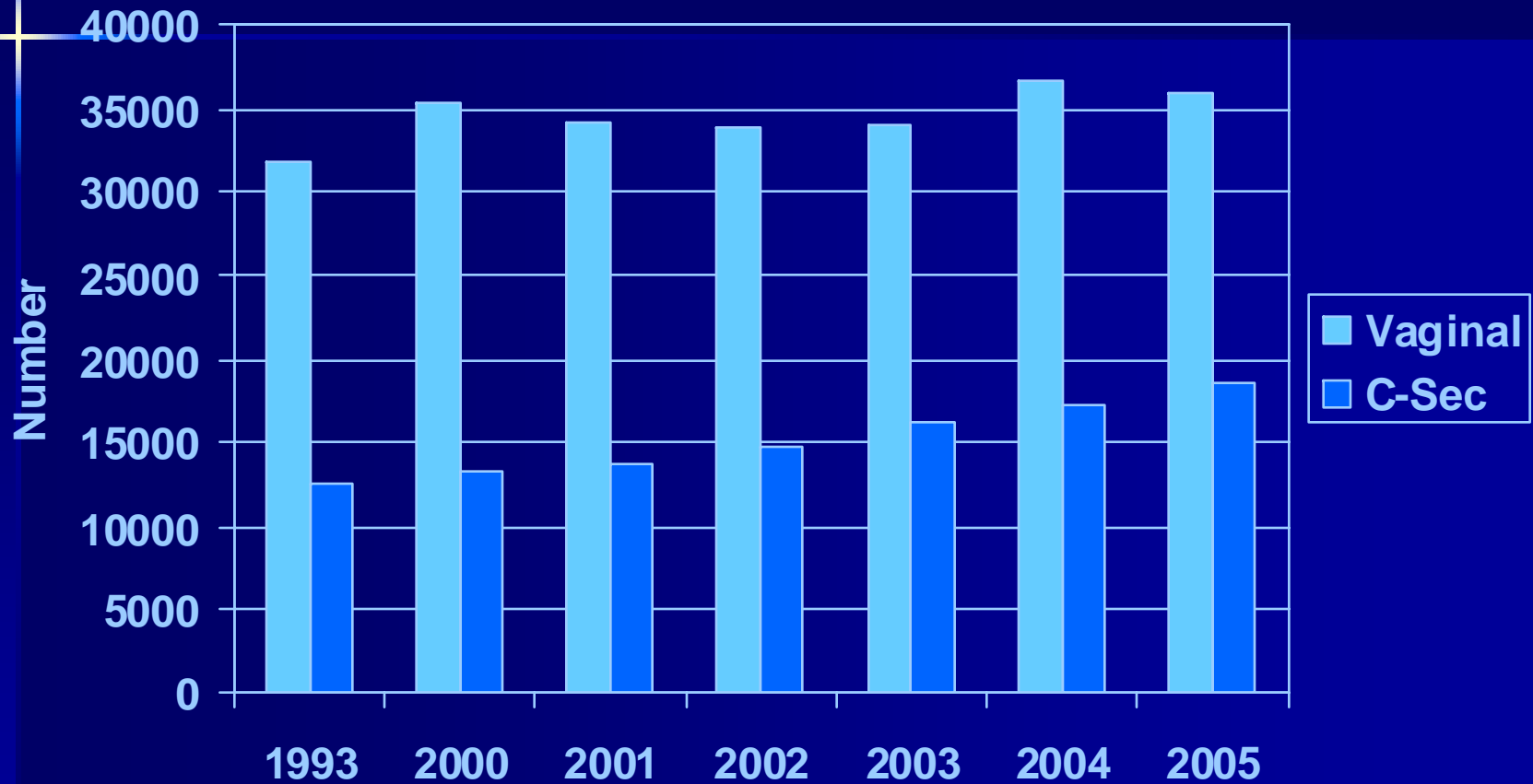


*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

**2005 data is preliminary and numbers could change

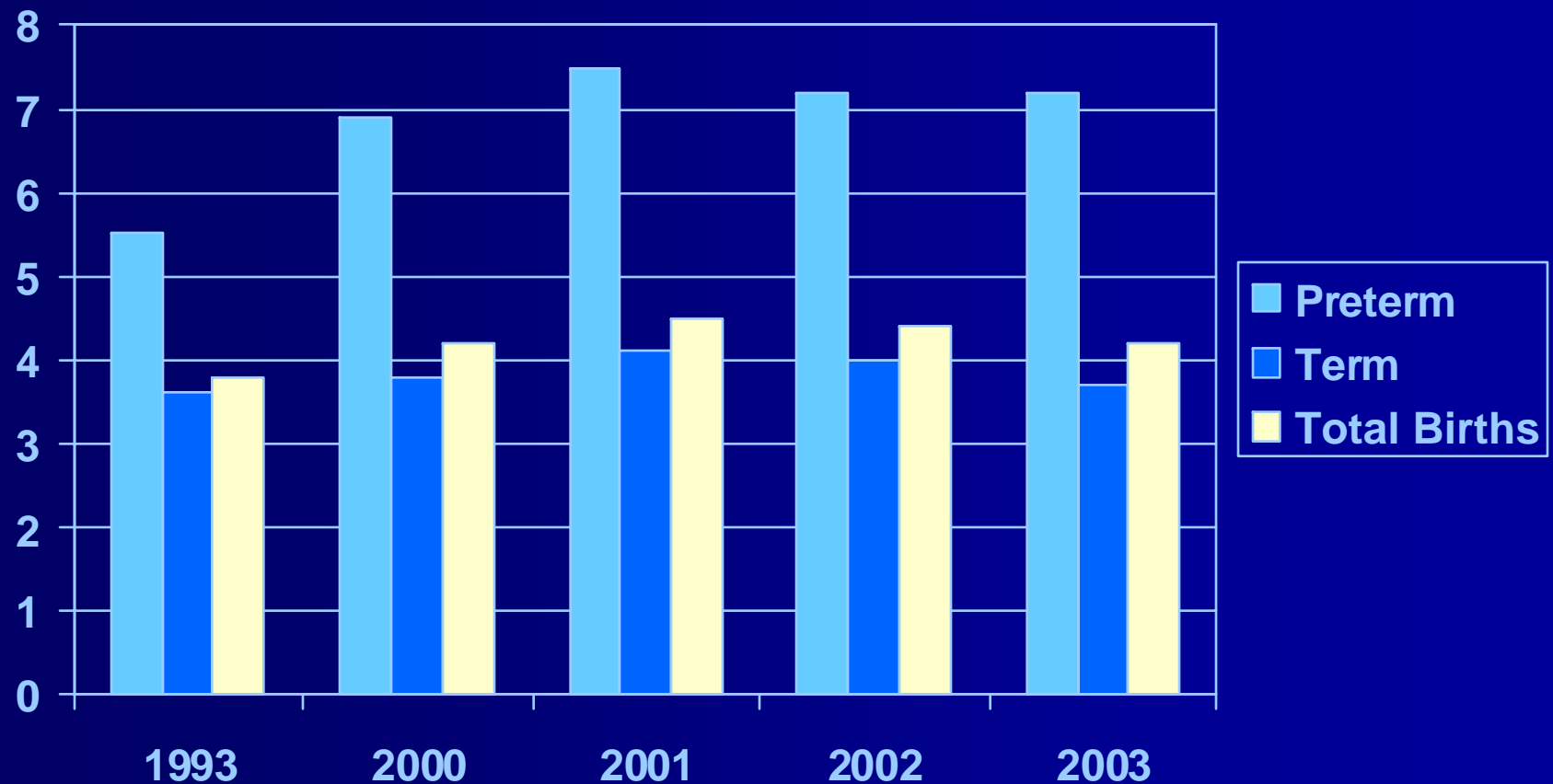
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 1993, & 2000-2005

