

This work is licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike License](https://creativecommons.org/licenses/by-nc-sa/4.0/). Your use of this material constitutes acceptance of that license and the conditions of use of materials on this site.



Copyright 2006, The Johns Hopkins University and Melissa Hawkins. All rights reserved. Use of these materials permitted only in accordance with license rights granted. Materials provided "AS IS"; no representations or warranties provided. User assumes all responsibility for use, and all liability related thereto, and must independently review all materials for accuracy and efficacy. May contain materials owned by others. User is responsible for obtaining permissions for use from third parties as needed.



JOHNS HOPKINS  
BLOOMBERG  
SCHOOL *of* PUBLIC HEALTH

# *The Epidemiology of Infant Mortality I: Terminology and Immediate Causes*

---

Melissa Hawkins, PhD  
Johns Hopkins University



JOHNS HOPKINS  
BLOOMBERG  
SCHOOL *of* PUBLIC HEALTH

## *Section A*

---

Standard Terminology in Reproductive Health

# Standard Terminology in Reproductive Health

## ■ *Rate*

- Measures the frequency of an event within a particular population during a given period of time

## ■ *Ratio*

- Indicates a relationship between one element and a different element
- Individuals in the numerator do not have to be part of the denominator

# *Live Birth Terminology*

- A live birth is defined as "the complete expulsion or from the mother of a product of human conception, irrespective of the duration of pregnancy, which, after such expulsion or extraction, breathes or shows any other evidence of life, such as a beating heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached"

# *Live Birth Terminology: Categories of Gestational Age*

## ■ **Pre-term**

- Infants born through the 37th week

## ■ **Term infants**

- Infants born between the first day of the 38th week and the last day of the 42nd week of gestation

## ■ **Post-term**

- Infants born from the beginning of the first day of the 43rd week onward

# *Live Birth Terminology: Categories of Birth Weight*

- **Normal birth weight**
  - Birth weights greater than or equal to 2500 grams
- **Low birth weight (lbw)**
  - Birth weights less than 2500 grams
- **Very low birth weight (vlbw)**
  - Birth weights less than 1500grams

- **Crude birth rate**

- Impact of fertility on population growth by relating the total number of births during a calendar year to the total population

- **General fertility rate**

- Relates the number of births within the general population to the population "at risk" (i.e., women of reproductive age)

# *Fetal and Infant Mortality Terminology*

- **Infant death** is "any death at any time from birth up to, but not including, one year of age (364 days, 23 hours, 59 minutes from the moment of birth)"

# *Fetal Mortality Terminology*

- Fetal mortality indices express the probability of pregnancies within specific populations
  - **Fetal death rate**—the number of live births and the number of fetal deaths comprise the denominator (population at risk of fetal death)
  - **Fetal death ratio**—only uses the number of live births in the denominator

# *Fetal Mortality Terminology*

- AAP and ACOG recommend reporting fetal deaths by gestational age and birth weight
- Fetal death calculations do not include induced terminations of pregnancy
- Currently, there is no national system for reporting induced terminations of pregnancy within the U.S.

# *Infant Mortality Terminology*

- Infant mortality indices indicate the likelihood that live births with particular characteristics will die (or survive) during the first year of life
- Infant death may occur during the neonatal period (prior to the 28th day of life)
- Infant death may occur during the post-neonatal period (from 28 days of life up to one year of life)

# *Infant Mortality Terminology*

- For all three indices, the number of live births during a calendar year represents the population at risk
  - Another denominator for the post-neonatal mortality rate—number of live births minus the number of neonatal deaths, which is a more appropriate representation of the population at risk of dying during this period

# Neonatal Mortality Terminology

- Neonatal period can be further subdivided
  - *Neonatal Period I*—birth through 23 hours and 59 minutes
  - *Neonatal Period II*—end of 24th hour of life through six days, 23 hours and 59 minutes
  - *Neonatal Period III*—end of 7th day through 27 days, 23 hours, and 59 minutes

# *Perinatal Mortality Terminology*

- Indices for perinatal mortality combine both fetal and infant deaths within the first few days or weeks of life
- Assumption is that similar factors may be responsible for deaths occurring both shortly before the expected date of delivery and shortly after delivery

