

## Infant Mortality Statistics from the 2009 Period Linked Birth/Infant Death Data Set

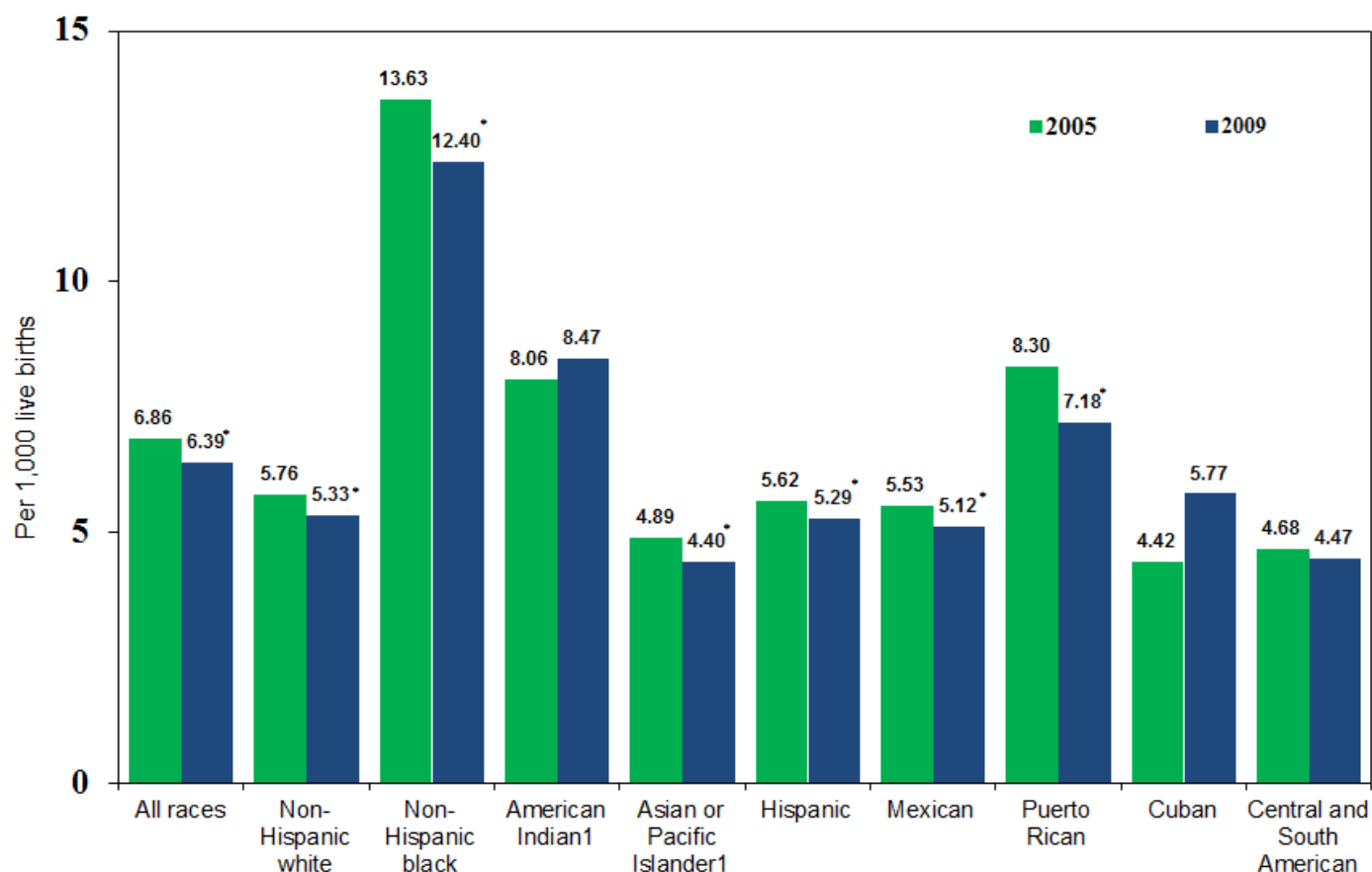
By T.J. Mathews, M.S. and Marian F. MacDorman, Ph.D., Division of Vital Statistics

*A reformatted, typeset version of this report will replace the current version.*

### Abstract

**Objective:** This report presents 2009 period infant mortality statistics from the linked birth/infant death data set (linked file) by maternal and infant characteristics. The linked file differs from the mortality file which is based entirely on death certificate data.

Figure 1. Infant mortality rates by race and ethnicity of mother: United States, 2005 and 2009



\* Significant decline

<sup>1</sup>/ Includes persons of Hispanic and non-Hispanic origin.

SOURCE: National Vital Statistics System, NCHS, CDC



## **Infant Mortality Statistics from the 2009 Period Linked Birth/Infant Death Data Set**

by T.J. Mathews, M.S. and Marian F. MacDorman, Ph.D., Division of Vital Statistics

### **Abstract**

*Objectives* - This report presents 2009 period infant mortality statistics from the linked birth/infant death data set (linked file) by maternal and infant characteristics. The linked file differs from the mortality file which is based entirely on death certificate data.

*Methods* - Descriptive tabulations of data are presented and interpreted.

*Results* - The U.S. infant mortality rate was 6.39 infant deaths per 1,000 live births in 2009, 3 percent lower than the rate of 6.61 in 2008. The number of infant deaths was 28,075 in 2008 and 26,408 in 2009, a decline of 1,667 infant deaths. Infant mortality rates ranged from 4.40 per 1,000 live births for Asian or Pacific Islander mothers to 12.40 for non-Hispanic black mothers. Infant mortality was higher for male infants and infants born preterm or at low birthweight, who were born in multiple deliveries, to mothers who were unmarried, and for those whose mothers were born in the 50 States or the District of Columbia. From 2008 to 2009, the neonatal mortality rate (less than 28 days) declined by 3 percent to 4.18 neonatal deaths per 1,000 live births, while the postneonatal mortality rate (28 days to less than one year) declined 5 percent to 2.21. Preterm and low birthweight

infants had the highest infant mortality rates and contributed greatly to overall US infant mortality. The three leading causes of infant death - Congenital malformations, low birthweight, and SIDS - accounted for 46 percent of all infant deaths. In 2009, 35.4 percent of infant deaths were "preterm-related".

**Keywords:** infant mortality, infant health, birthweight, gestational age, maternal characteristics

### **Introduction**

This report presents infant mortality data from the 2009 period linked file. In the linked file information from the death certificate is linked to information from the birth certificate for each infant under 1 year of age who died in the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, or Guam during 2009 (1). Linked birth-infant death data are not available for American Samoa and the Commonwealth of the Northern Marianas. The purpose of the linkage is to use the many additional variables available from the birth certificate to conduct more detailed analyses of infant mortality patterns (2,3). This report presents infant mortality data by race and Hispanic origin of the mother, birthweight, period of gestation, sex of infant, plurality, maternal age, live-birth order, mother's marital status, mother's place of birth, age at death, and underlying cause of death (Tables 1 through 6, A through D, and Figures 1 through 6).

Data based exclusively on the vital statistics mortality file,

provide further information on trends in infant mortality and on causes of infant death (4). The linked file is used to analyze and calculate infant mortality rates by race and ethnicity which are more accurately measured from the birth certificate. Some rates calculated from the mortality file differ from those published using the linked file. A more detailed discussion of these differences is presented in the Technical Notes.

## **Methods**

Data shown in this report are based on birth and infant death certificates registered in all states, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam. As part of the Vital Statistics Cooperative Program (VSCP), each state provides matching birth and death certificate numbers for each infant under 1 year of age who died in the state during 2009 to the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). When the birth and death occurred in different states, the state of death was responsible for contacting the state of birth identified on the death certificate to obtain the original birth certificate number. NCHS used the matching birth and death certificate numbers provided by the states to extract final edited data from the NCHS natality and mortality statistical files. These data were linked to form a single statistical record, thereby establishing a national linked record file.

After the initial linkage, NCHS returned lists of unlinked

infant death records and records with inconsistent data between the birth and death certificates to each state. State additions and corrections were incorporated, and a final national linked file was produced. In 2009, 98.6 percent of all infant death records were successfully linked to their corresponding birth records. These records were weighted to adjust for the 1.4 percent of infant death records that were not linked to their corresponding birth certificates (see the Technical Notes).

Information on births by age, race, or marital status of mother is imputed if it is not reported on the birth certificate. These items were not reported for less than 1 percent of U.S. births in 2009 (2,3).

Race and Hispanic origin are reported independently on the birth certificate. In tabulations of birth data by race and Hispanic origin, data for Hispanic persons are not further classified by race as the vast majority of women of Hispanic origin are reported as white. Data for American Indian or Alaska Native (AIAN) and Asian or Pacific Islander (API) births are not shown separately by Hispanic origin because the vast majority of these populations are non-Hispanic.

Cause-of-death statistics in this publication are classified in accordance with the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD-10) (5) (see Technical Notes).

This report includes data based on the 1989 and 2003 revisions of the birth certificate. Three key data items are considered non-comparable between the 1989 and 2003 revisions: trimester of pregnancy prenatal care began, maternal educational attainment, and maternal smoking during pregnancy (2,3)(see Technical Notes).

## **{h2}Data by maternal and infant characteristics**

This report presents descriptive tabulations of infant mortality data by a variety of maternal and infant characteristics. These tabulations are useful for understanding the basic relationships between risk factors and infant mortality, *unadjusted for the possible effects of other variables*. In reality, women with one risk factor often have other risk factors as well. For example, teenage mothers are more likely to be unmarried and of a low-income status and mothers who do not receive prenatal care are more likely to be of a low-income status and uninsured. The preferred method for disentangling the multiple interrelationships among risk factors is multivariate analysis; however, an understanding of the basic relationships between risk factors and infant mortality is a necessary precursor to more sophisticated types of analyses, and is the aim of this publication.