Kentucky Live Births by Mode of Delivery



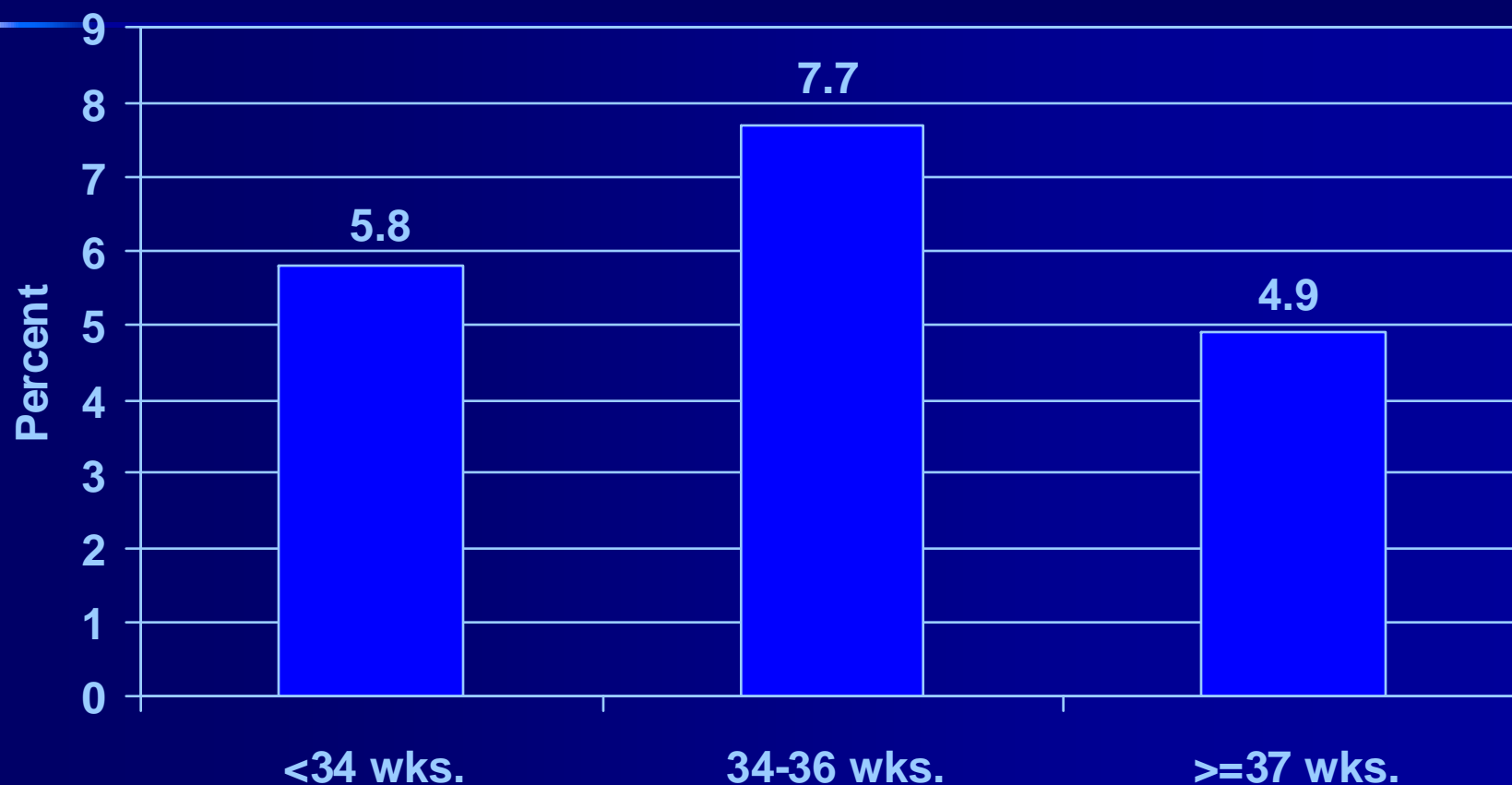
*2005 data is preliminary and numbers could change
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 1993, & 2000-2005

Percent of Live Births that were Complicated by PIH by Preterm* Status; Kentucky, 1993, & 2000-2003



*Preterm birth is defined as any live birth occurring <37 completed weeks gestation
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 1993, & 2000-2003

Percent of Live Births Complicated with Diabetes by Gestational Age Groups; Kentucky, 2005*



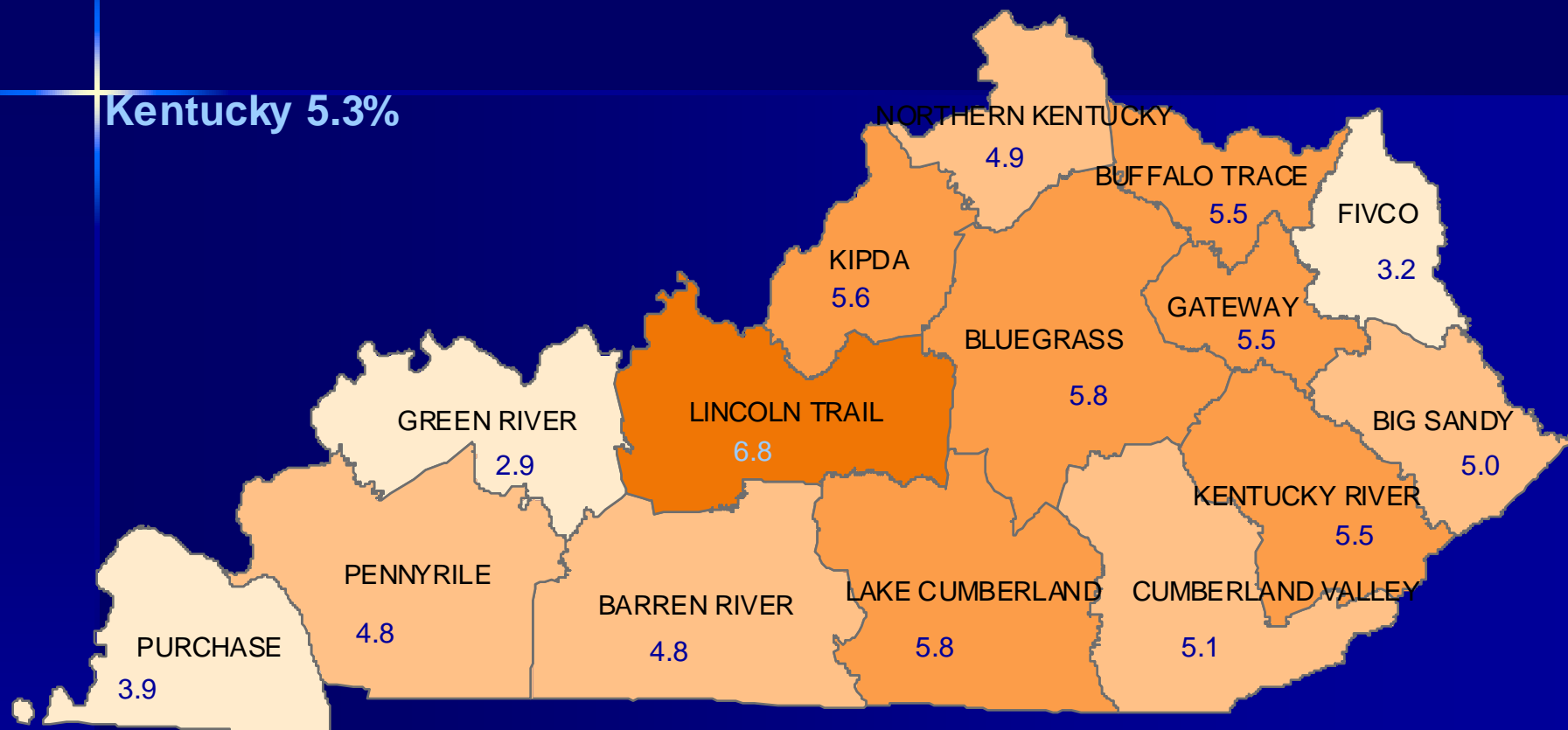
*2005 data is preliminary and numbers could change

Note: Diabetes includes both pre-existing and gestational

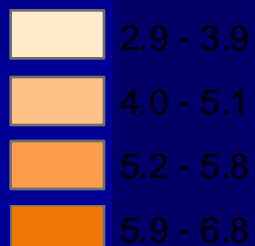
Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 2005

Percent of Births Born to Women with Diabetes* by Area Development District; Kentucky, 2005**

