



Infant Mortality in the United States, 1935-2007:

OVER SEVEN DECADES OF PROGRESS AND DISPARITIES



Gopal K. Singh, PhD and Peter C. van Dyck, MD, MPH
*Health Resources and Services Administration
Maternal and Child Health Bureau*



Infant mortality has long been considered an important indicator of a nation's health and well-being (1). Although the infant mortality rate in the United States has declined dramatically over the past seven decades, racial/ethnic, socioeconomic, and geographical disparities in infant mortality remain marked (1,2). The United States also lags behind other developed countries as its pace of decline in infant mortality has not kept up with that of other nations (1, 2). In 1960, the U.S. ranked 12th lowest in infant mortality. By 2006, its international ranking had slipped to 31st (Figure 1). In this brief report, we describe long-term trends in U.S. infant mortality rate according to age at death, race/ethnicity, birthweight, length of gestation, maternal age, state of residence, and cause of death by using both historical and the latest national vital statistics data (2, 4-6). As shown below, dramatic declines in infant mortality rates over the long term were due to large declines in mortality from pneumonia and influenza, birth defects, prematurity and low birthweight, respiratory distress syndrome (RDS), sudden infant death syndrome (SIDS), and injuries. Improvements in living conditions, advances in neonatal medicine and infant health care, reductions in smoking during pregnancy, and increased access to and use of prenatal care have been suggested as factors responsible for decreases in infant mortality over the past several decades (1-3).

Trends in Infant, Neonatal, and Postneonatal Mortality by Race

The infant mortality rate in the United States showed a consistently downward trend between 1935 and 2000, with the rate declining from 55.7 per 1,000 live births in 1935 to 6.9 in 2000, at an impressive pace of 3.1% per year. However, between 2000 and 2007, the infant mortality rate decreased only slightly from 6.9 in 2000 to 6.8 in 2007, with much of the statistically significant decline occurring in the neonatal period.

During 1935-2007, the infant mortality rate for white infants declined by 3.2% per year, while the rate for black infants declined by 2.6% annually. As a result of the slower decline in mortality for black infants, the racial disparity in the infant mortality rate increased between 1935 and 2007. In 1935, the rate for black infants was 81.9 deaths per 1000 live births, 58% higher than the rate for white infants (51.9). In 2007, the black infant mortality rate of 13.2 was 135% higher than the white infant mortality rate of 5.6 (Figure 2).

Figure 1: Infant Mortality Rate per 1,000 Live Births, 2006, Selected Countries (United States Rank = 12th Best in 1960 and 31st Best in 2006)