# Perinatal Mortality Terminology

- Perinatal death is also divided into three different periods
  - *Perinatal Period I*—infant deaths < 7 days + fetal deaths of 28 weeks or >
  - *Perinatal Period II*—infant deaths < 28 days + fetal deaths of 20 weeks or >
  - *Perinatal Period III*—infant deaths < 7 days + fetal deaths with 20 weeks or >

# Maternal Mortality Terminology

- A *maternal death* is "the death of a woman from any cause related to or aggravated by pregnancy or its management (regardless of duration or site of pregnancy), but not from accidental or incidental causes"
- Death resulting from complications of induced abortion is considered a maternal death

# *Maternal Mortality Terminology*

- Maternal mortality indices express the likelihood of a pregnant woman dying from causes associated with pregnancy, childbirth or the puerperium
- The number of live births is used as a proxy for the population of pregnant women

# *Maternal Mortality Terminology*

- Population at risk should include all live births, induced terminations of pregnancy, and fetal deaths during a given period of time
- Under the current system, it is not feasible to identify every woman at risk

# *Maternal Mortality Measures*

- WHO defines a maternal death as death to a pregnant woman within 42 days of the end of pregnancy
- AAP and the ACOG recommend that maternal mortality statistics be tabulated in two ways
  - Without limitation on when death occurs
  - Maternal deaths that occur within 42 days of the end of pregnancy

# *Maternal Mortality Measures*

- Interest has shifted to perinatal outcomes in developed countries because of declines in maternal mortality
- Developing countries have not yet experienced this trend
  - Type of data that exists differs
- WHO recommends that birth weight, and not gestational age, is used to obtain accurate perinatal health statistics