Kentucky 5.3%



Percentage



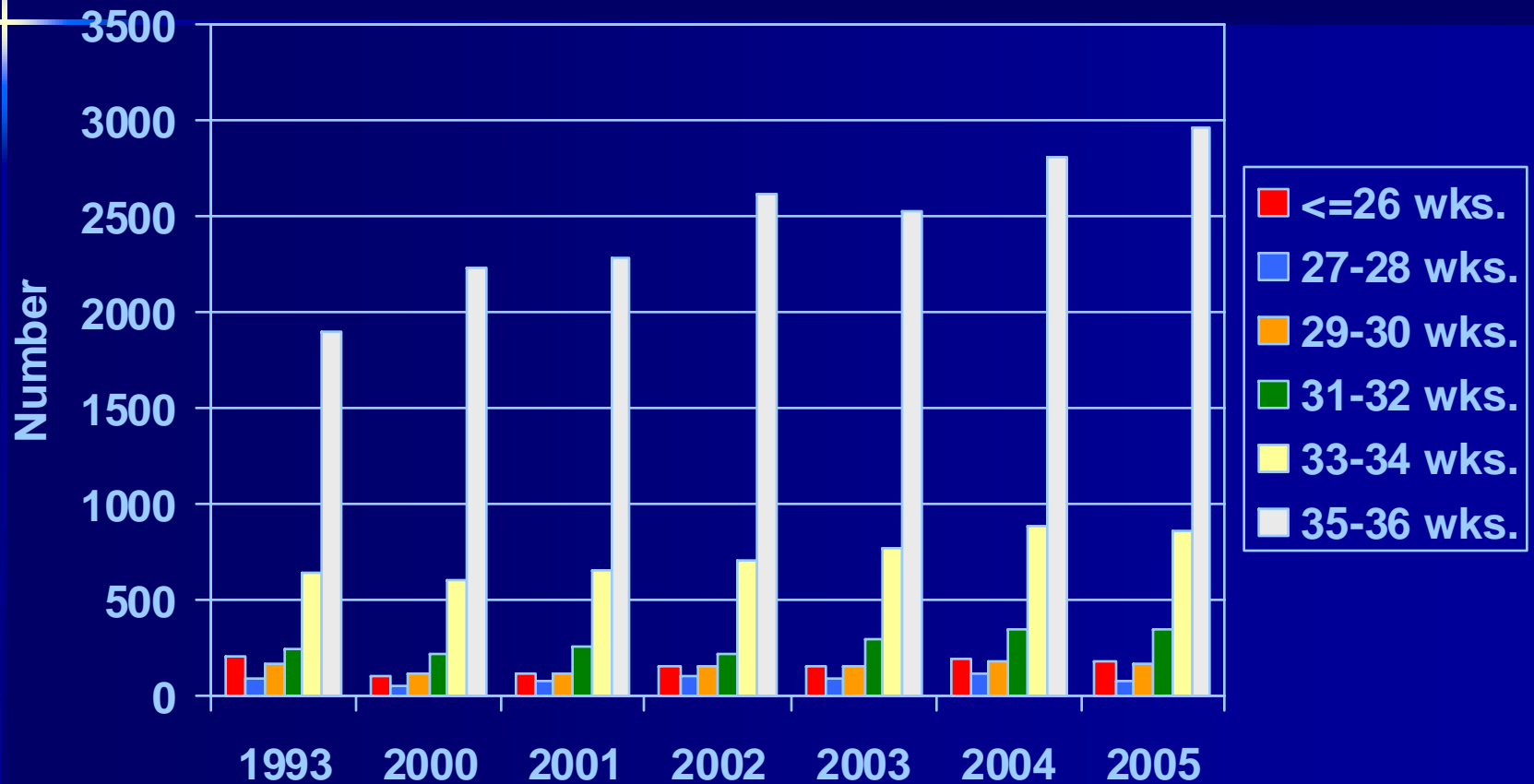
*Note: Includes both gestational and pre-existing diabetes

**2005 data is preliminary and numbers could change

Area Development District is based on the mother's county of residence at time of birth

Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 2005

Preterm* Vaginal Live Births by Gestational Age in Kentucky

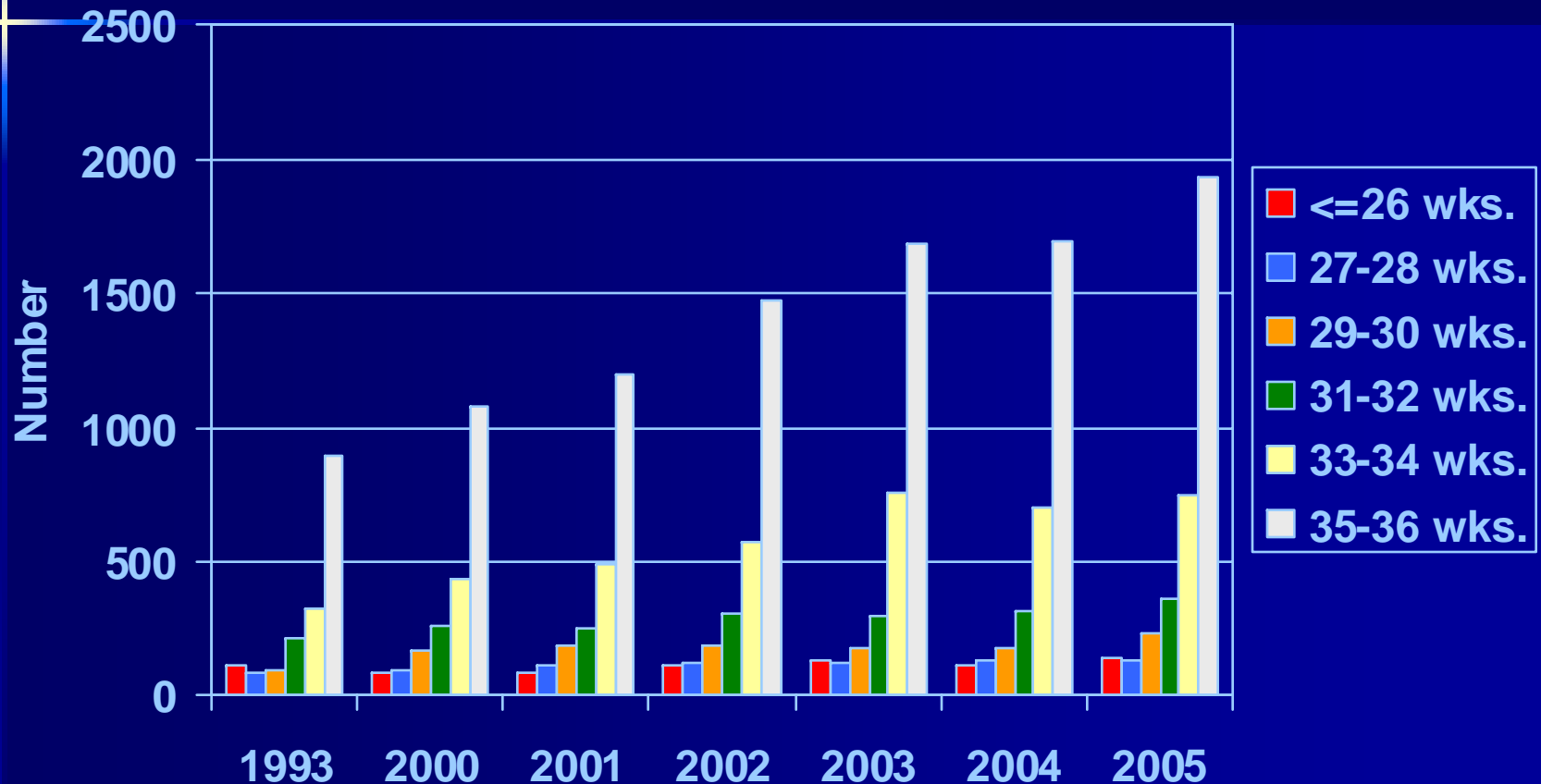


*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

**2005 data is preliminary and numbers could change

Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 1993, & 2000-2005

Preterm* Cesarean Live Births by Gestational Age in Kentucky

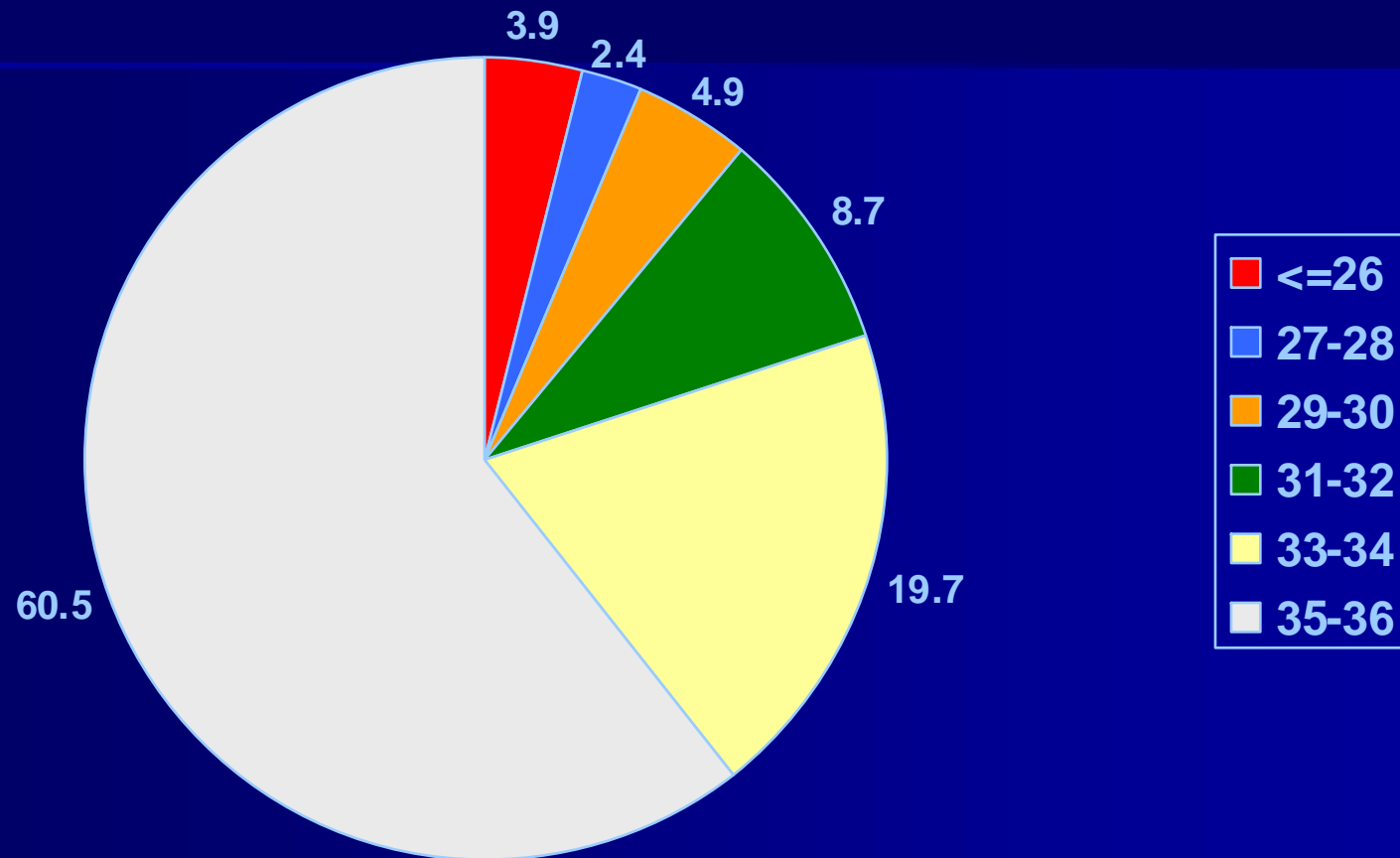


*Preterm birth is defined as any live birth occurring <37 completed weeks gestation

**2005 data is preliminary and numbers could change

Data Source: Kentucky Vital Statistics Files, Live Birth Certificate Files, 1993, & 2000-2005

Percent of Live Births that were Preterm** by Gestational Age; Kentucky, 2005*

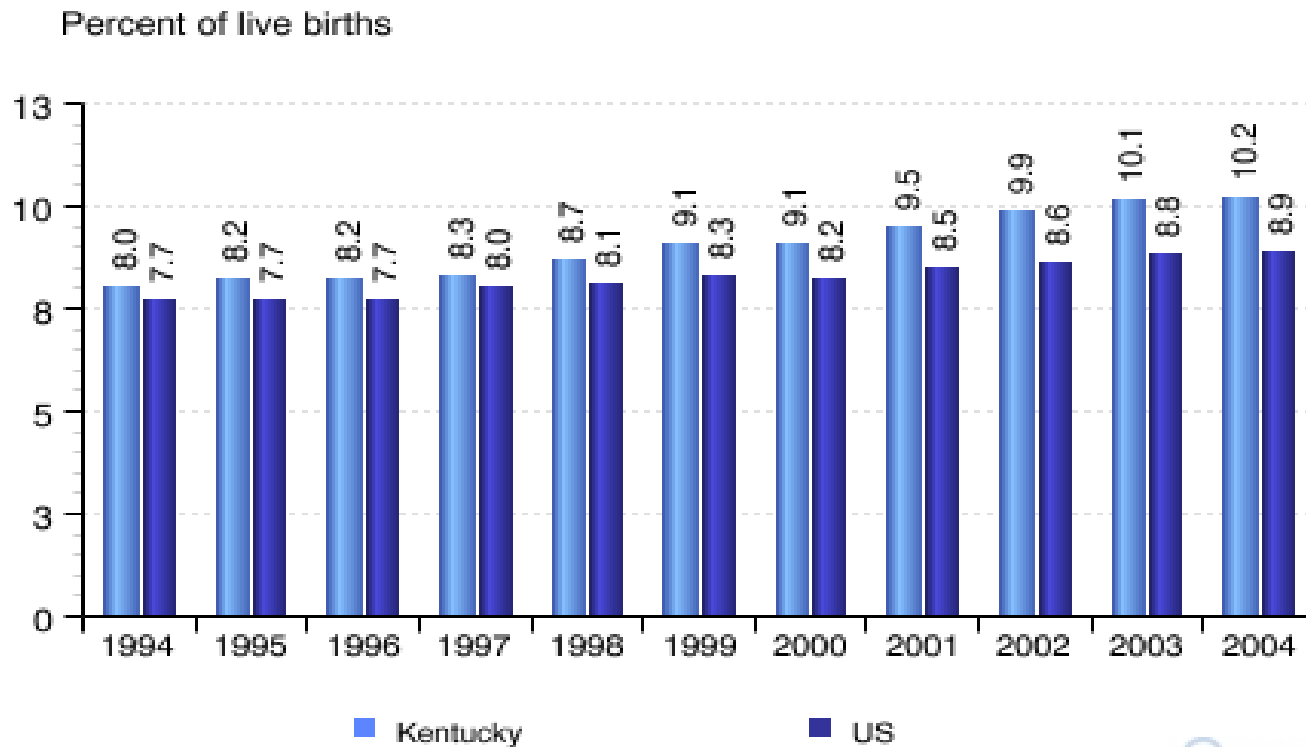


*2005 data is preliminary and numbers could change

**Preterm birth is defined as any live birth occurring <37 completed weeks gestation

Data Source: Kentucky Vital Statistics Files, Live Birth Certificate files, 2005

Late preterm birth rates: Kentucky and US, 1994-2004



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Late preterm is between 34 and 36 weeks gestation.

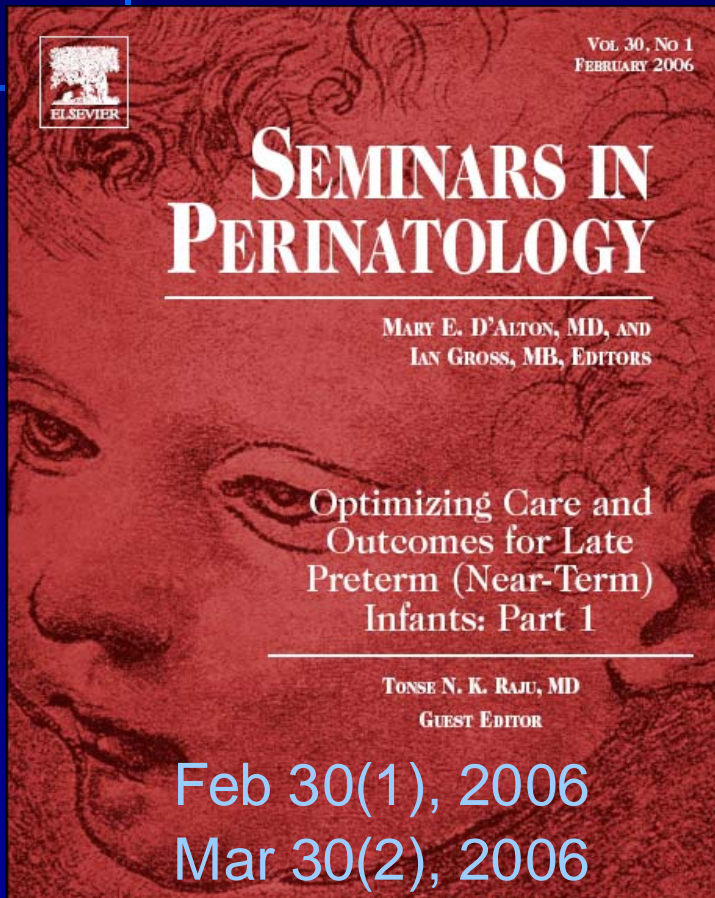
Source: National Center for Health Statistics, final natality data. Retrieved April 27, 2006, from www.marchofdimes.com/peristats.