*Race and Hispanic origin data* - Infant mortality rates are presented here by race and detailed Hispanic origin of mother. The linked file is particularly useful for computing accurate infant mortality rates for this purpose because the race and Hispanic origin

of the mother from the birth certificate are used in both the numerator and denominator of the infant mortality rate. In contrast, for the vital statistics mortality file, race information for the denominator is the race of the mother as reported on the birth certificate, whereas the race information for the numerator is the race of the decedent as reported on the death certificate (2-4). Thus, standard infant mortality rates can be based on inconsistent information. In addition, race information from the birth certificate reported by the mother is considered to be more reliable than that from the death certificate where the race and ethnicity of the deceased infant are reported by the funeral director based on information provided by an informant or by observation. These different reporting methods can lead to differences in race and ethnic specific infant mortality rates between the two data files (4,6).

The 2003 revision of the U.S. Standard Certificate of Live Birth allows the reporting of more than one race (multiple races) for each parent (2,3,7,8). Thirty-three states reported multiple race data on their birth certificates for either part or all of 2009 and 30 states in 2008. To provide uniformity and comparability of the data, multiple race is imputed to a single race (see Technical Notes).

*Statistical significance* - Text statements have been tested for statistical significance, and a statement that a given infant mortality rate is higher or lower than another rate indicates that

the rates are significantly different. Information on the methods used to test for statistical significance, as well as information on differences between period and cohort data, the weighting of the linked file, and a comparison of infant mortality data between the linked file and the vital statistics mortality file are presented in the Technical Notes. Additional information on maternal age, marital status, period of gestation, birthweight, and cause-of-death classification is also presented in the Technical Notes.

## **Results and Discussion**

### **Trends in Infant mortality**

The infant mortality rate declined from 1995 to 2000, plateaued from 2000 to 2005, and has declined again since then (Table B). The overall 2009 infant mortality rate from the linked file was 6.39 infant deaths per 1,000 live births, 3 percent lower than the rate of 6.61 in 2008 and 7 percent lower than the rate in 2005 (6.86) (Table B). The 2009 rate from the mortality file was also 6.39 (4). From 2008 to 2009, the rate for non-Hispanic white women declined 3 percent and for Mexican women declined 8 percent (Table B).

Several groups had declines between 2005 and 2009: Puerto Rican (13 percent), Asian or Pacific Islander (10 percent), non-Hispanic black (9 percent), and non-Hispanic white women (7 percent) (Table B and Figure 1).

### **Infant mortality by race and Hispanic origin of mother**

Infant mortality rates continued to vary considerably by race



and Hispanic origin of mother (9,10). In 2009, the highest rate, 12.40 per 1,000 live births, was for infants of non-Hispanic black mothers, 2.8 times greater than the lowest rate of 4.40 for infants of Asian or Pacific Islander mothers. Rates were also higher for infants of American Indian or Alaska Native (8.47) and Puerto Rican (7.18) mothers. Rates were intermediate, but all below the US rate, for infants of Cuban (5.77), non-Hispanic white (5.33), and Mexican mothers (5.12) (Tables A and B). Central and South American mothers (4.47) also had a low rate. These differences are explained in part by the differences in cause-specific infant mortality rates among race and Hispanic origin groups (11,12). Disparities in the infant mortality rate between non-Hispanic black and non-Hispanic white mothers by state are described and discussed in the section, "Infant mortality by state and race/ethnicity."

### **Age at death**

Both neonatal and postneonatal mortality declined from 2008 to 2009. The neonatal mortality rate declined by 3 percent from 4.29 to 4.18 deaths under 28 days of age per 1,000 live births (Table B). From 2008 to 2009, neonatal mortality rates declined for Mexican women. The postneonatal mortality rate declined by 5 percent from 2.32 to 2.21 deaths from 28 days to under 1 year of age per 1,000 live births. From 2008 to 2009, postneonatal mortality rates declined for non-Hispanic white and Central and South American women (Table B). Changes for other groups were not significant. In 2009, nearly

two-thirds (65 percent) of all infant deaths occurred during the neonatal period (Table A).

Non-Hispanic black women had the highest neonatal mortality rate of 8.13; the rate was 2.4 times that for non-Hispanic white women (3.40). Neonatal mortality rates were also higher for Puerto Rican (4.76) and AIAN (4.38) than for non-Hispanic white women. Neonatal mortality rates were lower for API (3.11) women than for non-Hispanic white women (Tables A and B).

Infants of non-Hispanic black (4.27) and AIAN (4.09) women had the highest postneonatal mortality rates of any group - more than twice those for non-Hispanic white women (1.93) (Tables A and B). In contrast, postneonatal mortality rates for Mexican (1.67), Central and South American (1.30), and API women (1.29) were 14-33 percent lower than for non-Hispanic white women (Table A).

From 2005 to 2009, the neonatal mortality rate declined more (by 8 percent) than the postneonatal mortality rate (5 percent) (Table B). Declines in neonatal mortality from 2005 to 2009 were observed for non-Hispanic white, non-Hispanic black, Mexican and Puerto Rican women (Table B), while declines in postneonatal mortality were observed for non-Hispanic white and API women.

#### **Infant mortality by state and race/ethnicity**

Total infant mortality rates by state for 2005 and 2009 and the number of infant deaths for 2009 are presented in Table C. Rates declined in nine states plus Puerto Rico. Four of these states were

in the southeastern US. These declines ranged from 26 percent for South Carolina to 8 percent for California. California had the highest number of infant deaths (2,590) and Vermont the fewest (38).

In order to examine variations across states in more detail and to obtain statistically reliable state-specific rates by race and Hispanic origin, three years of data were combined (Table 2). Across the U.S., infant mortality rates are generally higher in the South and Midwest and lower elsewhere. For 2007-2009 infant mortality rates ranged from a high of 10.01 for Mississippi to a low of 4.76 for New Hampshire. The highest rate noted (11.48) was for the District of Columbia (D.C.); however, the rate for D.C. is more appropriately compared with rates for other large U.S. cities, because of the high concentrations of high-risk women in these areas.

Infant mortality rates differ by state among race and Hispanic origin groups. Rates for infants of non-Hispanic black mothers could be reliably computed (20 or more infant deaths) in 38 states and the District of Columbia; among these states, mortality rates ranged from a high of 15.28 in Kansas to a low of 7.80 in Washington. For infants of non-Hispanic white mothers, Alabama had the highest infant mortality rate (7.53) and New Jersey had the lowest rate (3.71). Among the 42 states where infant mortality rates could be reliably computed for Hispanic mothers, Pennsylvania had the highest rate (8.32) and Louisiana had the lowest (3.84).

For infants of American Indian or Alaska Native (AIAN) mothers,

mortality rates could be reliably computed for only 16 states, and for Asian or Pacific Islander (API) mothers, rates could only be computed for 28 states. For infants of AIAN mothers, mortality rates ranged from 15.60 in North Dakota to 5.90 in New Mexico. Infant mortality rates for infants of API mothers ranged from 6.96 in Arizona to 2.68 in New Jersey.

The data shown in table 2 and summarized above illustrate the wide disparities that exist in infant mortality rates across states. One method for describing race and ethnic disparities in infant mortality is to calculate the ratio between the infant mortality rates of two different race/ethnic groups. The U.S. infant mortality rate ratio for non-Hispanic black relative to non-Hispanic white populations for the three years 2007-2009 was 2.33. It's important to keep in mind that large ratios can occur for two reasons: the infant mortality rate for non-Hispanic black women can be comparatively high, or the rate for non-Hispanic white women can be relatively low. The reverse can be true when the rate ratio is low. State variation is a composition of risk factors and variation in risk factor-specific rates. Several states that lack a calculable infant mortality rate for non-Hispanic black due to fewer than 20 infant deaths do not have a rate ratio shown here (12 states)(Figure 2).

Areas with the highest rate ratios of 2.7 or greater for 2007-2009 were the District of Columbia (3.8), New Jersey (3.3), Delaware (2.8), Maryland (2.8), and Connecticut (2.7). Nine areas had ratios

less than 2.0: West Virginia (1.6), Kentucky (1.7), Oregon (1.7), Washington (1.7), Alabama (1.8), Nevada (1.8), Arkansas (1.9), Louisiana (1.9), and Mississippi (1.9) (see Table 2 for rate ratios).

### **Sex of Infant**

In countries throughout the world infant mortality rates are typically higher for male infants (13). In the United States in 2009, the overall infant mortality rate for male infants was 7.01 per thousand, 22 percent higher than the rate for female infants (5.75). Infant mortality rates were higher for male than female infants in each race and Hispanic-origin group, although the difference was not significant for infants of Cuban mothers (Table 1).

### **Multiple births**

For multiple births, the infant mortality rate in 2009 was 27.39, five times the rate of 5.64 for singleton births (Table 1). From 2008-2009, infant mortality rates declined by 3 percent for single births and by 5 percent for multiple births (14). Infant mortality rates for multiple births were higher than the rates for single births for all race and Hispanic-origin groups.

The risk of infant death increases with the increasing number of infants in the pregnancy. In 2009, the infant mortality rate for twins (25.50) was nearly 5 times the rate for single births (5.64). The infant mortality rate for triplets (60.97) was 10 times, the rate for quadruplets (129.58) was 23 times, and the rate for quintuplets and higher order births (350.00) was 62 times the rate for single

births.

Multiple pregnancy can lead to an accentuation of maternal risks and complications associated with pregnancy (2, 15-17). For example, multiple births are much more likely to be born preterm and at low birthweight than singleton births (2, 15-17). The higher risk profile of multiple births has a substantial impact on overall infant mortality (16,18). For example, in 2009 multiple births accounted for 3 percent of all live births, but 15 percent of all infant deaths in the US (Table 1).

#### **Period of Gestation**

The gestational age of an infant is perhaps the most important predictor of his or her survival and subsequent health. Infants born too small and too soon have a much greater risk of death and both short term and long term disability than those born at term (37-41 weeks of gestation) (19-23), and the percent of preterm births has been linked to variations in infant mortality rates among countries (24). Because of their much greater risk of death, preterm infants have a large impact on the US infant mortality rate. In 2009, two-thirds (67.0 percent) of all infant deaths occurred to the 12.2 percent of infants who were born preterm (Table D and Figure 3). Infant mortality rates are highest for very preterm (<32 weeks) infants, and the risk decreases sharply with increasing gestational age (19,23). In 2009, the infant mortality rate for very preterm infants (172.15) was 73 times the rate of 2.36 for term infants

(Table D). The infant mortality rate for infants born at 32-33 weeks of gestation was 16.07, seven times the rate for term infants.