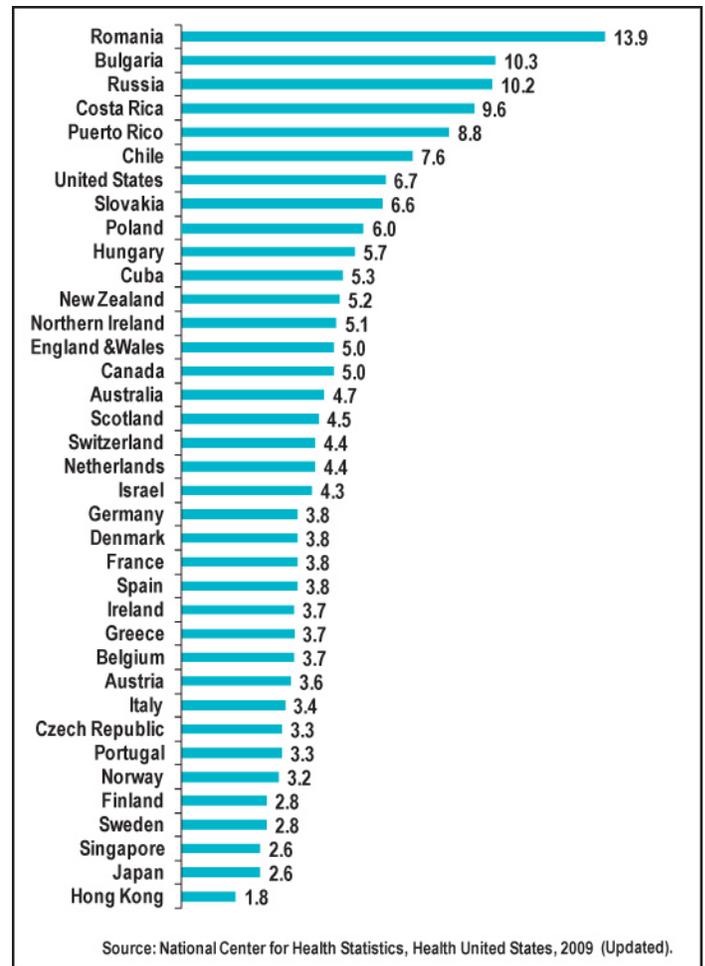


Figure 2: Infant Mortality Rate by Race, United States, 1935-2007

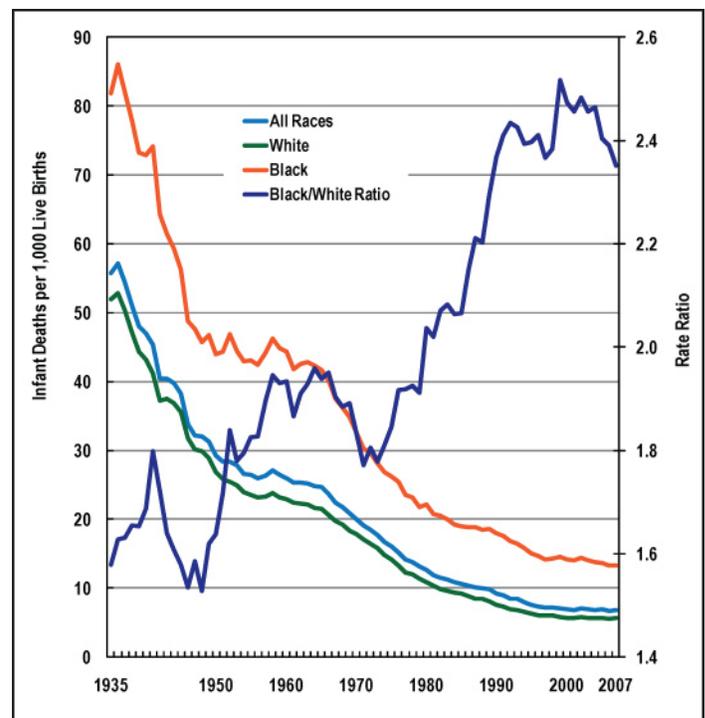


Figure 3: Neonatal and Postneonatal Mortality Rates by Race, United States, 1935-2007