The “Late Preterm” Infant

- Preterm: any neonate whose birth occurs thru the end of the last day of the 37th week (259th day) following the onset of the last menstrual period
- *“Late Preterm”*: any neonate whose birth occurs beginning the first day of the 34th week (239th day) through the end of the last day of the 36th week (259th day) following the onset of the last menstrual period
- Term: any neonate whose birth occurs from the beginning of the first day (260th day) of the 38th week through the end of the last day of the 42nd week (294th day) following the onset of the last menstrual period
- Post-term: any neonate whose birth occurs from the beginning of the first day (295th day) of the 43rd week following the onset of the last menstrual period

Engle WE. Semin Perinatol 30:2-6, 2006

July 2005- Invitational NICHD Workshop on Near Term/Late Preterm births (34-36 weeks)



SPECIAL ARTICLE

Optimizing Care and Outcome for Late-Preterm (Near-Term) Infants: A Summary of the Workshop Sponsored by the National Institute of Child Health and Human Development

Tonse N. K. Raju, MD^a, Rosemary D. Higgins, MD^a, Ann R. Stark, MD^b, Kenneth J. Leveno, MD^c

^aNational Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland; ^bDivision of Neonatology, Department of Pediatrics, Baylor College of Medicine, Houston, Texas; and ^cDepartment of Obstetrics and Gynecology, University of Texas Southwestern Medical Center, Dallas, Texas

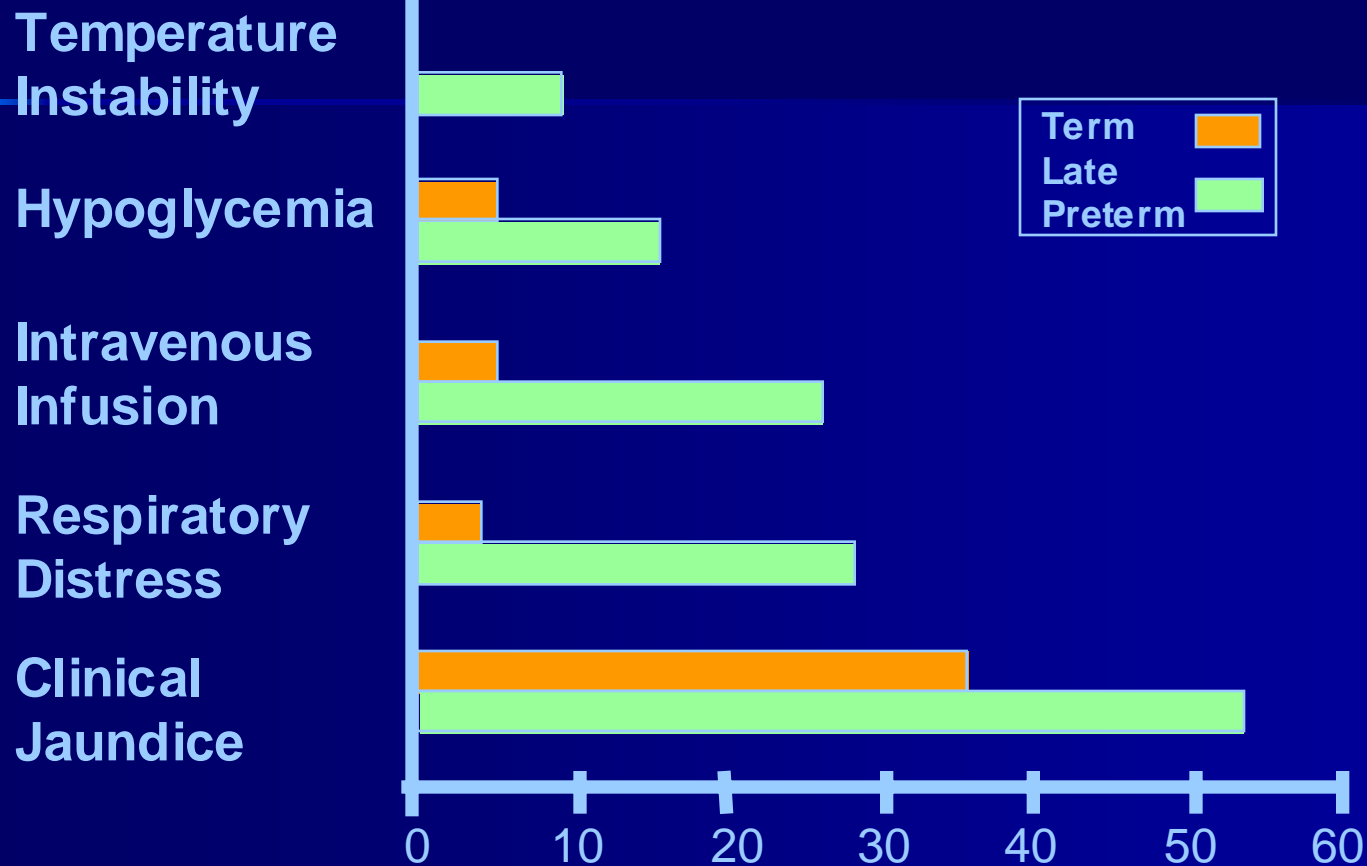
The authors have indicated they have no financial relationships relevant to this article to disclose.

Peds, 118(3):1207-14, 2006

Clinics in Perinatology, Dec 2006

Consequences of Late Preterm

Late Preterm Infants are still Preterm



Wang M. Pediatrics 114:372-376, 2004.

Respiratory Morbidity in Late Preterm Infants

- Most babies in NICUs on ventilators are late preterm infants
- Late preterm infants are still at risk for RDS/surfactant deficiency, especially IDM
- TTN (“wet lung”) is 7X more common than RDS
- Compared to babies delivered at 38-40 weeks, babies born:
 - at 37 weeks are 2X more likely to require a ventilator;
 - at 36 weeks, 5X
 - at 35 weeks, 9X, and
 - at 34 weeks, 20X
- **ACOG recommends no elective C/S before 39 weeks unless determination of fetal lung maturity**

Jain, L and Eaton, DC. Semin Perinatol 30:34-43

Escobar GJ, Clark RH, Greene JD Short-Term Outcomes of Infants Born at 35 and 36 Weeks Gestation: We Need to Ask More Questions. Semin Perinatol 30 (2006):28-33

Late Preterm Infants: Respiratory Morbidity

- ❑ Secretion of fetal lung fluid slows prior to onset of labor (catecholamines)
- ❑ Limited role for “Starling forces” and “vaginal squeeze”
- ❑ Surfactant may be marginal in late preterm infants
- ❑ Fluid transport via transepithelial sodium channels in alveolar epithelial cells (~60% FLF absorption)
 - Limiting factor: the number of sodium channels and other maturational changes in the epithelium

Jain, L and Eaton, DC. Semin Perinatol 30:34-43

Late Preterm Infants: Respiratory Morbidity

- Pulmonary vasoconstriction present during fetal life is overcome and pulmonary artery pressure falls
 - Mean Pulmonary Artery pressure rises during fetal life
 - Peaks at term
 - Not as much a problem in young premies
- Pulmonary arteries and arterioles vasodilate/relax
 - Elastic lamina thicker than any other time in life
 - Dilation triggered by O₂
 - Can clamp down again if hypoxia
- Pulmonary arteries and arterioles uncoil