Although mortality falls with increasing gestational age, even infants born only a few weeks early have a substantially increased risk of death and disability when compared with term infants (25-28). In 2009, the infant mortality rate for late preterm infants (34-36 weeks) was 7.13, 3 times the rate for infants born at term. Even within the term period, infants born at 37-38 weeks of gestation (early term) had mortality rates that were 1.6 times higher than those born at 39-41 weeks of gestation (Table D).

From 2008 to 2009, the infant mortality rate declined significantly for gestational age groupings <37, 32-33, 37-41, and 39-41 weeks. Infant mortality rates for other gestational age groupings were essentially unchanged from 2008-2009.

There were large differences in the percent of preterm births by race and ethnicity and these differences have a large impact on infant mortality rates (14, 29-30). In 2009, the percent of preterm births ranged from 10.8 percent of births to API women to 17.5 percent of births to non-Hispanic black women (Table 3).

Gestational age-specific infant mortality rates also varied by race and ethnicity (Table 1). Compared with non-Hispanic white women, infant mortality rates were significantly higher for non-Hispanic black women for all gestational age categories except for 32-33 weeks of gestation, and for AIAN women for all categories except <32 and

32-33 weeks of gestation. Compared with non-Hispanic white women, infant mortality rates were lower for API and Central and South American women for gestational age groupings 34-36, 37-38, 39-41, and 37-41 weeks, and for 42 weeks or more for Central and South American women. Patterns were mixed for Mexican and Puerto Rican women.

The percentage of preterm births increased by 36 percent, from 9.4 percent in 1984 to high of 12.8 percent in 2006 (2). However, since 2006, the trend has reversed, and the percent preterm declined to 12.2 percent in 2009, a decline of 5 percent (Table D). The decline in the percentage of preterm births occurred during both the early (<34 weeks) and late preterm periods. Early term (37-38 weeks) births also declined, while the percentage of births at 39-41 weeks of gestation increased (Figure 3 and Table D). Similar to the changes for births, the percentage of infant deaths that were preterm declined from 68.1 percent in 2006 to 67.0 percent in 2009, while the percentage of infant deaths that were term increased from 29.5 percent in 2006 to 30.5 percent in 2009 (2).

### **Birthweight**

Birthweight is another important predictor of infant health. It is closely associated with, but does not exactly correspond with, the period of gestation. Infant mortality rates are highest for the smallest infants and decrease sharply as birthweight increases. In 2009, infant mortality rates were 24 times higher for low birthweight (less than 2,500 grams) infants (53.05 per 1,000) than for infants



with birthweights of 2,500 grams or more (2.21)(Table 1). The infant mortality rate for very low birthweight (less than 1,500 grams) infants was 231.23, more than 100 times the rate for infants with birthweights of 2,500 grams or more. Among the smallest infants (less than 500 grams (1 lb. 1 oz. or less)) (Table 4) 85 percent were reported to have died within the first year of life. Reporting of deaths among these very small infants may be incomplete (31). Infant mortality rates were lowest at birthweights of 3,500-4,999 grams.

Because of their much higher mortality rates, infants born at the lowest birthweights have a substantial impact on overall infant mortality rates. For example, infants born weighing less than 1,000 grams accounted for only 0.7 percent of births, but nearly half (47 percent) of all infant deaths in the US in 2009 (Table 4). Conversely, 91.8 percent of infants born in the US in 2009 weighed 2,500 grams or more, but these infants accounted for less than one-third (31.9 percent) of infant deaths. The large race and Hispanic-origin variations in the percent of births at low birthweight (less than 2,500 grams)(from 6.5 percent for Mexican women to 13.7 percent for non-Hispanic black women) mean that some race/ethnic groups are disproportionately impacted by the high infant mortality rates for low birthweight infants (Table 3).

From 2005 to 2009, infant mortality rates for the total population declined for the broader birthweight categories of <2500, <1500 and 2500+ grams, and for detailed birthweight categories of

500-749, 2000-2499, and 2500-2999 grams (Table 4). Changes for other detailed birthweight categories were not statistically significant.

### **Maternal age**

Infant mortality rates vary with maternal age; in 2009 infants of teenage mothers (9.05) and mothers aged 40 and over (7.90) had the highest rates. The lowest rates were for infants of mothers in their early thirties (Table 1).

In 2009, among births to teenagers, infants of the youngest mothers (under 15 years) had the highest mortality rate (15.31); the rate was 14.92 in 2008. The rate for infants of mothers aged 15-17 years was 9.47 in 2009, 8 percent lower than in 2008 (10.33); the rate for infants of mothers aged 18-19 years was 8.75 in 2009 compared with 9.15 in 2008 (tabular data not shown). The rate for infants of mothers aged 35-39 was 5.82 in 2009, 6 percent lower than in 2008 (6.19)(14).

Infant mortality rates for births to non-Hispanic white mothers less than 20 years of age were 29 percent higher than for mothers aged 40 and over. In contrast, for Mexican mothers, rates for births to the oldest mothers were 51 percent higher than rates for infants of teenagers.

### **Live birth order**

Infant mortality rates were generally higher for first births than for second births, and then generally increased as birth order increased (Table 1). In 2009, the infant mortality rate for first

births (6.42) was 13 percent higher than for second births (5.60). The higher parities and therefore the highest order births (5<sup>th</sup> child and above) are more likely to be associated with older maternal age, multiple births, and lower socioeconomic status (32).

### **Marital Status**

Marital status may be a marker for the presence or absence of social, emotional and financial resources (33,34). Infants of mothers who are not married have been shown to be at higher risk for poor outcomes (35). In 2009, infants of unmarried mothers had an infant mortality rate of 8.58 per 1,000, 76 percent higher than the rate for infants of married mothers (4.87) (Table 1). Within each race and Hispanic origin group, infants of unmarried mothers had higher rates of mortality, and with the exception of Cuban infants, these differences were significant.

### **Nativity**

In 2009, the infant mortality rate for mothers born in the 50 States and the District of Columbia (6.80 per 1,000) was 44 percent higher than the rate for mothers born elsewhere (4.72) (Table 1). Among race and Hispanic origin groups, mothers born in the 50 States and the District of Columbia had higher infant mortality rates than mothers born elsewhere for non-Hispanic black (65 percent), Asian or Pacific Islander (49 percent), non-Hispanic white (36 percent), Central and South American (30 percent), and Mexican mothers (20 percent) (Table 1 and Figure 4).

A variety of hypotheses have been advanced to account for the lower infant mortality rate among infants of mothers born outside the 50 States and the District of Columbia, including possible differences in migration selectivity, social support, and risk behaviors (36,37). Also, women born outside the 50 States and the District of Columbia have been shown to have different characteristics than their U.S. born counterparts with regard to socioeconomic and educational status (38).

#### **Leading causes of infant death**

Infant mortality rates for the five leading causes of infant death are presented in Table 5 by race and Hispanic origin of mother. The leading cause of infant death in the United States in 2009 was Congenital malformations, deformations and chromosomal abnormalities (congenital malformations), accounting for 20 percent of all infant deaths. Disorders relating to short gestation and low birthweight, not elsewhere classified (low birthweight) was second, accounting for 17 percent of all infant deaths, followed by Sudden infant death syndrome (SIDS) accounting for 8 percent of infant deaths. The fourth and fifth leading causes in 2009 were Newborn affected by maternal complications of pregnancy (maternal complications) (6 percent), and Accidents (unintentional injuries) (4 percent). Together the five leading causes accounted for 56 percent of all infant deaths in the US in 2009. The order of the top five leading causes was the same as in 2008 and 2007. From 2005 to 2009, the infant mortality rate from

maternal complications declined by 8 percent, while changes for the other four leading causes were not statistically significant (Figure 5).

In 2009 as in previous years, the rank order of leading causes of infant death varied substantially by race and Hispanic origin of the mother. Congenital malformations was the leading cause of infant death for all groups except for non-Hispanic black and Puerto Rican women, for whom low birthweight was the leading cause.

When differences between cause-specific infant mortality rates were examined by race and ethnicity, infant mortality rates from Congenital malformations were 47 percent higher for AIAN, 32 percent higher for non-Hispanic black, and 23 higher percent for Mexican women than for non-Hispanic white women. Infant mortality rates from congenital malformations were 13 percent lower for API than for non-Hispanic white women.

Infants of non-Hispanic black women had the highest mortality rates from low birthweight. The rate for non-Hispanic black women was nearly three times the rate for non-Hispanic white women. The rate for Puerto Rican women was more than twice the rate for non-Hispanic white women.

SIDS rates for AIAN women were more than twice those for non-Hispanic white women. SIDS rates for non-Hispanic black women were 84 percent higher than for non-Hispanic white women. In contrast, SIDS rates for API, Mexican, and Central and South American women

were less than one-half those for non-Hispanic white women. As most SIDS deaths occur during the postneonatal period, the high SIDS rates for infants of non-Hispanic black and AIAN women accounted for much of their elevated risk of postneonatal mortality.

For maternal complications (which include incompetent cervix, premature rupture of membranes, and multiple pregnancy, for example), infants of non-Hispanic black women had the highest mortality rates - 2.7 times those for non-Hispanic white women. Non-Hispanic black women have a much higher percentage of preterm births (Table 3), which may help to explain the high infant mortality rates from maternal complications, as this cause occurs predominantly among preterm infants. Infant mortality rates from maternal complications were 61 percent higher for Puerto Rican than for non-Hispanic white women.

Compared with non-Hispanic white women, the infant mortality rate from unintentional injuries was 2.4 times higher for AIAN women and 2.0 times higher for non-Hispanic black women. Infant mortality rates from unintentional injuries were 34 percent lower for Mexican women and 62 percent lower for API women than for non-Hispanic white women.

### **Preterm-Related Causes of Death**

In order to more fully assess the impact of preterm birth on infant mortality, CDC researchers have developed a grouping of *preterm-related* causes of death. A cause of death was considered

preterm-related if 75 percent or more of infants whose deaths were attributed to that cause were born at less than 37 weeks of gestation, and the cause of death was a direct consequence of preterm birth based on a clinical evaluation and review of the literature (39,40).