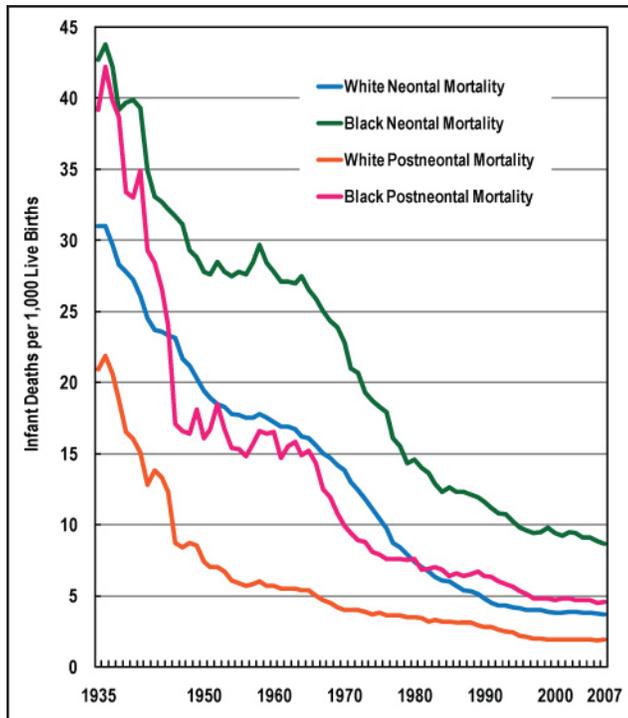
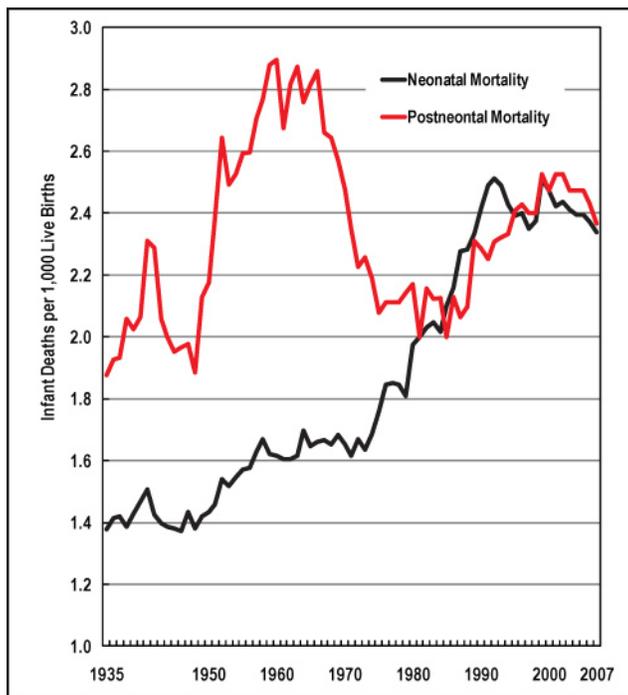


Figure 4: Black/White Ratios of Neonatal and Postneonatal Mortality Rates, United States, 1935-2007



Neonatal mortality refers to infant deaths in the first 27 days of life, whereas postneonatal mortality refers to infant deaths between 28 days and 1 year of age. Approximately two thirds of infant deaths occur in the neonatal period (4). Like infant mortality, the racial disparity in neonatal mortality has increased over time, as white infants experienced faster declines (3.3% per year) in infant mortality than black

infants (2.3% per year). Compared to white infants, the risk of neonatal mortality was 38% higher for black infants in 1935, but 134% higher in 2007 (Figures 3 and 4). Since 1950, the risk of postneonatal mortality for black infants has been more than twice the risk for white infants. In 2007, the postneonatal mortality rate for black infants was 8.7 deaths per 1000 live births, 2.4 times higher than the rate for white infants (3.7). For the past 25 years, the black postneonatal mortality rate has exceeded the neonatal mortality rate of white infants (Figure 3).

According to the 2006 linked birth/infant death data, the infant mortality rate per 1,000 live births was highest for non-Hispanic blacks (13.4), followed by American Indians/Alaska Natives (8.3), Puerto Ricans (8.0), non-Hispanic whites (5.6), Mexicans (5.3), Cuban (5.1), Asian/Pacific Islanders (4.6), and Central and South Americans (4.5). Compared to non-Hispanic whites, the infant mortality rate was significantly higher for non-Hispanic blacks, American Indians/Alaska Natives, and Puerto Ricans and significantly lower for Asian/Pacific Islanders and Central and South Americans. The 2002 linked data indicate that, within the Asian/Pacific Islander population, Chinese infants had the lowest infant mortality rate (3.1), followed by Asian Indians, Koreans, and Vietnamese (3.7), Japanese (4.9), Filipinos (5.8), and Hawaiians (9.3). Thus, a detailed comparison shows a more than fourfold racial/ethnic difference in the infant mortality rate, ranging from 3.1 for Chinese to 13.9 for non-Hispanic blacks.