Abnormal Transition => Pulmonary Hypertension

"PPHN" - often vasospastic then unrelenting

Heyman MA, Hoffman JIE. In Neonatal Pulmonary Care, 1986

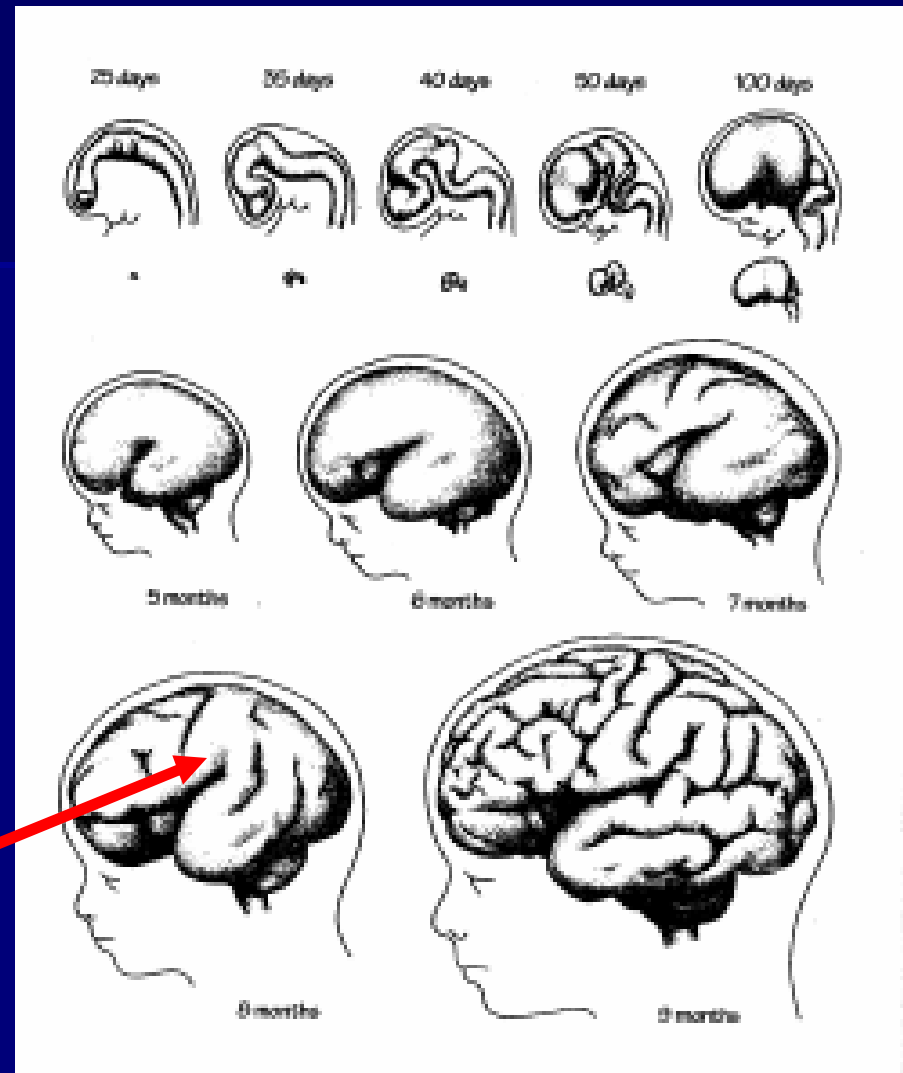
The Late Preterm Infant: HYPOGLYCEMIA

- Glucose is the major metabolic fuel for the brain
- “Transient” hypoglycemia is associated with neurodevelopmental abnormalities
- Late preterm, the compensatory mechanisms responsible for protecting the brain from hypoglycemic injury are not in place
- The immature brain is at risk for damage due to:
 - limited reserves of energy substrates
 - Glucose & alternate fuels
 - high-energy phosphates
 - limited antioxidant defense

*Garg M, Devaskar SU. Glucose metabolism in the Late Preterm Infant.
Clin Perinatol 33:853-70, 2006.*

Development of the Human Brain through Gestation

- Lower functions mature first
- Cortex is last to develop
- Brain at 35 wks weighs only 2/3 what it will weigh at term



The Late Preterm Infant – Brain Development: Brainstem

■ BRAINSTEM – Vital Functions

- Respiration, rhythmic
- Heart rate variability
- Homeostatic mechanisms
- Sleep
- Coordination of Suck/Swallow/Breathe

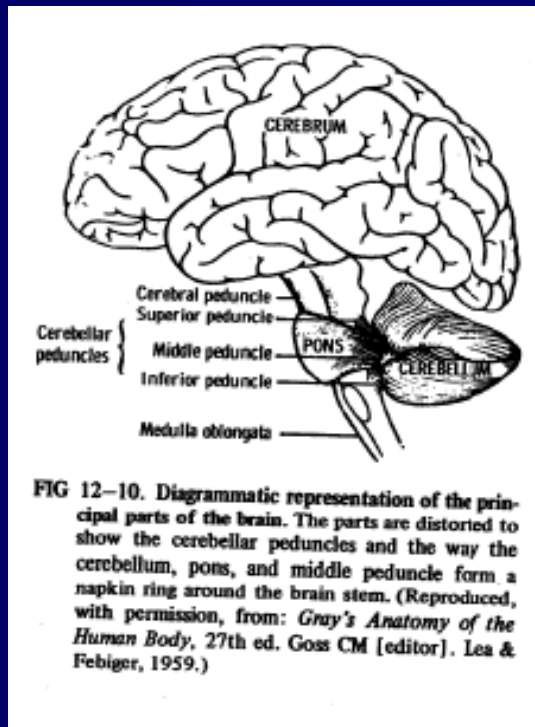
■ Immature Control in LPTB Evidenced by

- Periodic breathing, Apnea
- Decr HR variability
- Immature Responses to hypoxia, CO₂
- REM sleep
- Feeding difficulties

■ Darnall RA, Ariagno RL, Kinney HC. The Late Preterm Infant and the Control of Breathing, Sleep, and Brainstem Development: A Review. Clin Perinatol 33(2006): 883-914

■ Hunt CE. Ontogeny of Autonomic Regulation in Late Preterm Infants Born at 34-37 weeks Postmenstrual Age. Semin Perinatol 30 (2006): 73-76

The Late Preterm Infant – Brain Development: Cerebellum



CEREBELLUM

- Volume of the Cerebellum at 34 weeks is only 55% of that at term
- Function related to
 - Fine motor control
 - Coordination
 - Motor sequencing
 - Cognition & language
 - Social function & learning
- PTB alters cerebellar growth and autoregulation

Adams- Chapman I. Neurodevelopmental Outcome of the Late Preterm Infant. *Clin Perinatol* 33(2006): 947-964

The Late Preterm Infant – Brain Development: Cerebral Cortex

WHITE MATTER

-Volume of the white matter increases

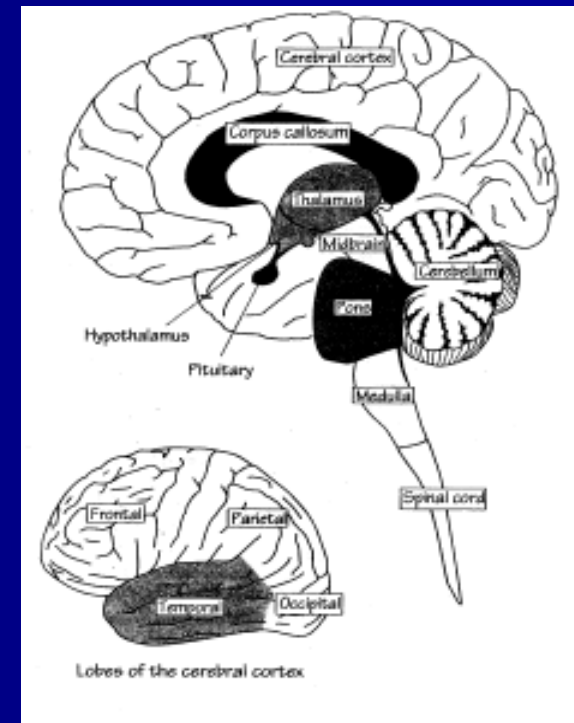
5-fold from 35-41 weeks

-PVL precedes the onset of active myelin sheath synthesis – pre-oligodendrocytes

-myelin helps protect from injury in mature white matter

- PVL assoc with cognitive and behavior abnormalities correlates with preferential injury to pre-OL

-In the Late Preterm Infant, PreOL predominate in white matter



Kinney HC. The Near-Term (Late Preterm) Human Brain and Risk for Periventricular Leukomalacia: A Review. *Semin Perinatol* 30 (2006): 81-88

The Late Preterm Infant – Brain Development: Cerebral Cortex

- CEREBRAL CORTEX Volume at 34 weeks is only 53% of term volume
- Cortex is seat of higher order functions – cognition, perception, reason, motor control
- Functional processing units form in columns; more surface area allows more functioning units
- Brain organizes during late preterm period –huge development of synapses, axon growth, dendrites, neurotransmitters
- Myelination does not begin in the cortex until the late preterm period

Brain Development in the Late Preterm Infant : Neurodevelopmental Outcomes

- Compared to term infants, late preterm infants:
 - Are **twice as likely to die of SIDS**
 - Have an **80% increased risk of ADHD**
 - **Have a 20% risk of clinically significant behavior problems at 8 yrs of age**
 - Are more likely to be diagnosed with Developmental Delay in the first 3 years
 - Are more likely to be referred for special needs in pre-school
 - Are more likely to have problems with school readiness
 - Are more likely to have severe hyperbilirubinemia and resultant neurologic consequences

Fuchs K, Wapner R. Elective Cesarean Section and Induction and Their Impact on Late Preterm Births. Clin Perinatol 33: 793-801, 2006.

Adams- Chapman I. Neurodevelopmental Outcome of the Late Preterm Infant. Clin Perinatol 33: 947-964, 2006.

Costs of Prematurity

Immediate and long term health effects on the infant

Immediate and long term stress to the family

Financial cost to family

Financial costs to society

- Prematurity is responsible for more than **\$26.2 billion dollars** in annual societal economic costs (medical, educational, and lost productivity) in the U.S. [IOM, 2006]

- Prematurity leads to many chronic medical conditions costing health care dollars

- Maternity and newborn care is often the single largest cost to many companies' health benefit plans

Costs of Late Preterm

■ Infant Hospitalization costs:

- Late preterm infants accrue increased hospital expenses after birth than term infants
- Late preterm infants have a higher rate for readmission to the hospital

■ Obstetrical Costs:

- A California study estimated that over \$49 Million could be saved if non-indicated deliveries between 34 and 37 weeks were avoided for one year.

Gilbert WM, Nesbitt TS, Danielson B. The cost of prematurity: quantification by gestational age. Obstet Gynecol 102:488-92, 2003.