The preterm-related cause-of-death grouping includes Disorders related to short gestation and low birthweight not elsewhere classified, and most of the Maternal complications of pregnancy category from the five leading causes of death. Also included are a variety of other causes of death closely associated with prematurity such as Respiratory distress of newborn, Bacterial sepsis of newborn, Necrotizing enterocolitis of newborn, and others. The comprehensive list of preterm-related cause-of-death categories (ICD-10 codes) is shown in the note on Table 6. Even this comprehensive grouping probably underestimates the total impact of preterm-related infant mortality, as some cause-of-death categories (notably those beginning with the words "Other" and "All other") had a high percentage of preterm infant deaths but lacked sufficient specificity to be able to establish the etiologic connection to prematurity with any degree of certainty. Preterm-related infant mortality rates shown in table 6 and figure 6 are computed per 100,000 live births (rather than per 1,000 live births as in previous reports (14)) to make their computation consistent with infant mortality rates for leading causes of death (table 5).

Table 6 shows trends in preterm-related infant mortality by race and Hispanic origin of mother from 2000 to 2009. In 2009, 9,341 out of a total of 26,408 infant deaths (35.4 percent) in the United States were preterm-related. The percent of infant deaths that were preterm-related increased from 34.6 percent in 2000 to a high of 36.9 percent in 2003. However, since 2003, the percent of infant deaths that were preterm-related declined to 35.4 percent in 2009.

Preterm-related infant mortality rates varied considerably by race and ethnicity of the mother (Table 6). The preterm-related infant mortality rate was more than 3 times higher for non-Hispanic black (540.4) than for non-Hispanic white women (163.8). The preterm-related infant mortality rate was 87 percent higher for Puerto Rican women (306.6), and 35 percent higher for AIAN women (221.9) than for non-Hispanic white women. In 2009, 43-44 percent of infant deaths to non-Hispanic black and Puerto Rican women were due to preterm-related causes, while the percentage was lower for other race and ethnic groups (Table 6).

From 2005 to 2009, preterm-related infant mortality rates declined by 10 percent for the total population, by 11 percent for non-Hispanic white and Mexican women, and by 14 percent for non-Hispanic black women (Table 6 and Figure 6). Changes for other race and ethnic groups were not statistically significant.

Preterm-related infant mortality explains much of the higher risk of infant mortality for non-Hispanic black and Puerto Rican



women, when compared to white women. In 2009, 77 percent of the difference in the overall infant mortality rates between Puerto Rican and non-Hispanic white women was due to preterm-related causes of death. About 53 percent of the difference in infant mortality rates between non-Hispanic black and non-Hispanic white women was due to these causes. In contrast, preterm-related infant mortality accounted for only 18 percent of the difference in infant mortality rates between AIAN and non-Hispanic white women, while SIDS accounted for 21 percent, congenital malformations 18 percent, and unintentional injuries 12 percent of the difference.

## **References**

1. National Center for Health Statistics. Public Use Data File Documentation: 2009 Period Linked birth/infant death data set. National Center for Health Statistics, Hyattsville, Maryland. Forthcoming.
2. Martin JA, Hamilton BE, Ventura SJ et al. Births: Final data for 2009. National vital statistics reports; vol 60 no 1. Hyattsville, Maryland: National Center for Health Statistics. 2011.
3. National Center for Health Statistics. User guide to the 2009 natality public use file. Hyattsville, MD. Available at: [NCHS natality 2009 user guide](#)
4. Kochanek KD, Xu J, Murphy SL et al. Deaths: Final data for 2009. National vital statistics reports; vol 60 no 3. Hyattsville, Maryland: National Center for Health Statistics. 2011.

5. World Health Organization. International Statistical Classification of Diseases and Related Health Problems, Tenth Revision. Geneva: World Health Organization. 1992.
6. Rosenberg HM, Maurer JD, Sorlie PD, Johnson NJ, et al. Quality of death rates by race and Hispanic origin: A summary of current research, 1999. National Center for Health Statistics. Vital Health Stat 2(128). 1999.
7. National Center for Health Statistics. U.S. Certificate of Live Birth. Available from: [US certificate of live birth](#) . 2003.
8. Hamilton BE, Ventura SJ. Characteristics of births to single- and multi-race women: California, Hawaii, Pennsylvania, Utah, and Washington, 2003. National vital statistics reports; vol 55 no 15. Hyattsville, MD: National Center for Health Statistics. 2007.
9. Tomashek KM, Qin C, Hsia J, Iyasu S, Barfield WD, Flowers LM. Infant mortality trends and differences between American Indian/Alaska Native infants and white infants in the United States, 1989-1991 and 1998-2000. AJPH 96:2222-2227. 2006.
10. Singh SK, Kogan MD. Persistent socioeconomic disparities in infant, neonatal, and postneonatal mortality rates in the United States, 1969-2001. Pediatrics 119:e928-e939. 2007.
11. MacDorman MF. Race and ethnicity disparities in fetal mortality, preterm birth, and infant mortality in the United States: An overview. Seminars in Perinatology 35(4):200-8. 2011.
12. MacDorman MF, Mathews TJ. Understanding racial and ethnic

- disparities in U.S. infant mortality rates. NCHS data brief no. 74. Hyattsville, MD: National Center for Health Statistics. 2011.
13. Fuse K, Crenshaw EM. Gender imbalance in infant mortality: A cross-national study of social structure and female infanticide. *Social Science & Medicine* 62(2006):360-374. 2005.
14. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2008 period linked birth/infant death data set. *National vital statistics reports*, vol 60 no 5 Hyattsville, Maryland: National Center for Health Statistics. 2011.
15. Martin JA, Hamilton be, Osterman MJK. Three decades of twin births in the United States, 1980-2009. NCHS Data brief No. 80. Hyattsville, MD: National Center for Health Statistics. 2012.
16. American College of Obstetricians and Gynecologists. Multiple Gestation: Complicated twin, triplet, and high order multifetal pregnancy. ACOG Practice Bulletin no. 56, Washington, DC: American College of Obstetricians and Gynecologists, October, 2004.
17. Goldenberg RL, Culhane JF, Iams JD Romero R. Epidemiology and causes of preterm birth. *Lancet* 371:75-84. 2008.
18. Luke B, Brown MB. The changing risk of infant mortality by gestation, plurality, and race: 1989-91 versus 1999-2001. *Pediatrics* 118:2488-2497. 2006.
19. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Lancet* 371:261-269. 2008.

20. Hintz SR, Kendrick DE, Wilson-Costello DE et al. Early childhood neurodevelopmental outcomes are not improving for infants born at <25 weeks' gestational age. *Pediatrics* 127:62-70. 2011.
21. Loe IM, LEE ES, Luna B, Feldman HM. Behavior problems of 9-16 year old preterm children: Biological, sociodemographic, and intellectual contributions. *Early Hum Dev* 87:247-52. 2011.
22. O'Shea TM, Allred EN, Dammann O et al. The ELGAN study of the brain and related disorders in extremely low gestational age newborns. *Early Hum Dev* 85:719-25. 2009.
23. Stoll BJ, Hansen NI, Bell EF et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. *Pediatrics* 126:443-56. 2010.
24. MacDorman MF, Mathews TJ. Behind international rankings of infant mortality: How the United States compares with Europe. NCHS data brief, no 23. Hyattsville, MD: National Center for Health Statistics. 2009.
25. Teune MJ, Bakhuizen S, Gyamfi Bannerman D et al. A systematic review of severe morbidity in infants born late preterm. *Am J Obstet Gynecol* 205(4):374.e1-9. 2011.
26. Talge NM Holzman D, Wang J et al. Late-preterm birth and its association with cognitive and socioemotional outcomes at 6 years of age. *Pediatrics* 126:1124-31. 2010.
27. Woythaler MA, McCormick MC, Smith VC. Late preterm infants have

- worse 24-month neurodevelopmental outcomes than term infants. *Pediatrics* 127:e622-9. 2011.
28. Cheng YW, Kaimal AJ, Bruckner TA et al. Perinatal morbidity associated with late preterm deliveries compared with deliveries between 37 and 40 weeks of gestation. *BJOG* 188:1446-54. 2011.
29. Culhane JF, Goldenberg RL. Racial disparities in preterm birth. *Semin Perinatol* 35:234-9. 2011.
30. MacDorman MF. Race and ethnic disparities in fetal mortality, preterm birth, and infant mortality in the United States: An overview. *Semin Perinatol* 35:200-8. 2011.
31. Paulson J, Ramsini W, Conrey E et al. Unregistered deaths among extremely low birthweight infants - Ohio, 2006. *MMWR* 56: 1101-1103. 2007.
32. Bai J, Wong FWS, Bauman A, Mohsin M. Parity and pregnancy outcomes. *Am J Obstet Gynecol* 186(2): 274-78. 2002.
33. McNamara TK, Orav EJ, Wilkins-Haug L, Chang G. Social support and prenatal alcohol use. *J Women's Health* 15(1):70-6. 2006.
34. Feldman PJ, Dunkel-Schetter C, Sandman CA, Wadhwa, P. Maternal social support predicts birth weight and fetal growth in human pregnancy. *Psychosomatic Medicine* 67:715-25. 2000.
35. Raatikainen K, Heiskanen N, Heinonen S. Marriage still protects pregnancy. *Br J Obstet Gynaecol* 112(10):1411-6. 2005.
36. Singh GK, Miller BA. Health, life expectancy, and mortality

- patterns among immigrant populations in the United States. *Can J Public Health* 95(3):114-21. 2004.
37. Liu KL, Laraque F. Higher mortality rate among infants of US-born mothers compared to foreign-born mothers in New York City. *J Immigr Minor Health* 8(3):281-9. 2006.
38. Acevedo-Garcia D, Soobader M, Berkman LF. The differential effect of foreign-born status on low birth weight by race/ethnicity and education. *Pediatrics* 115:20-30. 2005.
39. Callaghan WD, MacDorman MF, Rasmussen SA et al. The contribution of preterm birth to infant mortality rates in the United States. *Pediatrics* 118:1566-1573. 2006.
40. MacDorman MF, Callaghan WM, Mathews TJ, Hoyert DL, Kochanek KD. Trends in preterm-related infant mortality by race and ethnicity, United States, 1999-2004. *International Journal of Health Services* 37:635-641. 2007.
41. Buehler JW, Prager K, Hogue CJR. The role of linked birth and infant death certificates in maternal and child health epidemiology in the United States. *Am J Prev Med* 19(1S):3-11. 2000.
42. National Center for Health Statistics. 2003 revision of the U.S. Standard Certificate of Live Birth. Available from: [2003 revision of standard birth certificate](#) . 2003.
43. National Center for Health Statistics. Report of the Panel to Evaluate the U.S. Standard Certificates and Reports. National Center

for Health Statistics. Available from: [Panel report of standard certificates](#). 2000.