JOHNS HOPKINS  
BLOOMBERG  
SCHOOL *of* PUBLIC HEALTH

## *Section B*

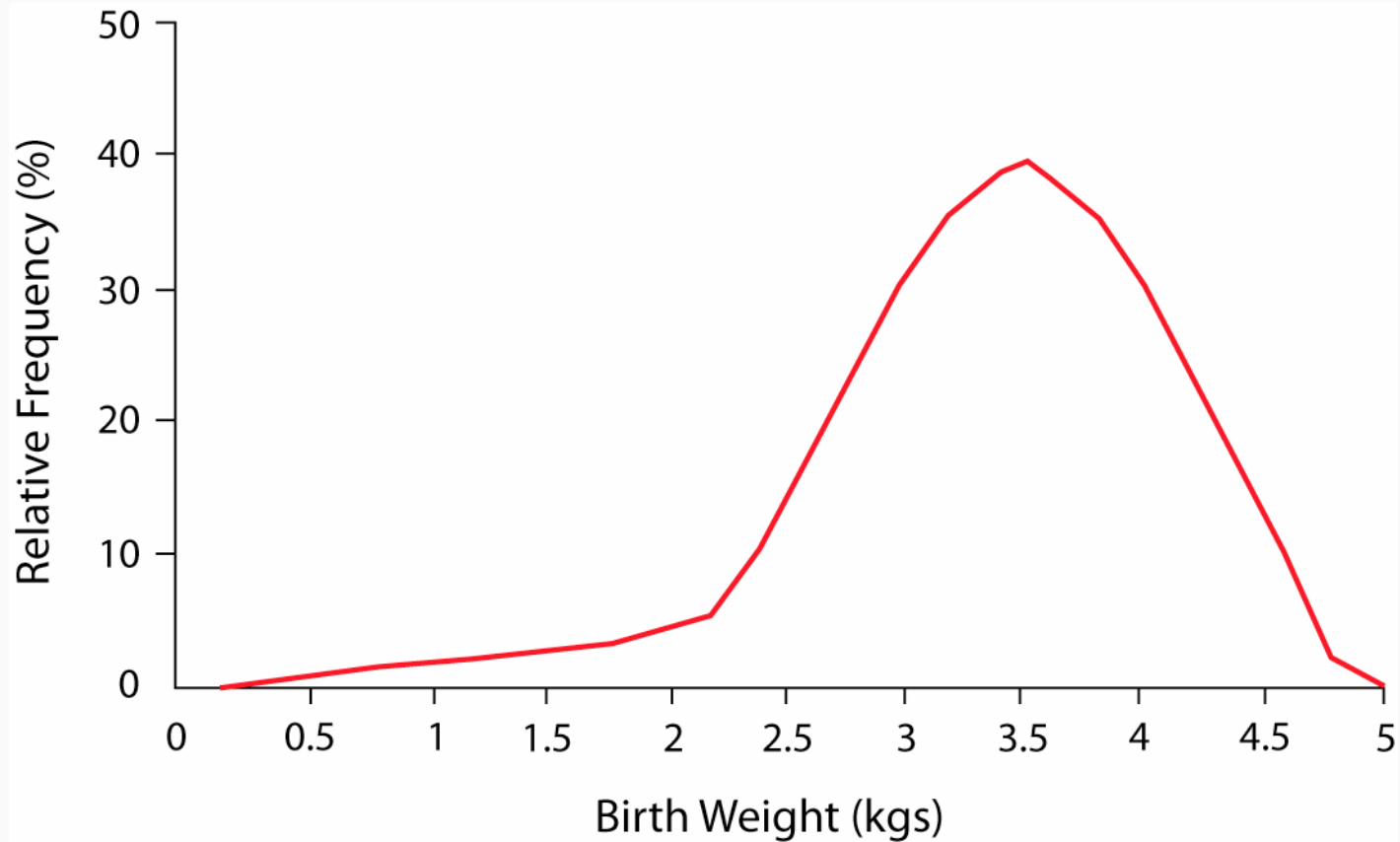
---

Birth Weight, Gestational Age, and Infant Mortality

# *Birth Weight, Gestational Age, and Infant Mortality*

- Distribution of birth weight in the U.S.
- Determinants of low birth weight
- Birth weight, gestational age, and infant mortality

# Distribution of Birth Weight in the U.S. Population



Note: 6% of births are LBW, 1% of births are VLBW



# *Determinants of LBW*

- LBW results from two processes