Trends in Infant Mortality by Birthweight, Length of Gestation, and Maternal Age

Birthweight and length of gestation are the two most important determinants of infant survival. In 2006, the mortality rate for low birthweight (<2,500 grams) infants was 55.4 deaths per 1,000 live births, approximately 25 times greater than the rate for normal birthweight ($\geq 2,500$ grams) infants. Nearly a quarter of all infants born with very low birthweight (<1,500 grams) die during the first year of life. The magnitude of decline in mortality over the past four decades was somewhat smaller for very low birthweight infants than for moderately low birthweight (1,500-2,499 grams) and normal birthweight infants. The mortality rate for infants with very low birth weight fell from 721.7 per 1,000 live births in 1960 to 240.4 in 2006, whereas the mortality rate for infants with normal birthweight decreased from 11.2 in 1960 to 2.2 in 2006 (Figure 5).

Figure 5: Infant Mortality Rate by Birthweight, United States, 1960-2006

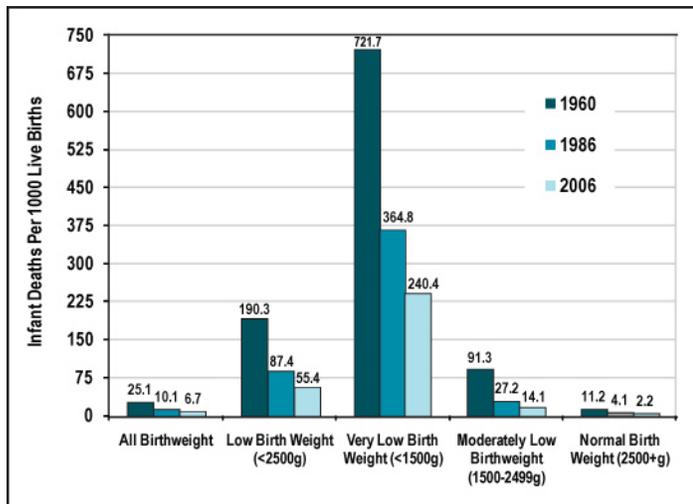
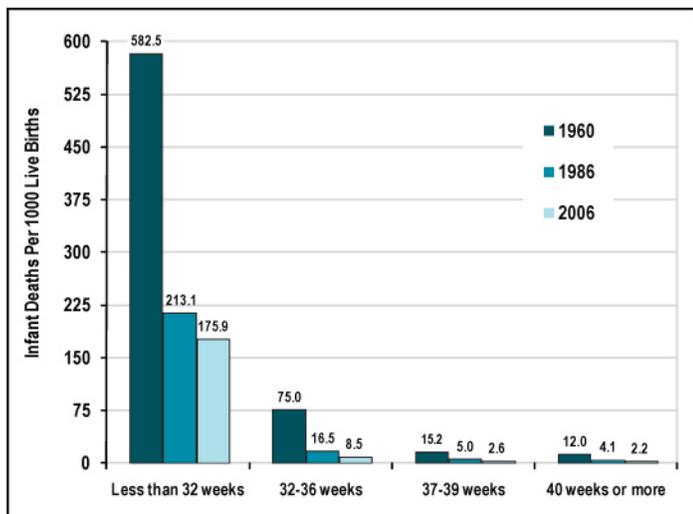


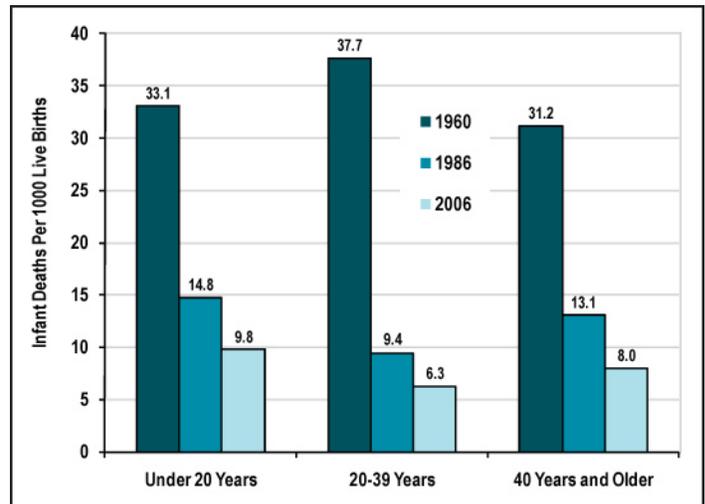
Figure 6: Infant Mortality Rate by Length of Gestation, United States, 1960-2006