44. National Center for Health Statistics. Technical appendix. Vital statistics of the United States, 2003, vol I natality. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. Hyattsville, MD: Available from: [2003 natality technical appendix](#).

45. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, et al. Births: Final data for 2007. National vital statistics reports; vol 58 no 24. Hyattsville, MD: National Center for Health Statistics. 2010.

46. Office of Management and Budget. Race and ethnic standards for federal statistics and administrative reporting. Statistical Policy Directive 15. May 12, 1977.

47. Office of Management and Budget. Revisions to the standards for the classification of federal data on race and ethnicity. Federal Register 62FR58781-58790. October 30, 1997. Available from: [OMB directive 15](#).

48. Johnson D. Coding and editing multiple race and ethnicity. Presented at the 2004 joint meeting of NAPHSIS and VSCP. Portland, OR. June 6-10, 2004. Available from: [Coding and editing multiple race and ethnicity](#).

49. National Center for Health Statistics. Vital statistics, instructions for classifying the underlying cause of death. NCHS instruction manual; part 2a. Hyattsville, Maryland: Public Health

Service. Published annually.

50. National Center for Health Statistics. Vital Statistics, instructions for classifying multiple causes of death. NCHS instruction manual; part 2b. Hyattsville, Maryland: Public Health Service. Published annually.

51. Israel RA, Rosenberg HM, Curtin LR. Analytical potential for multiple cause-of-death data. Am J Epidemiol 124(2): 161-79. 1986.

52. National Center for Health Statistics. 2008 Mortality Multiple Cause Public-Use Data File User's Guide. Hyattsville, Maryland: National Center for Health Statistics. Available from: [2008 mortality multiple cause user guide](#) Accessed: 2/23/2012.

53. World Health Organization. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Ninth Revision. Geneva: World Health Organization. 1977.

54. Anderson RN, Miniño AM, Hoyert DL, Rosenberg HM. Comparability of cause of death between ICD-9 and ICD-10: Preliminary estimates. National vital statistics reports; vol 49 no 2. Hyattsville, Maryland: National Center for Health Statistics. 2001.

55. National Center for Health Statistics Data Warehouse. Comparability of cause-of-death between ICD revisions. Available from: [ICD revisions comparison](#). 2008.

56. National Center for Health Statistics. ICD-10 cause-of-death lists for tabulating mortality statistics, effective 1999. NCHS instruction manual: part 9. Hyattsville, Maryland: Public Health



Service. 1999.

57. Brillinger DR. The natural variability of vital rates and associated statistics. *Biometrics* 42:693-734. 1986.

**List of detailed tables**

1. Infant mortality rates, live births, and infant deaths by selected characteristics by race and Hispanic origin of mother: United States, 2009 linked file

2. Infant mortality rates by race and Hispanic origin of mother: United States and each State, Puerto Rico, Virgin Islands, and Guam, 2007-2009 linked files

3. Percent of live births with selected maternal and infant characteristics by race and Hispanic origin of mother: United States, 2009 linked file

4. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2009 linked file, and percent change in birthweight-specific infant mortality, 2000-2009 linked files

5. Infant deaths and mortality rates for the five leading causes of infant death by race and Hispanic origin of mother: United States, 2009 linked file

6. Number of and percent of preterm-related infant deaths and preterm-related infant mortality rates by race and Hispanic origin of mother: United States, 2000-2009 linked files

## **Technical notes**

### **Differences between period and cohort data**

From 1983-91, NCHS produced linked files in a birth cohort format (41). Beginning with 1995 data, linked files are produced first using a period format and then subsequently using a birth cohort format. The 2009 period linked file contains a numerator file that consists of all infant deaths occurring in 2009 that have been linked to their corresponding birth certificates, whether the birth occurred in 2008 or in 2009. In contrast, the 2009 birth cohort linked file will contain a numerator file that consists of all infant deaths to babies born in 2009 whether the death occurred in 2009 or 2010. Beginning with 1995 data, the period linked file is the basis for all official NCHS linked file statistics.

### **Weighting**

In 2009 a record weight was added to the linked file to compensate for the 1.4 percent of infant death records that could not be linked to their corresponding birth certificates. This procedure was initiated in 1995. Records for Puerto Rico, the Virgin Islands, and Guam were not weighted. The percent of records linked varied by registration area (from 95.3-100.0 percent with all but four areas - California, Louisiana, New Mexico, and Texas at 97.5 percent or higher) (Table I). The number of infant deaths in the linked file for the 50 States and the District of Columbia was weighted to equal the sum of the linked plus unlinked infant deaths by State of occurrence

of birth and age of death (less than 7 days, 7-27 days, and 28 days to under 1 year). The addition of the weight reduced the potential for bias in comparing infant mortality rates by characteristics.

The 2009 linked file started with 26,437 infant death records. Of these 26,437 records, 26,076 were linked; 361 were unlinked because corresponding birth certificates could not be identified. The 26,437 linked and unlinked records contained 29 records of infants whose mothers' usual place of residence was outside of United States. These 29 records were excluded to derive a weighted total of 26,408 infant deaths for 2009.

**Comparison of infant mortality data between the linked file and the vital statistics mortality file**

The overall infant mortality rate from the 2009 period linked file of 6.39 is the same as the 2009 vital statistics mortality file (4). The number of infant deaths in the linked file (26,408) differs slightly from the number in the mortality file (26,412)(4).

Differences in numbers of infant deaths between the two data sources are primarily due to geographic coverage differences. For the vital statistics mortality file all deaths occurring in the 50 States and the District of Columbia are included regardless of the place of birth of the infant. In contrast, to be included in the US linked file, both the birth and death must occur in the 50 States and the District of Columbia (the territory linked file is a separate file). Also, weighting of the linked file may contribute to small

differences in numbers and rates by specific variables between these two data sets.

### **The 1989 and 2003 Revisions of the U.S. Standard Certificates of Live Birth**

This report includes 2009 data on items that are collected on *both* the 1989 Revision of the U.S. Standard Certificate of Live Birth (unrevised) and the 2003 Revision of the U.S. Standard Certificate of Live Birth (revised) (3). The 2003 revision is described in detail elsewhere (42-44).

### **Maternal education, prenatal care, and smoking during pregnancy**

Data for educational attainment, prenatal care, and tobacco use, although collected on both the revised and unrevised birth certificates, are not considered comparable between revisions. Since the 2009 linked file has birth records from both 2008 and 2009 the reporting areas of these three items from the 2003 revised certificate are those that revised by January 1, 2008. Twenty-seven states, California, Colorado, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Michigan, Montana, Nebraska, New Hampshire, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Vermont, Washington, and Wyoming had implemented the revised birth certificate by January 1, 2008. Data for Florida, Georgia, and Michigan are excluded in the smoking results because each state's birth certificate question on smoking is either not comparable to the

2003 revision or the item was not collected (3). Results for these three items from the limited reporting area are not generalizable to the country as a whole (2,3). The 27 revised states represent 65 percent of all births in 2008 (53 percent for the 24 states with smoking data which exclude Florida, Georgia, and Michigan).

However, maternal education, prenatal care, and smoking during pregnancy continue to have important relationships with infant mortality rates for smokers, those with late or no prenatal care, and those with less than a high school education (Table II). Analyses of these important variables will be expanded when all states adopt the 2003 revision.

#### **Marital status**

National estimates of births to unmarried women are based on two methods of determining marital status. In 2009, marital status was based on a direct question in 49 states and the District of Columbia. New York used inferential procedures to compile birth statistics by marital status; a birth is inferred as nonmarital if either of these factors, listed in priority-of-use order, is present: a paternity acknowledgment was received or the father's name is missing (3).

#### **Multiple race**

For the birth certificates in the 2009 data year, multiple race was reported by 33 states and the District of Columbia (both revised and non-revised): California, Colorado, Delaware, District of Columbia (for births after 1/31), Florida, Georgia, Hawaii, Idaho, Indiana,

Iowa, Kansas, Kentucky, Michigan, Minnesota, Montana, Nebraska, Nevada (for births after 5/31), New Hampshire, New Mexico, New York, North Dakota, Ohio, Oklahoma (for births after 3/31), Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Washington, and Wyoming (3,45). Data from the vital records of the remaining states followed the 1977 OMB standards in which a single race is reported (46,47). In addition, these unrevised areas also report the minimum set of four races as stipulated in the 1977 standards, compared with the minimum of five races mandated by the 1997 standards (3).

To provide uniformity and comparability of the data during the transition period, before multiple-race data are available for all reporting areas, it is necessary to bridge the responses of those who reported more than one race to a single race. Multiple race is imputed to a single race (one of the following: AIAN, API, black, or white) according to the combination of races, Hispanic origin, sex, and age indicated on the birth certificate using methods described elsewhere (3,8,48).

### **Period of gestation**

The primary measure used to determine the gestational age of the newborn is the interval between the first day of the mother's last normal menstrual period (LMP) and the date of birth. It is subject to error for several reasons, including imperfect maternal recall or misidentification of the LMP because of postconception bleeding,

delayed ovulation, or intervening early miscarriage. When the LMP date was not reported or was inconsistent with birthweight, the "obstetric estimate of gestation" was used (6 percent of births) (2,3).

### **Birthweight**

For the linked file, not stated birthweight was imputed for 3,077 records or 0.07 percent of the birth records in 2009 when birthweight was not stated but the period of gestation was known. In this case, birthweight was assigned the value from the previous record with the same period of gestation, maternal race, sex, and plurality. If birthweight and period of gestation were both unknown the not stated value for birthweight was retained. This imputation was done to improve the accuracy of birthweight-specific infant mortality rates, since the percent of records with not stated birthweight was higher for infant deaths (3.27 percent before imputation) than for live births (0.10 percent before imputation). The imputation reduced the percent of not stated records to 0.41 percent for infant deaths, and 0.02 percent for births. The not stated birthweight cases in the natality/birth file, as distinct from the linked file, are not imputed (3).