Cost Associated With Prematurity in Kentucky, 2005 data

- Total NICU charges related to preterm birth was **\$204,504,246** for calendar year 2005 with average charges ranging from \$11,000-\$88,000
(KY Hospital Discharge Database, 2005)
- Total amount paid by KY Medicaid for prematurity related initial hospitalization stays for calendar year 2005: **\$7,421,829.49** *(KY Medicaid Claims Database, 2005)*
- KY Medicaid paid out nearly 4X as much for the care of babies 35-36 weeks (late preterm infants) as they did for babies 25-26 weeks (micropremies).

Late Preterm Costs in Early Childhood

■ Early Intervention costs (Massachusetts):

- Mean cost of EI services per moderate/late preterm infants (33-36 weeks) was more than twice the cost per term birth
- Moderate/late preterm infants comprised 8.7% of the infants served, but 16% of the costs to the system.
- Very preterm births incurred only 8% of the costs to the system

[Clements KM, Barfield WD, Ayadi FA, Wilbur N. PEDIATRICS 119:e866-e874, 2007]

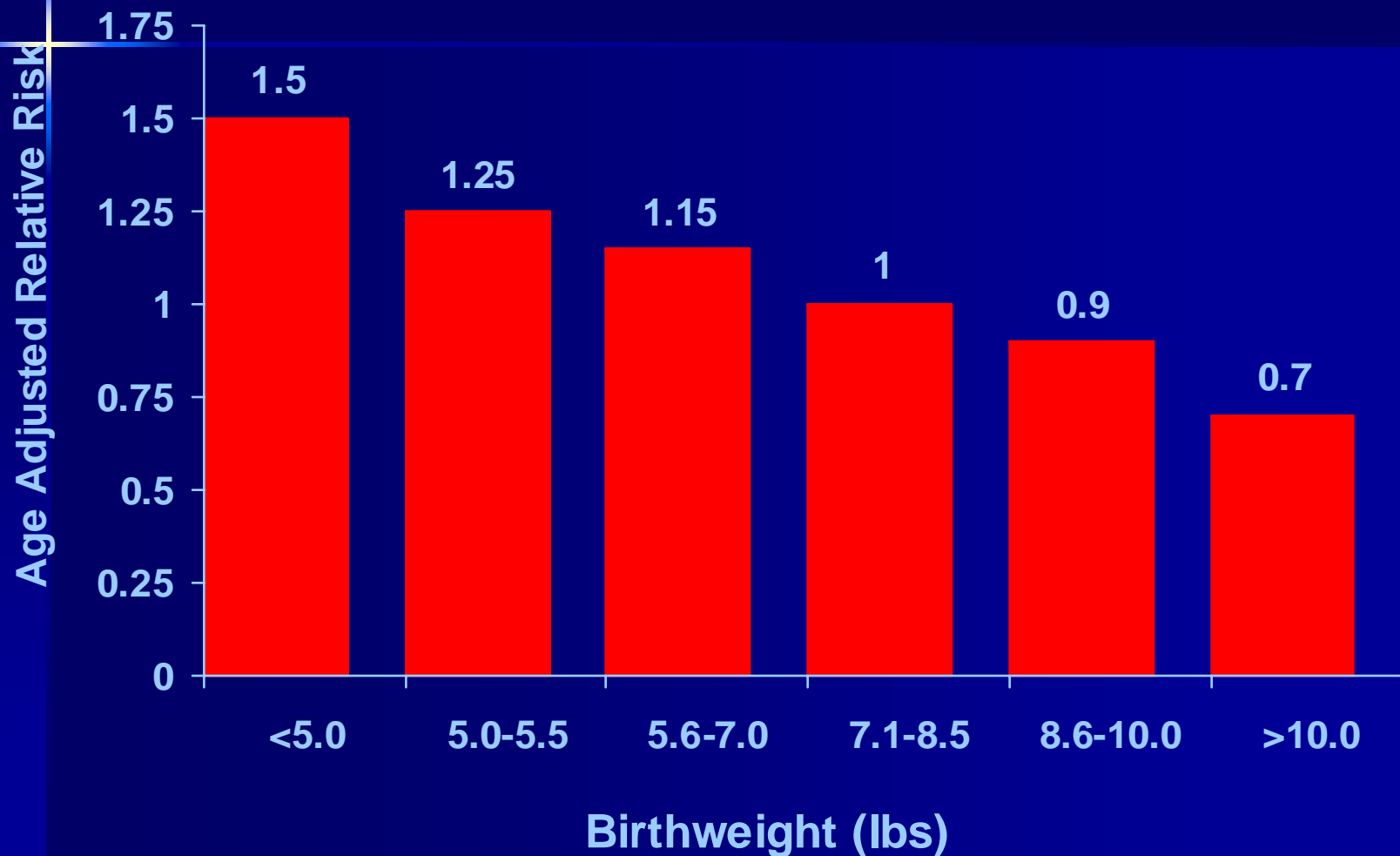
■ Kindergarten costs (Florida):

- If 9% of infants who weighed between 1500 and 2499gm at birth could be delivered at >2500 gm, the state could potentially have saved \$1Million in kindergarten costs

[Roth J, Figlio D, et al. Maternal and Infant Factors Associated with Excess Kindergarten Costs. PEDIATRICS 114(3):720-728, 2004]

Birth Weight and Coronary Heart Disease

Barker Hypothesis

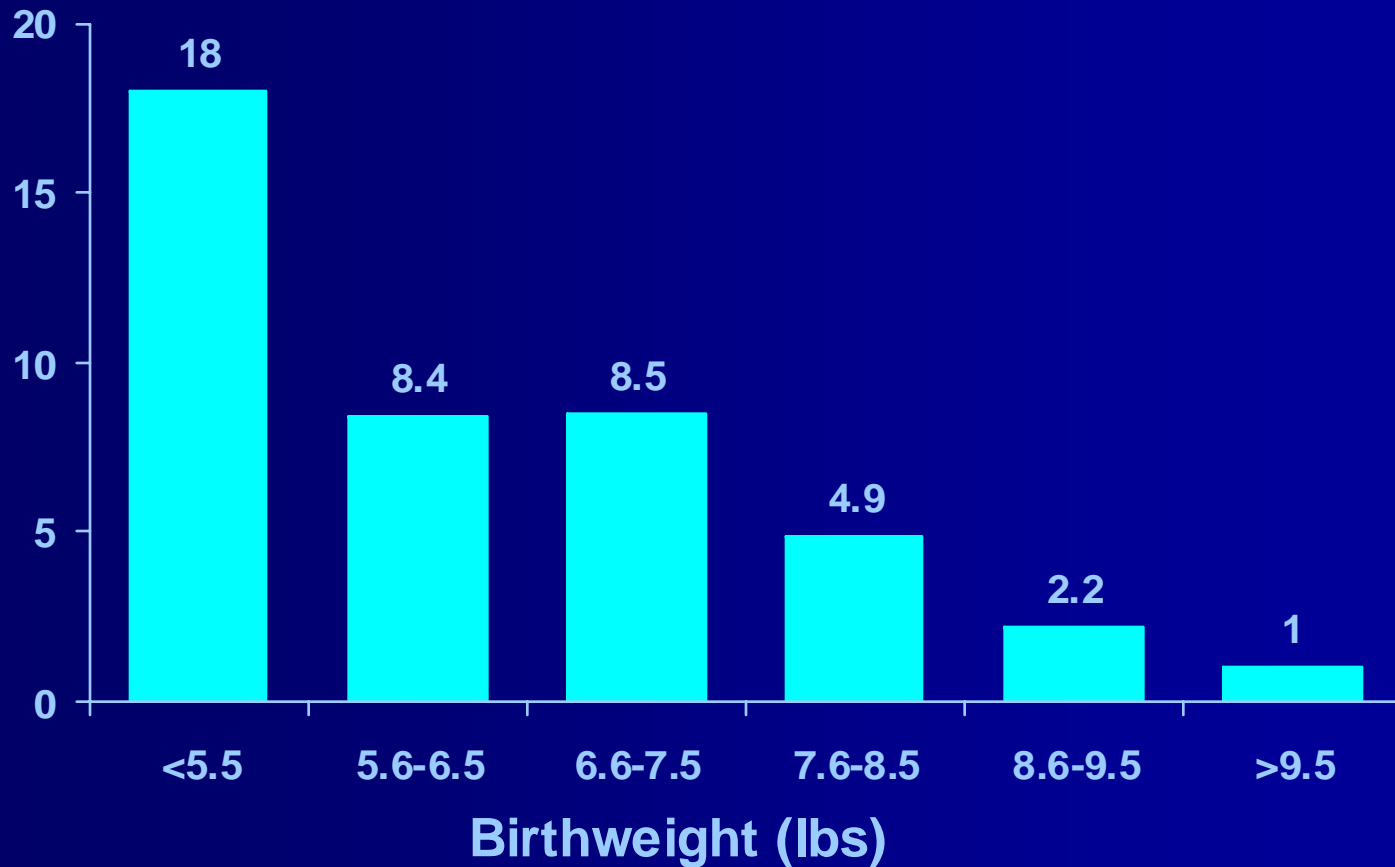


Rich-Edwards 1997

Birth Weight and Insulin Resistance Syndrome

Barker Hypothesis

Odds ratio adjusted for BMI



Barker 1993

Public Health Strategies to Address Late Preterm Birth

- Provider Education – new information
- ACOG Guidelines – avoid C-section or induction before **39 weeks** unless medical indication
- Educate public on risks of early delivery and importance of going full term unless there are medical risks
- Avoid deliveries for convenience prior to 39 weeks
- Smoking Cessation
- HANDS Home Visiting
- Centering Pregnancy
- Healthy Start