In 2006, the mortality rate for very preterm (< 32 weeks of gestation) infants was 175.9 deaths per 1,000 live births, 68 times greater than the rate for infants born at term (37-39 weeks of gestation). The mortality rate for very preterm infants fell from 582.5 per 1,000 live births in 1960 to 175.9 in 2006, whereas the mortality rate for term infants decreased from 15.2 in 1960 to 2.6 in 2006 (Figure 6).

The risk of mortality is generally higher among infants born to teen mothers and mothers aged 40 years or older. In 2007, the infant mortality rates for teen mothers and mothers aged ≥ 40 years were, respectively, 9.8 and 8.0 deaths per 1000 live births, significantly higher than the rate of 6.3 for mothers aged 20-39 years. The mortality rates for infants born to teen mothers and older mothers fell by over 70% between 1960 and 2006 (Figure 7).

Figure 7: Infant Mortality Rate by Maternal Age, United States, 1960-2006



Geographic Disparities in Infant Mortality, 1970 and 2007

In 2007, the infant mortality rate varied considerably by state of residence, ranging from a high of 13.1 per 1,000 live births for the District of Columbia and 10.0 for Mississippi to a low of 4.8 for Washington and 4.9 for Massachusetts. The District of Columbia and Mississippi had the highest infant mortality rates (29.1 and 28.5, respectively) in 1970 as well, with New Jersey having the lowest rate of 10.9. States in the Southeastern region of the United States have a substantially higher infant mortality rate than the rest of the nation (Figure 8). Between 1970 and 2007, the infant mortality rate for each state declined by at least 48%. However, the geographic pattern in infant mortality generally remained the same.

Leading Causes of Infant Death

The leading causes of infant death in 2007 were congenital anomalies (birth defects), short gestation and low birthweight, SIDS, maternal complications of pregnancy, unintentional injuries, cord and placental complications, and RDS. Together these causes accounted for 62.1% of all infant deaths in 2007 and 57.9% of all infant deaths in 1970 (Figures 9 and 10). In 2007, birth defects were the leading cause of infant death for non-Hispanic whites, Hispanics, American Indians/Alaska Natives, and Asian/Pacific Islanders, whereas SIDS was the leading cause of infant death for non-Hispanic blacks (4).

Leading causes of infant death in 1970 differed from those in 2007. Although birth defects were the leading cause, RDS, intrauterine hypoxia and birth asphyxia, and pneumonia and influenza were, respectively, second, third, and fifth leading causes of infant death in 1970.