  - **Shortened duration of pregnancy** (preterm birth)
  - **Intrauterine growth that is less than expected** for the length of gestation [intrauterine growth retardation (IUGR) or small for gestational age (SGA)]

# *Determinants of LBW*

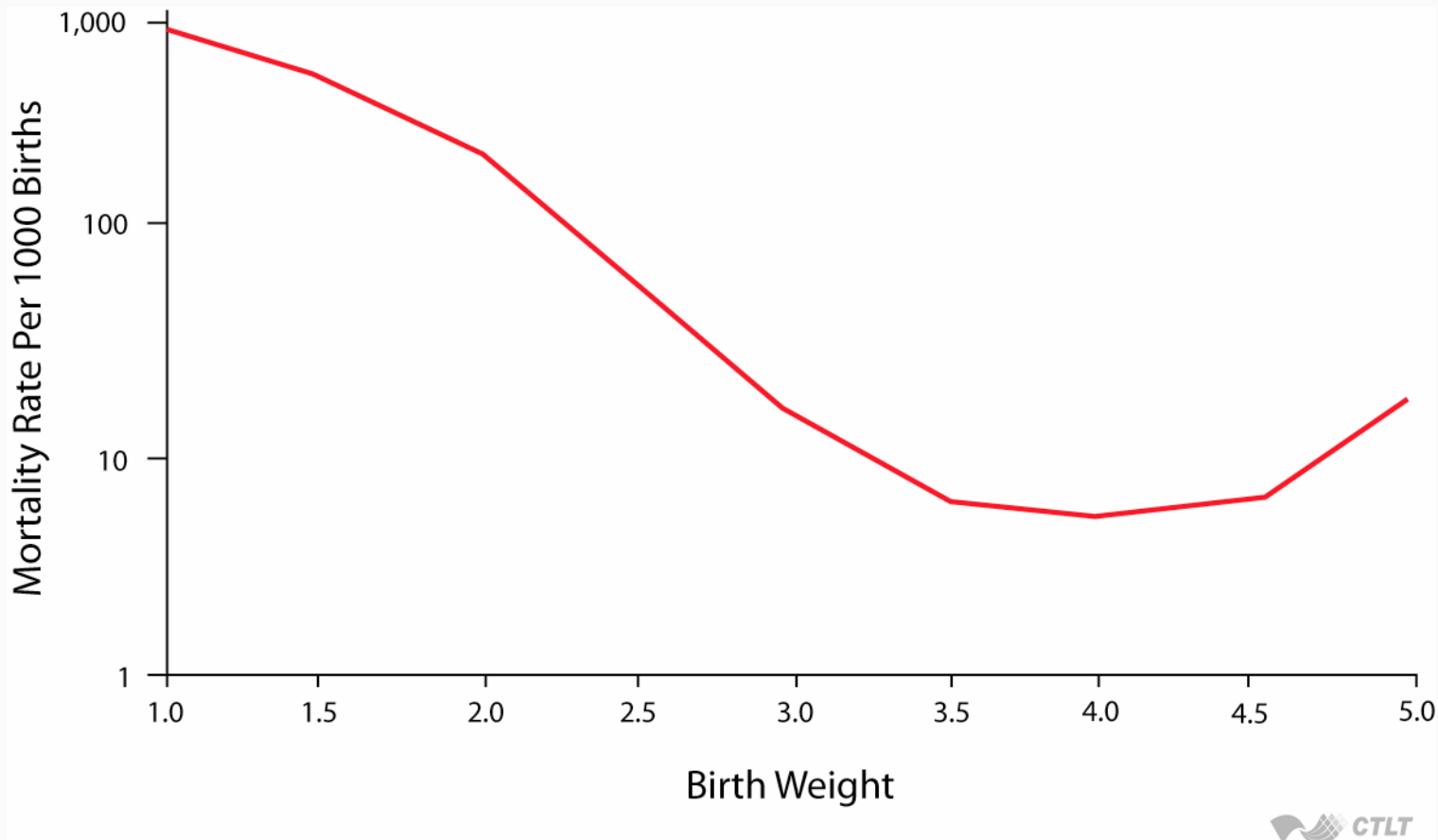
- LBW infant born at 40 weeks results from IUGR
- Preterm infant may be LBW but have an appropriate weight for its gestational age
  - LBW only because it was born early
- Preterm infant may also be growth-retarded
  - LBW because of both its shortened gestation and its growth retardation