### **Cause-of-death classification**

The mortality statistics presented in this report were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify and code causes of death

in accordance with the current *revision* of the *International Statistical Classification of Diseases and Related Health Problems*. The ICD provides the basic guidance used in virtually all countries to code and classify causes of death. The ICD not only details disease classification but also provides definitions, tabulation lists, the format of the death certificate, and the rules for coding cause of death. Cause-of-death data presented in this report were coded by procedures outlined in annual issues of the *NCHS Instruction Manual* (49,50).

In this report tabulations of cause-of-death statistics are based solely on the underlying cause of death. The underlying cause is defined by WHO as "the disease or injury which initiated the train of events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury" (5). It is selected from the conditions entered by the physician in the cause-of-death section of the death certificate. When more than one cause or condition is entered by the physician, the underlying cause is determined by the sequence of conditions on the certificate, provisions of the ICD, and associated selection and modification rules. Generally, more medical information is reported on death certificates than is directly reflected in the underlying cause of death. This is captured in NCHS multiple cause-of-death statistics (51,52).

About every 10-20 years, the International Classification of



Diseases is revised to take into account advances in medical knowledge. Effective with deaths occurring in 1999, the United States began using the Tenth Revision of the *International Statistical Classification of Diseases and Related Health Problems* (ICD-10) (5); during the period 1979-98, causes were coded and classified according to the Ninth Revision (ICD-9) (53).

Changes in classification of causes of death due to these revisions may result in discontinuities in cause-of-death trends. Measures of this discontinuity are essential to the interpretation of mortality trends, and are discussed in detail in other NCHS publications (4,54,55).

#### **Tabulation lists and cause-of-death ranking**

The cause-of-death rankings for ICD-10 are based on the List of 130 Selected Causes of Infant Death. The tabulation lists and rules for ranking leading causes of death are published in the NCHS Instruction Manual, Part 9, ICD-10 Cause-of-Death Lists for Tabulating Mortality Statistics, Effective 1999 (56). Briefly, category titles that begin with the words "Other" and "All other" are not ranked to determine the leading causes of death. When one of the titles that represents a subtotal is ranked (for example, Influenza and pneumonia (J10-J18)), its component parts are not ranked (in this case, Influenza (J10-J11) and Pneumonia (J12-18)).

#### **Preterm-related causes of death**

Preterm-related causes of death are those causes that have a

direct etiological connection to preterm birth. For an underlying cause of death to be considered preterm-related, 75 percent or more of infants whose deaths were attributed to that cause had to be born preterm, and the cause of death had to be a direct consequence of preterm birth based on a clinical evaluation and review of the literature (39). The cause-of-death categories included in this grouping are shown in the note to table 6. Causes that are incidental to preterm birth (for example, a Motor vehicle accident to a preterm infant) are not included. This grouping of preterm-related causes probably underestimates the total impact of preterm-related infant death, as some ICD categories (notably those beginning with the words "Other" and "All other") had a high percentage of preterm infant deaths but lacked sufficient specificity to be able to establish the etiologic connection to prematurity with any degree of certainty. Further details on the development of this cause-of-death grouping are available in related publications (39,40).

### **Computation of rates**

Infant mortality rates are the most commonly used index for measuring the risk of dying during the first year of life. For the linked birth/infant death dataset they are calculated by dividing the number of infant deaths in a calendar year by the number of live births registered for the same period and are presented as rates per 1,000 or per 100,000 live births. Both the mortality file and the linked birth/infant death file use this computation method but due to

unique numbers of infant deaths, as explained in the section above on the comparison of these two files, the rates will often differ for specific variables (particularly for race and ethnicity). Infant mortality rates in the linked file use the number of live births in the denominator to approximate the population at risk of dying before the first birthday. In contrast to the infant mortality rates based on live births, infant death rates, used only in age-specific death rates with the mortality file, use the estimated population of persons under 1 year of age as the denominator.

For all variables, not stated responses were shown in tables of frequencies, but were subtracted before rates were computed. Rates per 1,000 live births display two digits after the decimal place to provide a more precise and sensitive measurement. For rates per 100,000 live births (by cause of death) the infant mortality rate is shown for one decimal place. Adding an additional decimal for rates per 100,000 does not increase precision as it does for rates per 1,000.

As stated previously, infant death records for the 50 States and the District of Columbia in the US linked file are weighted so that the infant mortality rates are not underestimated for those areas that did not successfully link all records.

#### **Random variation in infant mortality rates**

The number of infant deaths and live births reported for an area represent complete counts of such events. As such, they are not

subject to sampling error, although they are subject to nonsampling error in the registration process. However, when the figures are used for analytic purposes, such as the comparison of rates over time, for different areas, or among different subgroups, the number of events that actually occurred may be considered as one of a large series of possible results that could have arisen under the same circumstances (57). As a result, numbers of births, deaths, and infant mortality rates are subject to random variation. The probable range of values may be estimated from the actual figures according to certain statistical assumptions.

In general, distributions of vital events may be assumed to follow the normal distribution. When the number of events is large, the relative standard error is usually small. When the number of events is small (perhaps less than 100) and the probability of such an event is small, considerable caution must be observed in interpreting the data. Such infrequent events may be assumed to follow a Poisson probability distribution (3,4). Estimates of relative standard errors (RSE's) and 95-percent confidence intervals are shown below.

The formula for the RSE of infant deaths and live births is:

$$\text{RSE}(D)=100*\sqrt{\frac{1}{D}} \quad \text{where } D \text{ is the number of deaths and}$$

$$\text{RSE}(B)=100*\sqrt{\frac{1}{B}} \quad \text{where } B \text{ is the number of births.}$$

For example, let us say that for group A the number of infant deaths was 497 while the number of live births was 81,555 yielding an infant mortality rate of 6.09 infant deaths per 1,000 live births.

The RSE of the deaths =  $100 * \sqrt{\frac{1}{497}} = 4.49$ , while the RSE of the births =

$$100 * \sqrt{\frac{1}{81,555}} = 0.35.$$

The formula for the RSE of the IMR is:

$$\text{RSE}(\text{IMR}) = 100 * \sqrt{\frac{1}{D} + \frac{1}{B}}$$

The RSE of the IMR for the example above

$$= 100 * \sqrt{\frac{1}{497} + \frac{1}{81,555}} = 4.50.$$

*Normal distribution*—When the number of events is greater than 100, the normal distribution is used to estimate the 95-percent confidence intervals as follows:

$$\text{Lower: } R_1 - 1.96 * R_1 * \frac{\text{RSE}(R_1)}{100}$$

$$\text{Upper: } R_1 + 1.96 * R_1 * \frac{\text{RSE}(R_1)}{100}$$

Thus, for Group A:

$$\text{Lower: } 6.09 - (1.96 * 6.09 * \frac{4.50}{100}) = 5.55$$

$$\text{Upper: } 6.09 + (1.96 * 6.09 * \frac{4.50}{100}) = 6.63$$

Thus the chances are 95 out of 100 that the true IMR for Group A

lies somewhere in the 5.55–6.63 interval.

*Poisson distribution*—When the number of events in the numerator is less than 100 the confidence interval for the rate can be estimated based on the Poisson distribution using the values in Table III.

Lower:  $IMR * L(.95, D_{adj})$

Upper:  $IMR * U(.95, D_{adj})$

where  $D_{adj}$  is the adjusted number of infant deaths (rounded to the nearest integer) used to take into account the RSE of the number of infant deaths and live births, and is computed as follows:

$$D_{adj} = \frac{D * B}{D + B}$$

$L(.95, D_{adj})$  and  $U(.95, D_{adj})$  refer to the values in Table III corresponding to the value of  $D_{adj}$ .

For example, let us say that for Group B the number of infant deaths was 53, the number of live births was 9,241, and the infant mortality rate was 5.74.

$$D_{adj} = \frac{53 * 9,241}{53 + 9,241} = 53$$

Therefore the 95-percent confidence interval (using the formula in Table III for 1–99 infant deaths) =

$$\text{Lower: } 5.74 * 0.74907 = 4.30$$

$$\text{Upper: } 5.74 * 1.30802 = 7.51$$

*Comparison of two infant mortality rates*—If either of the two rates to be compared is based on less than 100 deaths, compute the confidence intervals for both rates and check to see if they overlap. If so, the difference is not statistically significant at the 95-percent level. If they do not overlap, the difference is statistically significant. If both of the two rates ( $R_1$  and  $R_2$ ) to be compared are based on 100 or more deaths, the following z-test may be used to define a significance test statistic:

$$z = \frac{R_1 - R_2}{\sqrt{R_1^2 \left( \frac{RSE(R_1)}{100} \right)^2 + R_2^2 \left( \frac{RSE(R_2)}{100} \right)^2}}$$

If  $|z| \geq 1.96$ , then the difference is statistically significant at the 0.05 level and if  $|z| < 1.96$ , the difference is not significant.

#### **Availability of linked file data**

Linked file data are available for download at: [Vital Stats online](#). Beginning with 2005, the public-use file no longer includes geographic detail; such files are available upon special request. See: [DVS data release policy](#). Data are also available in issues of Vital and Health Statistics, Series 20, National Vital Statistics Reports, and Data Briefs from the [NCHS](#) website.

**Suggested citation**

Mathews TJ, MacDorman MF. Infant mortality statistics from the 2009 period linked birth/infant death data set. National vital statistics report; vol 60 no 5. Hyattsville, MD: National Center for Health Statistics. 2013.