Figure 8: Geographic Disparities in Infant Mortality, 1970 and 2007

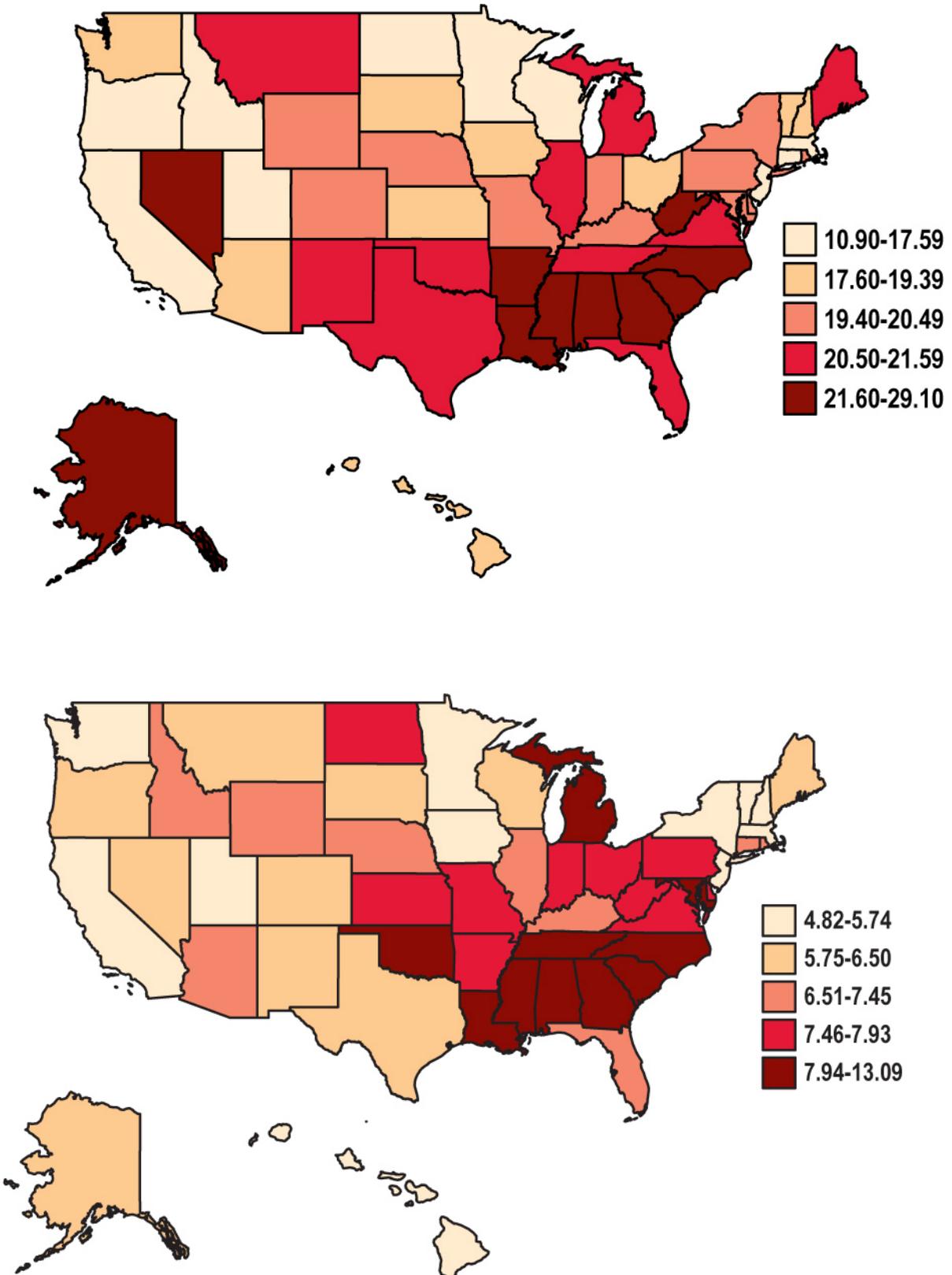
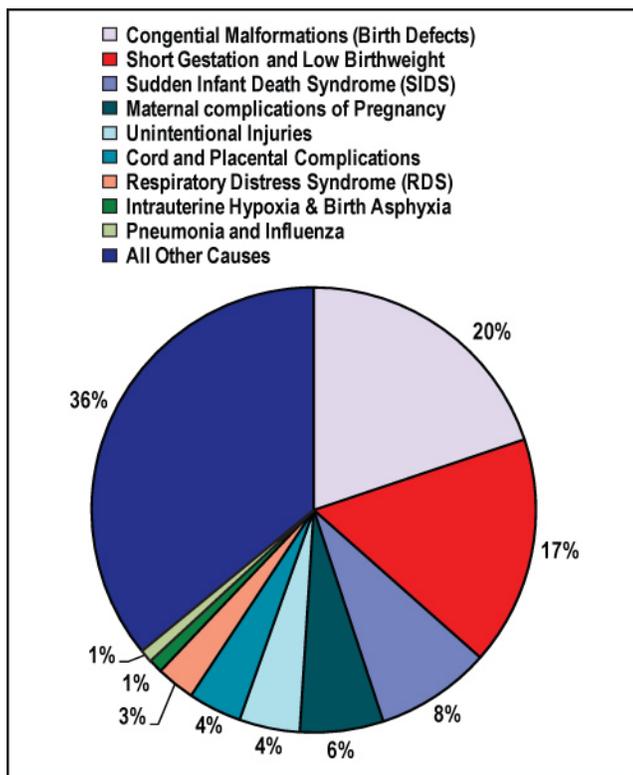