<b><u>GA</u></b>	<b><u>LBW</u></b>	<b><u>NORMAL BW</u></b>
> 37 weeks	IUGR	Normal
< 37 weeks	Preterm and/or IUGR	Preterm

# *Perinatal Mortality*

- Relation of perinatal mortality to BW . . . see inverse relationship, as perinatal mortality decreases sharply as birth weight increases
- See an up turn at the higher ends of birth weight also

# Relation of Perinatal Mortality Rate to Birth Weight



Source: Adapted by CTLT from Shapiro, S., McCormick, M.C., et al. (1980). Relevance of correlates of infant deaths for significant morbidity at one year of age. *Am. J. Obstet. Gynecol.* 136: 363-373

# *Birth Weight and Gestational Age*

- Birth weight is a powerful predictor of infant mortality
- LBW infants are 21 times more likely to die within the first year of life than normal weight infants
- VLBW infants are 87 times as likely to die as normal-weight infants

# *Birth Weight and Gestational Age*

- Are LBW babies at high risk of dying because they are small or because they are pre-term?
  - Small proportion of mortality is accounted for by GA at delivery
  - Birth weight appears to be the stronger predictor
- Gestational age is in the causal pathway leading to higher birth weight



JOHNS HOPKINS  
BLOOMBERG  
SCHOOL *of* PUBLIC HEALTH

## *Section C*

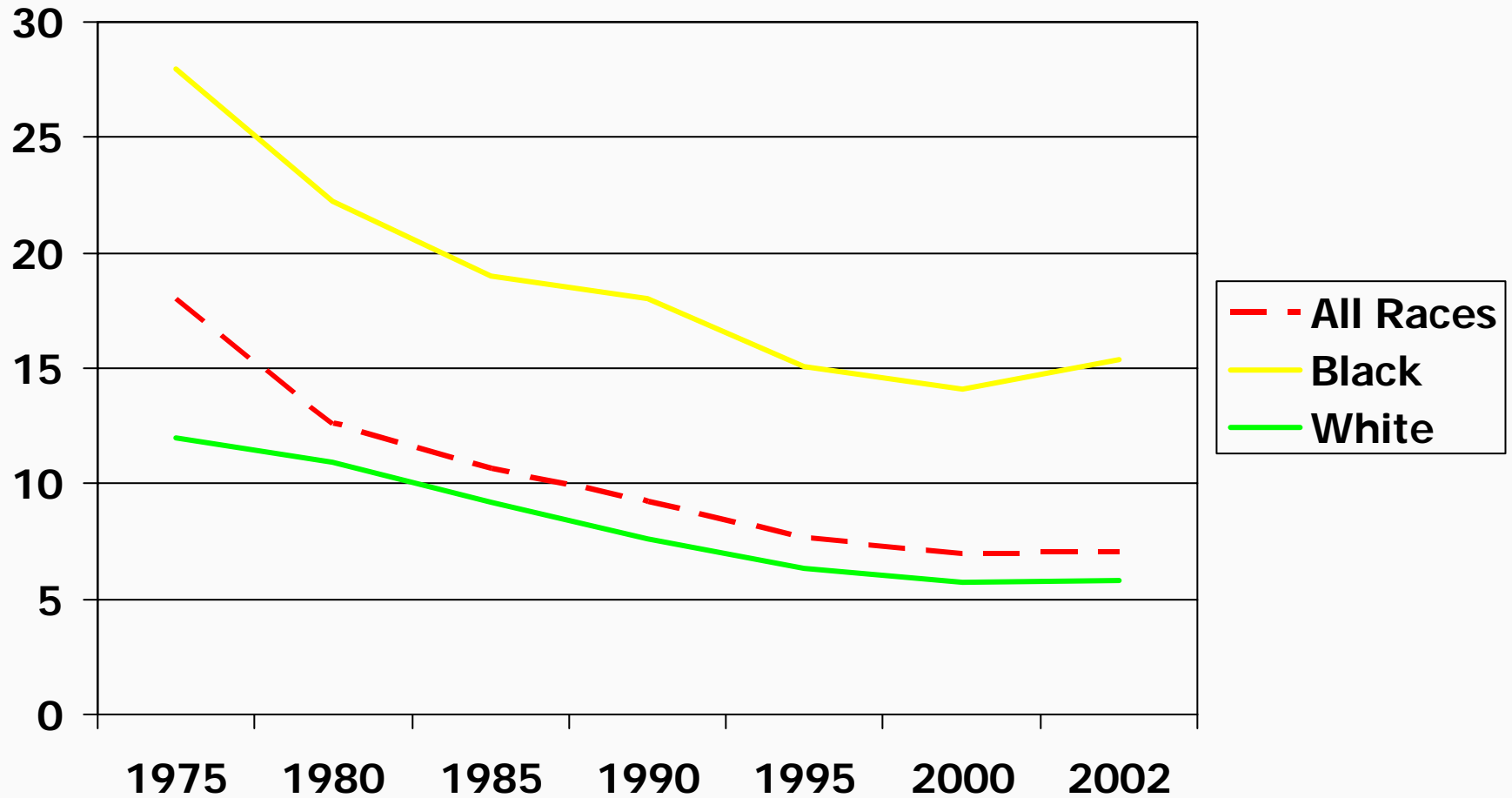
---

Causes of Infant Death

## *Infant Mortality Rates by Race*

- IMR rates by race in the U.S., 1975–2002
- See continual decline in infant mortality rate
- Also, see black rate consistently higher, close to double (and the gap is widening in recent years)

# Infant Mortality Rates by Race: United States, 1975–2002



## *Infant Mortality in the U.S.*

- 2002—overall infant mortality rate was 7.2 infant deaths per 1,000 births
  - Mortality rates were lowest for infants born to Asian and Pacific Islander mothers (5.1)
  - Followed by white (5.8), Hispanic (5.7), American Indian (9.0), and African-American (14.4)