Table A. Infant, neonatal, and postneonatal deaths and mortality rates, by race and Hispanic origin of mother: United States 2009 linked file

Hispanic origin and race of mother	Live births	Number of deaths			Mortality rate per 1,000 live births		
		Infant	Neonatal	Postneonatal	Infant	Neonatal	Postneonatal
Total/1	4,130,665	26,408	17,261	9,148	6.39	4.18	2.21
Non-Hispanic white	2,212,552	11,785	7,515	4,271	5.33	3.40	1.93
Non-Hispanic black	609,584	7,560	4,957	2,603	12.40	8.13	4.27
American Indian or Alaska Native	48,665	412	213	199	8.47	4.38	4.09
Asian or Pacific Islander	251,089	1,105	780	324	4.40	3.11	1.29
Hispanic	999,548	5,285	3,554	1,731	5.29	3.56	1.73
Mexican	645,297	3,302	2,223	1,080	5.12	3.44	1.67
Puerto Rican	68,486	492	326	166	7.18	4.76	2.42
Cuban	16,641	96	60	35	5.77	3.61	2.10
Central and South American	148,647	665	471	193	4.47	3.17	1.30

1 Includes other and unknown Hispanic origin and Hispanic origin not stated, not shown separately.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 for 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table B. Infant, neonatal, and postneonatal mortality rates by race and Hispanic origin of mother: United States, 1995, 2000-2009 linked files

Race and Hispanic origin of mother	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Percent Change 2005 to 2009	Percent Change 2008 to 2009
Infant mortality rate													
All races	7.57	6.89	6.84	6.95	6.84	6.78	6.86	6.68	6.75	6.61	6.39	-6.9 **	-3.3 **
Non-Hispanic white	6.28	5.70	5.72	5.80	5.70	5.66	5.76	5.58	5.63	5.52	5.33	-7.5 **	-3.4 **
Non-Hispanic black	14.65	13.59	13.46	13.89	13.60	13.60	13.63	13.35	13.31	12.67	12.40	-9.0 **	-2.1
American Indian or Alaska Native	9.04	8.30	9.65	8.64	8.73	8.45	8.06	8.28	9.22	8.42	8.47	5.1	0.6
Asian or Pacific Islander	5.27	4.87	4.73	4.77	4.83	4.67	4.89	4.55	4.78	4.51	4.40	-10.0 **	-2.4
Hispanic	6.27	5.59	5.44	5.62	5.65	5.55	5.62	5.41	5.51	5.59	5.29	-5.9 **	-5.4 **
Mexican	6.03	5.43	5.22	5.42	5.49	5.47	5.53	5.34	5.42	5.58	5.12	-7.4 **	-8.2 **
Puerto Rican	8.88	8.21	8.53	8.20	8.18	7.82	8.30	8.01	7.71	7.29	7.18	-13.5 **	-1.5
Cuban	5.29	4.54	4.28	3.72	4.57	4.55	4.42	5.08	5.18	4.90	5.77	30.5	17.8
Central and South American	5.52	4.64	4.98	5.06	5.04	4.65	4.68	4.52	4.57	4.76	4.47	-4.5	-6.1
Neonatal mortality rate													
All races	4.92	4.62	4.54	4.67	4.63	4.52	4.54	4.46	4.42	4.29	4.18	-7.9 **	-2.6 **
Non-Hispanic white	4.04	3.78	3.79	3.85	3.79	3.70	3.71	3.64	3.61	3.50	3.40	-8.4 **	-2.9
Non-Hispanic black	9.65	9.19	8.97	9.33	9.26	9.13	9.13	8.95	8.74	8.28	8.13	-11.0 **	-1.8
American Indian or Alaska Native	3.94	4.39	4.20	4.60	4.55	4.26	4.04	4.30	4.55	4.18	4.38	8.4	4.8
Asian or Pacific Islander	3.37	3.43	3.12	3.37	3.40	3.20	3.37	3.18	3.38	3.08	3.11	-7.7	1.0
Hispanic	4.13	3.77	3.64	3.83	3.92	3.83	3.86	3.74	3.72	3.76	3.56	-7.8 **	-5.3 **
Mexican	3.94	3.61	3.49	3.64	3.76	3.74	3.78	3.73	3.68	3.78	3.44	-9.0 **	-9.0 **
Puerto Rican	6.11	5.80	5.99	5.81	5.70	5.34	5.95	5.44	5.14	4.98	4.76	-20.0 **	-4.4
Cuban	3.61	3.20	2.50	3.23	3.36	2.81	3.05	3.60	3.65	3.23	3.61	18.4	11.8
Central and South American	3.65	3.26	3.36	3.45	3.65	3.43	3.23	3.12	3.14	3.19	3.17	-1.9	-0.6
Postneonatal mortality rate													
All races	2.65	2.27	2.30	2.28	2.22	2.25	2.32	2.22	2.33	2.32	2.21	-4.7 **	-4.7 **
Non-Hispanic white	2.23	1.92	1.93	1.95	1.91	1.96	2.05	1.94	2.02	2.02	1.93	-5.9 **	-4.5 **
Non-Hispanic black	5.00	4.40	4.48	4.55	4.34	4.47	4.50	4.40	4.57	4.39	4.27	-5.1	-2.7
American Indian or Alaska Native	5.10	3.94	5.45	4.04	4.18	4.19	4.02	3.98	4.67	4.24	4.09	1.7	-3.5
Asian or Pacific Islander	1.90	1.44	1.61	1.40	1.43	1.47	1.51	1.37	1.40	1.43	1.29	-14.6 **	-9.8
Hispanic	2.14	1.82	1.79	1.79	1.73	1.71	1.76	1.67	1.79	1.83	1.73	-1.7	-5.5
Mexican	2.09	1.82	1.73	1.78	1.73	1.73	1.75	1.61	1.75	1.80	1.67	-4.6	-7.2
Puerto Rican	2.77	2.41	2.55	2.38	2.48	2.48	2.37	2.57	2.57	2.30	2.42	2.1	5.2
Cuban	1.68	*	1.71	*	*	1.74	1.37	1.42	1.53	1.62	2.10	53.3	29.6
Central and South American	1.86	1.38	1.61	1.60	1.39	1.22	1.46	1.41	1.43	1.57	1.30	-11.0	-17.2 **

\* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator.

\*\* Significant at p<.05.

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 in 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2 and 3.

Table C. Infant mortality rates, number of infant deaths and percent change by state: 2005 and 2009 linked files

(By place of residence)

State	Infant mortality rate per 1,000 live births		Percent change 2005 to 2009	Number of infant deaths in 2009
	2005	2009		
Total/1	6.86	6.39	-6.8 **	26,408
Alabama	9.53	8.28	-13.1 **	517
Alaska	5.93	6.89	16.2	78
Arizona	6.85	5.97	-12.9 **	554
Arkansas	7.83	7.56	-3.4	301
California	5.32	4.91	-7.6 **	2,590
Colorado	6.44	6.24	-3.1	428
Connecticut	5.85	5.55	-5.1	216
Delaware	9.02	7.96	-11.7	92
District of Columbia	13.67	10.40	-23.9	94
Florida	7.24	6.90	-4.8	1,527
Georgia	8.07	7.33	-9.2 **	1,036
Hawaii	6.58	5.93	-9.9	112
Idaho	5.98	5.48	-8.4	130
Illinois	7.38	6.92	-6.3	1,185
Indiana	8.04	7.82	-2.7	678
Iowa	5.44	4.61	-15.3	183
Kansas	7.37	7.10	-3.7	294
Kentucky	6.73	6.83	1.5	393
Louisiana	9.85	8.82	-10.4	573
Maine	6.87	5.72	-16.8	77
Maryland	7.30	7.22	-1.0	542
Massachusetts	5.13	5.09	-0.7	382
Michigan	7.89	7.60	-3.6	892
Minnesota	5.09	4.59	-9.8	324
Mississippi	11.46	10.09	-12.0	433
Missouri	7.52	7.07	-6.0	558
Montana	7.25	6.20	-14.5	76
Nebraska	5.66	5.38	-5.0	145
Nevada	5.66	5.82	2.8	219
New Hampshire	5.27	4.93	-6.4	66
New Jersey	5.17	5.22	1.0	576
New Mexico	6.17	5.31	-14.0	154
New York	5.82	5.36	-7.8 **	1,331
North Carolina	8.81	7.92	-10.1 **	1,004
North Dakota	5.96	6.33	6.2	57
Ohio	8.17	7.71	-5.7	1,116
Oklahoma	7.95	7.90	-0.7	431
Oregon	5.99	4.86	-18.8 **	229
Pennsylvania	7.29	7.10	-2.6	1,040
Rhode Island	6.46	5.86	-9.3	67
South Carolina	9.46	6.98	-26.2 **	423
South Dakota	6.98	6.70	-4.0	80
Tennessee	8.77	7.99	-8.9	657
Texas	6.55	5.98	-8.6 **	2,403
Utah	4.52	5.27	16.6	284
Vermont	6.49	6.22	-4.1	38
Virginia	7.47	7.14	-4.4	750
Washington	5.07	4.92	-2.9	439
West Virginia	8.16	7.66	-6.1	163
Wisconsin	6.54	5.99	-8.4	424
Wyoming	6.63	5.96	-10.1	47
Puerto Rico	9.22	7.73	-16.1 **	346
Virgin Islands	*	*	---	12
Guam	10.59	10.48	-1.0	36

\*\* Significant at  $p < 0.05$ .

\* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator.

--- Data not available.

1 Excludes data for Puerto Rico, Virgin Islands, and Guam.

Table D. Infant mortality rates, and percent distribution of live births and infant deaths by period of gestation, United States, 2000 and 2005-2009 linked files

	All gestational ages	Preterm (less than 37 weeks)					Term (37-41 weeks)			Post-term (42 weeks or more)
		Total	Early preterm (<34 weeks)		Late preterm (34-36 weeks)	Early term				
			Total	< 32 weeks		32-33 weeks	(37-38 weeks)	39-41 weeks		
Infant mortality rates by gestational age/1										
2009	6.39	34.94	103.48	172.15	16.07	7.13	2.36	3.09	1.98	2.86
2008	6.61	35.76	105.71	175.45	17.58	7.40	2.44	3.13	2.08	2.69
2007	6.75	36.05	107.13	178.36	16.12	7.42	2.43	3.09	2.07	2.62
2006	6.68	35.15	105.31	175.94	16.19	7.08	2.39	3.02	2.05	2.80
2005	6.86	36.55	109.77	183.24	16.69	7.30	2.43	3.08	2.07	2.66
2000	6.89	37.88	109.75	180.95	17.37	7.96	2.59	3.38	2.24	2.91
Percent distribution of infant deaths/2										
2009	100.0	67.0	57.3	53.3	3.9	9.7	30.5	13.4	17.1	2.5
2008	100.0	67.2	57.3	53.1	4.2	9.9	30.4	13.3	17.2	2.3
2007	100.0	68.2	58.2	54.4	3.8	10.0	29.6	13.2	16.4	2.2
2006	100.0	68.1	58.3	54.3	4.0	9.8	29.5	13.2	16.3	2.4
2005	100.0	68.6	58.8	54.9	3.9	9.8	29.1	12.9	16.3	2.3
2000	100.0	65.6	55.8	52.0	3.7	9.4	31.2	12.3	18.9	3.2
Percent distribution of live births/2										
2009	100.0	12.2	3.5	2.0	1.5	8.7	82.3	27.6	54.7	5.5
2008	100.0	12.3	3.6	2.0	1.6	8.8	82.0	27.8	54.1	5.7
2007	100.0	12.7	3.6	2.0	1.6	9.0	81.7	28.6	53.1	5.6
2006	100.0	12.8	3.7	2.0	1.6	9.1	81.5	28.9	52.6	5.7
2005	100.0	12.7	3.6	2.0	1.6	9.1	81.4	28.3	53.1	5.8
2000	100.0	11.6	3.4	1.9	1.5	8.1	81.1	24.5	56.6	7.3

<sup>1</sup> Infant mortality rates are deaths at less than 1 year of age per 1,000 live births in specified group.