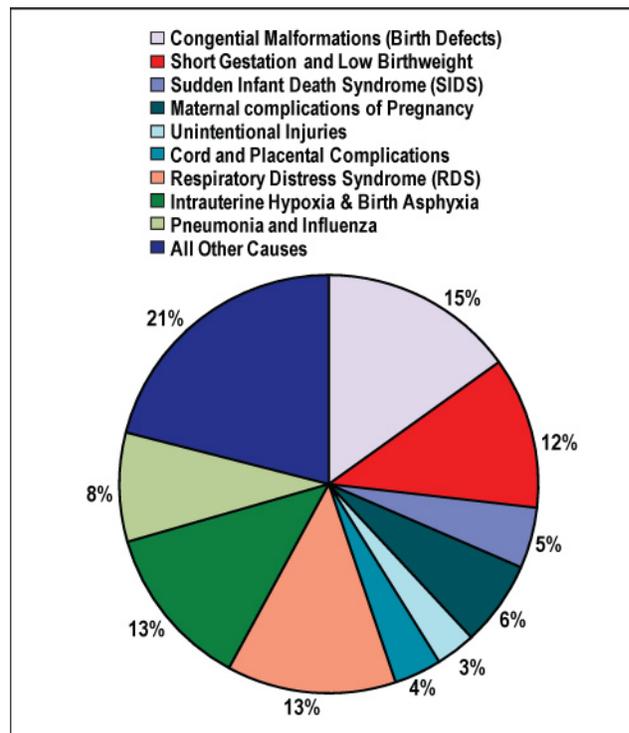
Figure 9: Leading Causes of Infant Death, 2007



Infant mortality from the latter three causes fell by more than 90% between 1970 and 2007.

The annual trends in mortality from six major causes of infant death indicate generally downward trends in mortality from all causes, except for a recent upturn in mortality from prematurity and low birthweight and unintentional injuries (Figure 11). It should be noted that changes in disease classification across the seventh, eighth, ninth, and tenth revisions of the International Classification of Diseases may affect interpretation of the long-term trends in some of these causes; however, the effects of these changes have been minimal on mortality trends during the time period covered (1,4). Infant mortality from birth defects fell sharply in a consistent manner from 361.4 infant deaths per 100,000 live births in 1960 to 134.0 in 2007. Although infant mortality from prematurity and low birth weight fell dramatically from 457.0 infant deaths per 100,000 live births in 1960 to 83.6 in 1988, it showed a slightly upward trend between 1988 and 2007. SIDS mortality declined markedly from 152.5 infant deaths per 100,000 live births in 1980 to 56.8 in 2007. RDS mortality showed a rapid downward trend between 1972 and 2007, with the mortality rate falling from 274.7 infant deaths per 100,000 live births in 1972 to 18.3 in 2007.

Figure 10: Leading Causes of Infant Death, 1970



Trends in Black/White Disparity in Mortality from Major Causes of Infant Death

The broad category of perinatal conditions, which accounted for approximately 50% of all infant deaths in 2007, includes deaths from prematurity and low birthweight, maternal complications of pregnancy, complications of placenta and cord, birth trauma, RDS, birth asphyxia, perinatal infections, neonatal hemorrhage, and bacterial sepsis of newborn. The black/white disparity in mortality from perinatal conditions increased consistently from 1970 through the early 1990s, but decreased slightly between 1993 and 2007. Nevertheless, compared to white infants, black infants had a two times higher risk of dying from perinatal conditions in 1970, but a 2.6 times higher risk in 2007.