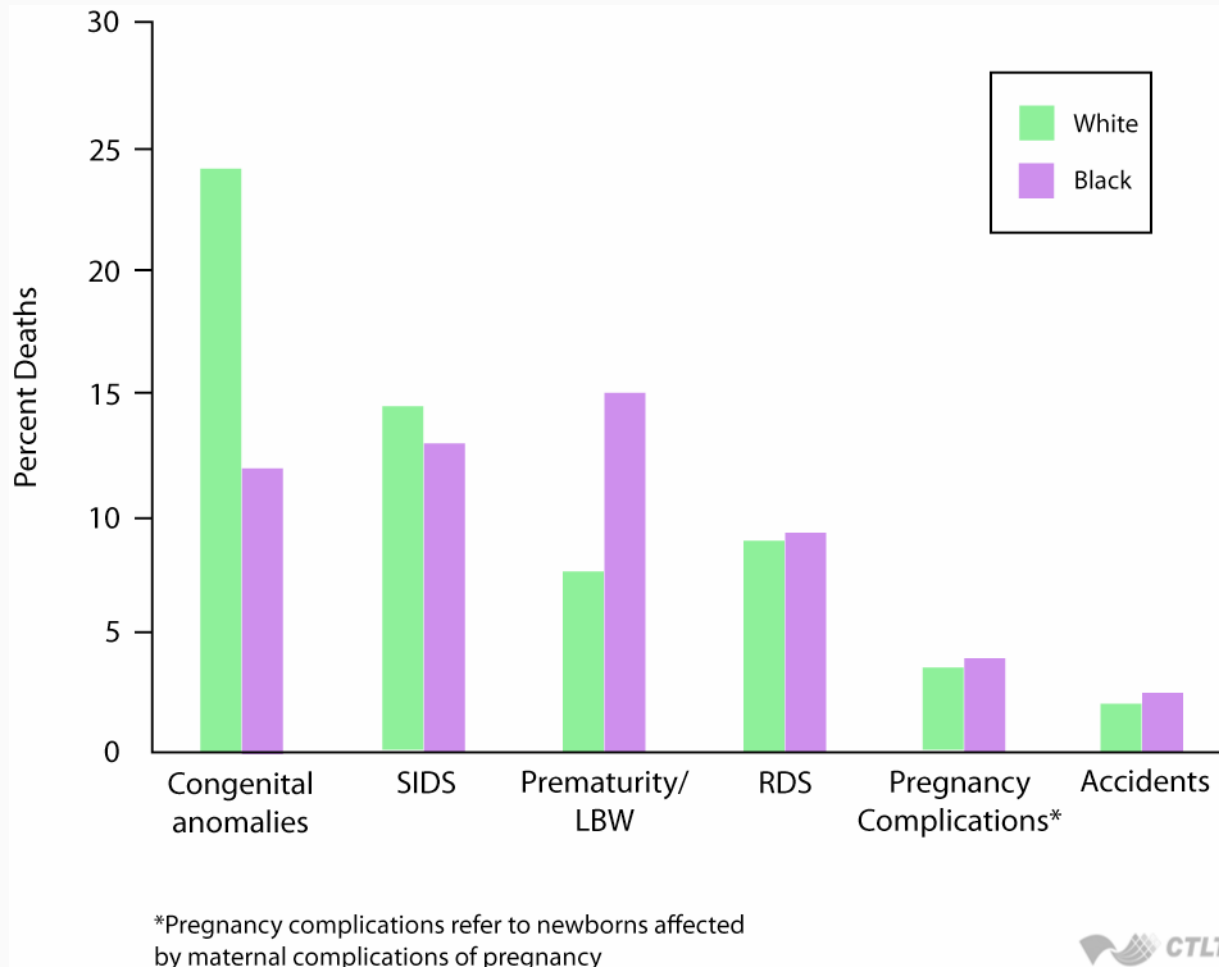
# *Causes of Infant Death*

- Deaths from SIDS have been decreasing, possibly due to changes in recommended sleep positions for infants
- Unintentional injury deaths, on the other hand, have been increasing

## *Leading Causes of IM, 2000*

- Perinatal causes top the list
  - Congenital anomalies
  - Pre-Term Birth (PTB)/Low Birth Weight (LBW)
  - Sudden Infant Death Syndrome (SIDS)
  - Problems related to complications of pregnancy
  - Respiratory Distress Syndrome (RDS)