Smoking in Pregnancy

- "Smoking during pregnancy is the **SINGLE MOST PREVENTABLE CAUSE** of morbidity and mortality for maternal and infant health in the United States." CDC
- Eliminating smoking could prevent 10% of all infant deaths and 12% of deaths due to perinatal conditions. [Surgeon General]
- Kentucky has the second highest percentage of women who smoke during pregnancy KY 26.7%, US 10.2%
- Some counties in Kentucky show rates as high as 51% for smoking during pregnancy
- Despite decreased smoking rates we now see across the state, smoking during pregnancy has not declined in Kentucky.
- New DPH smoking quit line has counselors trained to deal with pregnant smokers: 1-800-QUIT-NOW

Evidence based Intervention: Kentucky HANDS Program

Health Access Nurturing Development Services

- A voluntary, intensive home visitation program for overburdened first time parents, designed to assist in critical developmental points beginning prenatally and following the family until the child is 2 years of age.

EVALUATION OF OUTCOMES (n=19,369)

In teen mothers in HANDS, matched with a comparable group of non-participants:

- Prematurity 50% less likely with 16 or more visits
- LBW 32% less likely
- VLBW 80% less likely
 - NO VLBW infants in participants who entered first trimester
- Birth Defects 50% less likely
- Infant Mortality 75% less likely
 - HANDS IM in teen population only 1.6% (Kentucky 7.1% overall)
- Substantiated abuse: none in 2002 cohort (studied in 2004)
- Neglect: more investigations but less substantiations in HANDS participants than comparison group
- Key to optimal outcomes is entry in first trimester

Healthy Babies ARE WORTH THE WAIT™

— A Prematurity Prevention Partnership —

- Goal: 15% reduction in the rate of singleton preterm births in targeted sites in Kentucky
- Sites: 3 intervention and 3 comparison sites in eastern, central and western Kentucky
- Sample size of about 12,000 live births over three years
- Targeting late preterm birth prevention and awareness



Healthy Babies ARE WORTH THE WAIT™

— A Prematurity Prevention Partnership —

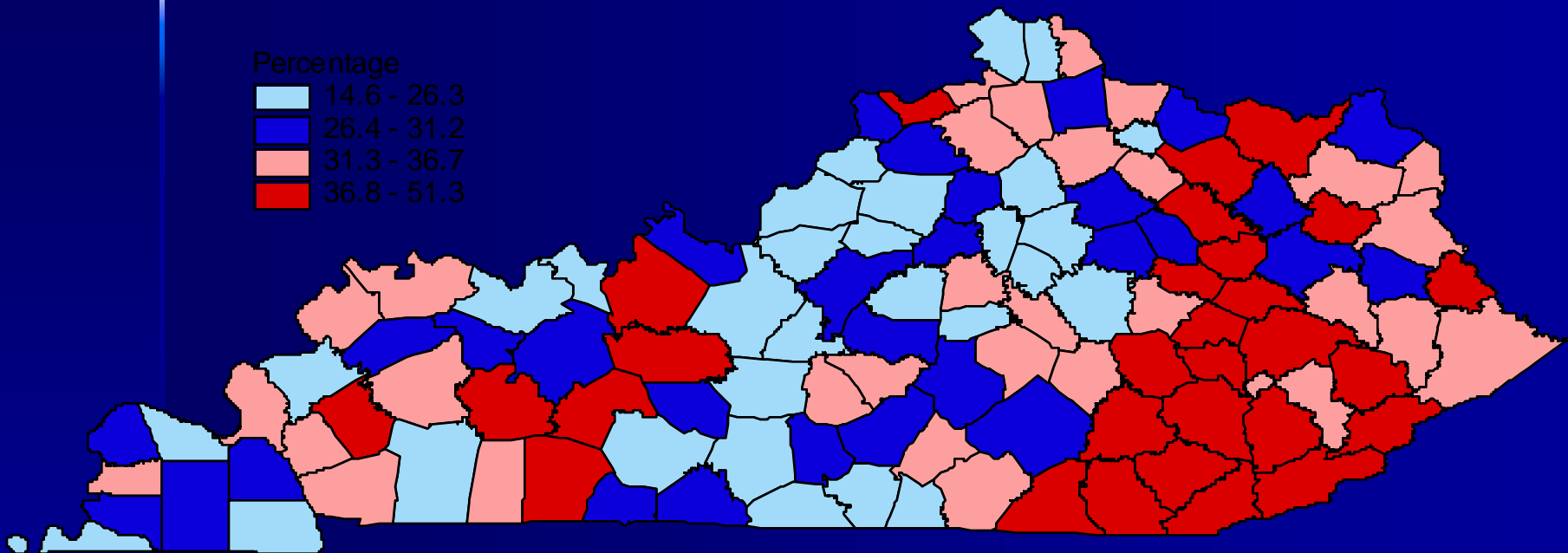
- A system of collaboration among local and state level clinical and public health leadership
- Bundled evidenced based interventions to prevent preterm birth in an ecological design, focus on singleton late preterm birth
- Linked elements of clinical care, public health and consumer education:
 - Professional Continuing Education
 - Grand Rounds & Training
 - Clinical Interventions in Prenatal Period
 - Standard clinical guidelines
 - Patient safety
 - Public Health Intervention/ Patient Education & Support
 - Augmenting existing services for case management, screening & referral
 - home visiting, smoking cessation, quit line
 - Consumer Awareness and Education
 - Health literacy in context of prenatal care
 - Community outreach

Summary

- Kentucky's rate of Preterm Birth is rising twice as fast as the national rate
- This rise is largely due to an increase in Late Preterm Infants
- Late Preterm Infants have increased morbidity and mortality compared to term infants
- Providers, patients, and public need to be aware of the risks of late preterm delivery and ways to prevent it.
- Prevention of preterm birth is possible in some cases

Smoking during Pregnancy by County in Kentucky, 2004*

Kentucky: 26.7%



Lowest: Oldham County, 14.6%

Highest: Jackson County, 51.3%

*2004 data is preliminary and numbers could change
Source: Kentucky Vital Statistics Files; Live Birth Certificate Files, 2004

Smoking during pregnancy

- Risks for mother: PROM, abruption, placenta previa, fertility, conception delay
- Risks for neonate: stillbirth, increased death from SIDS, IUGR, preterm delivery, LBW; risk of hyperactivity disorder; deficient language and motor skills; learning problems; mental retardation.
- Eliminating smoking could prevent 10% of all infant deaths and 12% of deaths due to perinatal conditions. [Surgeon General]
- Smoking-attributable costs for MATERNAL conditions in US ranged from \$59M - \$ 942Million
[Kime IK, Ayadi MF, Adams EK. MCH Epi Conference, 2005]

Smoking in Pregnancy

ACOG recommendations

- Recommend integrating 5A's into routine prenatal practice
 - A 5-15 min intervention with patients can double or triple the quit rates of pregnant smokers
- Training manual from ACOG
- Chart reminder stickers from ACOG
- Powerpoint from ACOG
- CME Program from ACOG
- QUIT LINES recommended by ACOG

Smoking in Pregnancy

Evidence-based Interventions

The 5 A's:

- ASK if the patient is smoking
- ASSESS if the patient is ready to quit
- ADVISE
- ASSIST
- ARRANGE

Smoking in Pregnancy

Evidence-based Interventions

Make Yours A Fresh Start Family:

- Survey new patients to identify smokers
- Tailor the health risk message and urge the smoker to quit
- Assess the smoker's readiness to quit
- Give a self-help guide and help plan appropriate steps to quit
- Evaluate progress at subsequent visits

Based on AHRQ Clinical Practice Guidelines on smoking cessation

Includes booklets for pregnant women, moms of young children, and one for fathers/family members

Trained personnel in all 120 county Health Departments