Birth defects, the leading cause of infant death, accounted for one of every five infant deaths in 2007. Although infant mortality from birth defects showed a downward trend for both white and black infants, the pace of mortality decline was faster for white infants, leading to an increased racial disparity between 1970 and 2007. Black infants, whose mortality rate did not differ significantly from the rate for white infants in 1970, had a 20% higher risk of

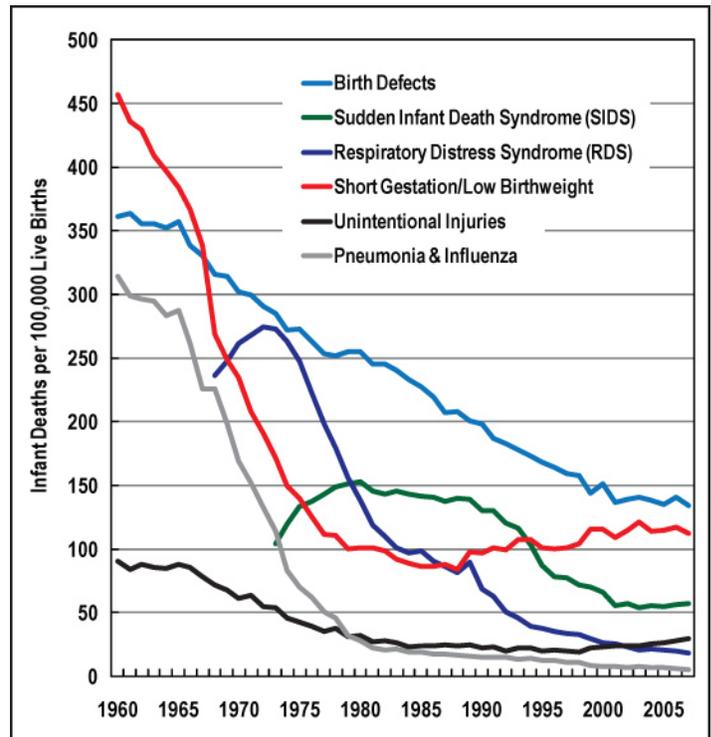
infant mortality from birth defects than white infants in 2007.

Infant mortality from pneumonia and influenza fell impressively for both white and black infants during 1970-2007. The rate for white infants declined from 133.7 per 100,000 live births in 1970 to 4.0 in 2007. The rate for black infants declined from 462.6 per 100,000 live births in 1970 to 10.5 in 2007. However, in 2007, black infants were still 2.6 times more likely to die from pneumonia and influenza than their white counterparts. Between 1970 and 2007, infant mortality from unintentional injuries was more than halved for both white and black infants. However, in 2007, the rate for black infants was 60.0 deaths from unintentional injuries per 100,000 live births, 2.4 times higher than the rate for white infants (24.6).

Summary

Dramatic declines in infant mortality among all demographic groups during the past several decades represent a major public health success (3). Despite the impressive decline in overall infant mortality, three- to four-fold racial/ethnic and geographic disparities in infant mortality remain. Currently, the infant mortality rates for all states as well as for all racial/ethnic groups except Chinese, Asian Indians, Koreans, Vietnamese, and Central and South Americans fall short of the Healthy People 2010 target of 4.5 infant deaths per 1,000 live births. In view of the recent leveling-off of the infant mortality rate following several decades of consistent decline, the efforts to achieve further reductions in infant mortality at the national level must continue to be directed at reducing racial/ethnic and geographic disparities in infant mortality.

Figure 11: Trends in Infant Mortality from Major Causes of Death, United States, 1960-2007



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Suggested Citation:

Singh GK, van Dyck PC. *Infant Mortality in the United States, 1935-2007: Over Seven Decades of Progress and Disparities*. A 75th Anniversary Publication. Health Resources and Services Administration, Maternal and Child Health Bureau. Rockville, Maryland: U.S. Department of Health and Human Services; 2010.

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