# Causes of Infant Deaths by Race in the U.S.



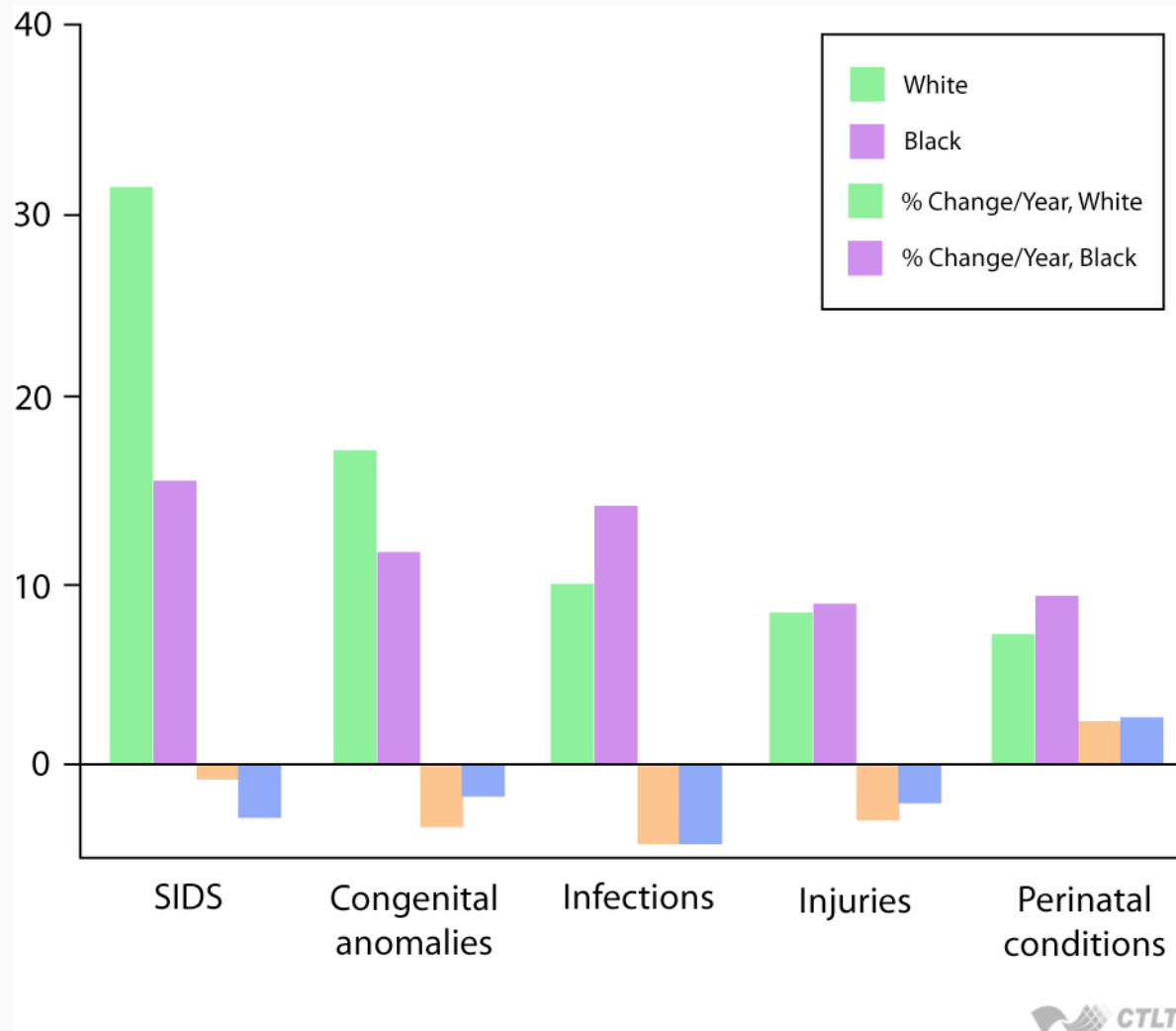
## **Causes of Neonatal Mortality**

- LBW and pre-maturity and their resulting disorders are most common, followed by congenital anomalies, and then SIDS

## **Causes of Post-Neonatal Mortality**

- SIDS is the number one cause in the post-neonatal period for both black and white infants, followed by congenital anomalies, infections, and injuries

# Post-Neonatal Mortality Rates by Cause and Race in the U.S.



# *Causes of Infant Deaths*

- The only cause of post-neonatal death that has been increasing is that due to perinatal conditions (RDS, birth trauma, complications of LBW, intrauterine hypoxia/birth asphyxia)
- May be due to the increased survival of infants suffering from these conditions in the neonatal period, who then go on to die in the post-neonatal period

# *Causes of Infant Deaths*

- Mortality from homicide has also been increasing overall (although decreases in 2001)
  - 1993—the IMR per 100,000 live births due to homicide and accidents was 7.2 and 18.3, respectively
  - 1999—they were 8.0 and 25.7
  - 2001—6.9 and 21.6

# *Trends in Preterm Birth*

- Rate of PTB has risen steadily in the U.S.
- Since 1999, pre-maturity and LBW has been the leading cause of neonatal mortality in the U.S.
- Promising results of 17P to reduce recurrent PTB
- Research to understand the factors that contribute to disparities in perinatal outcomes include the following:
  - Infections/inflammation, stress/racism, SES, clotting abnormalities, nutritional factors, and genetic predispositions