<sup>2</sup> Infant deaths and live births with unknown gestational age are subtracted from the total number of events used as denominators for percentage computations.

Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and by race and Hispanic origin of mother: United States, 2009 linked file

Characteristics	All races and origins <sup>1</sup>	Non-Hispanic				Hispanic				
		White	Black	American Indian or Alaska Native <sup>2</sup>	Asian or Pacific Islander	Total	Mexican	Puerto Rican	Cuban	Central and South American
Infant mortality rates per 1,000 live births in specified group										
Total	6.39	5.33	12.40	8.47	4.40	5.29	5.12	7.18	5.77	4.47
Age at death										
Total neonatal	4.18	3.40	8.13	4.38	3.11	3.56	3.44	4.76	3.61	3.17
Early neonatal (< 7 days)	3.33	2.66	6.52	3.35	2.56	2.88	2.78	3.90	2.94	2.62
Late neonatal (7-27 days)	0.85	0.74	1.61	1.03	0.55	0.68	0.66	0.86	*	0.54
Postneonatal	2.21	1.93	4.27	4.09	1.29	1.73	1.67	2.42	2.10	1.30
Sex										
Male	7.01	5.84	13.82	9.37	4.67	5.68	5.47	7.88	5.55	5.03
Female	5.75	4.78	10.93	7.53	4.10	4.88	4.75	6.48	5.88	3.88
Plurality										
Single births	5.64	4.64	10.97	8.00	3.78	4.79	4.70	6.33	4.80	3.96
Plural births	27.39	22.32	47.64	27.63	23.12	26.03	24.36	34.06	*	24.92
Birthweight										
Less than 2,500 grams	53.02	46.24	68.35	62.15	37.74	52.27	53.22	55.70	56.44	48.33
Less than 1,500 grams	231.23	212.72	253.05	243.08	214.68	231.70	235.10	230.65	248.98	225.86
1,500-2,499 grams	13.83	13.73	13.94	21.68	9.31	14.75	16.09	12.49	*	12.05
2,500 grams or more	2.21	2.13	3.46	4.23	1.36	1.76	1.77	1.99	1.56	1.35
Period of gestation										
Less than 37 weeks	34.94	29.92	52.88	34.88	27.65	29.50	29.03	38.03	32.26	26.58
Less than 32 weeks	172.15	158.22	202.20	153.33	161.44	156.14	156.36	173.53	160.66	150.94
32-33 weeks	16.07	15.80	17.31	*	14.25	15.98	17.17	*	*	13.54
34-36 weeks	7.13	7.03	8.97	12.43	5.35	5.99	6.11	6.49	*	4.85
37-41 weeks	2.36	2.26	3.65	4.15	1.45	1.94	1.96	2.25	1.61	1.43
37-38 weeks	3.09	3.12	4.34	5.33	2.00	2.38	2.44	2.98	*	1.66
39-41 weeks	1.98	1.86	3.23	3.55	1.16	1.72	1.71	1.86	*	1.32
42 weeks or more	2.86	2.53	4.72	6.35	3.30	2.38	2.52	*	*	*
Age of mother										
Under 20 years	9.05	8.94	12.60	9.14	9.40	6.43	6.20	7.96	*	5.83
20-24 years	7.43	6.64	12.53	9.67	5.64	5.16	4.81	7.13	6.06	4.89
25-29 years	5.73	4.71	12.02	6.97	3.98	4.82	4.69	7.79	5.82	4.11
30-34 years	5.07	4.09	11.83	8.11	3.80	4.69	4.61	5.77	5.64	3.56
35-39 years	5.82	4.66	13.34	*	4.24	5.62	5.67	6.25	*	4.50
40-54 years	7.90	6.31	14.26	*	5.96	9.06	9.39	*	*	8.06
Live-birth order										
1	6.42	5.19	12.66	7.39	4.38	5.85	5.80	8.06	5.40	4.58
2	5.60	4.86	11.09	8.75	3.76	4.53	4.49	5.26	4.83	4.11
3	6.20	5.50	11.79	8.87	4.93	4.46	4.15	6.89	*	4.25
4	7.58	6.71	12.93	10.94	5.53	5.73	5.44	7.73	*	4.52
5 or more	9.41	7.51	15.60	8.92	8.62	7.41	6.94	11.83	*	5.45
Marital status										
Married	4.87	4.36	10.25	6.29	4.05	4.81	4.77	6.12	5.24	3.93
Unmarried	8.58	7.68	13.20	9.62	6.10	5.71	5.45	7.75	6.26	4.96
Mother's place of birth										
Born in the 50 States and D.C.	6.80	5.37	12.89	8.77	5.90	5.98	5.67	7.13	7.30	5.60
Born elsewhere	4.72	3.94	7.79	*	3.96	4.73	4.72	7.03	4.33	4.30

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and by race and Hispanic origin of mother: United States, 2009 linked file--Con.

Characteristics	All races and origins <sup>1</sup>	Non-Hispanic				Hispanic				
		White	Black	American Indian or Alaska Native <sup>2</sup>	Asian or Pacific Islander	Total	Mexican	Puerto Rican	Cuban	Central and South American
Live births										
Total	4,130,665	2,212,552	609,584	48,665	251,089	999,548	645,297	68,486	16,641	148,647
Sex										
Male	2,113,856	1,134,654	309,751	24,752	129,526	510,477	329,299	35,134	8,476	75,932
Female	2,016,809	1,077,898	299,833	23,913	121,563	489,071	315,998	33,352	8,165	72,715
Plurality										
Single births	3,987,108	2,126,141	585,781	47,507	243,086	976,232	631,544	66,372	16,035	145,035
Plural births	143,557	86,411	23,803	1,158	8,003	23,316	13,753	2,114	606	3,612
Birthweight										
Less than 2,500 grams	337,989	159,421	83,278	3,556	20,824	69,581	41,845	6,589	1,258	9,891
Less than 1,500 grams	60,917	26,039	18,949	650	2,888	12,033	7,095	1,305	245	1,678
1,500-2,499 grams	277,072	133,382	64,329	2,906	17,936	57,548	34,750	5,284	1,013	8,213
2,500 grams or more	3,791,721	2,052,711	526,217	45,104	230,222	929,883	603,423	61,886	15,383	138,721
Not stated	955	420	89	5	43	84	29	11	*	35
Period of gestation										
Less than 37 weeks	502,306	241,301	106,316	6,537	27,200	119,507	73,996	9,414	2,201	17,796
Less than 32 weeks	81,185	34,805	23,541	1,037	3,698	17,683	10,578	1,723	361	2,511
32-33 weeks	63,776	29,620	14,326	913	3,298	15,520	9,608	1,219	262	2,289
34-36 weeks	357,345	176,876	68,449	4,587	20,204	86,304	53,810	6,472	1,578	12,996
37-41 weeks	3,394,486	1,843,476	471,889	38,753	212,371	820,908	532,427	55,059	13,644	122,074
37-38 weeks	1,138,029	590,838	177,717	13,142	71,566	282,462	181,014	19,114	5,196	41,466
39-41 weeks	2,256,457	1,252,638	294,172	25,611	140,805	538,446	351,413	35,945	8,448	80,608
42 weeks or more	228,588	125,425	30,512	3,305	11,221	57,946	38,085	3,940	789	8,581
Not stated	5,285	2,350	867	70	297	1,187	789	73	7	196
Age of mother										
Under 20 years	414,831	160,632	100,153	8,423	7,129	138,336	93,417	11,303	1,157	11,663
20-24 years	1,005,982	490,773	194,122	16,231	29,436	274,726	179,938	21,320	3,960	33,950
25-29 years	1,166,787	657,658	153,210	12,634	70,539	270,641	174,816	17,457	4,292	42,788
30-34 years	955,246	565,026	98,909	7,401	85,317	195,729	123,341	11,611	4,079	36,269
35-39 years	474,103	273,174	50,003	3,214	48,100	97,261	60,360	5,440	2,536	18,892
40-54 years	113,716	65,289	13,187	762	10,568	22,855	13,425	1,355	617	5,085
Live-birth order										
1	1,660,231	935,131	239,282	17,445	113,394	351,023	211,864	27,781	7,775	54,578
2	1,291,074	719,033	170,188	13,030	88,790	297,931	189,133	20,326	5,795	47,913
3	679,135	341,621	102,088	8,570	31,022	195,062	133,853	11,474	2,087	26,817
4	284,086	127,053	49,568	4,753	10,118	92,216	66,216	5,047	580	11,285
5 or more	189,567	78,936	41,854	4,594	6,379	57,220	40,925	3,465	290	6,792
Not stated	26,572	10,778	6,604	273	1,386	6,096	3,306	393	114	1,262
Marital status										
Married	2,437,007	1,571,300	165,540	16,853	207,832	468,103	311,277	23,847	8,978	70,764
Unmarried	1,693,658	641,252	444,044	31,812	43,257	531,445	334,020	44,639	7,663	77,883
Mother's place of birth										
Born in the 50 States and D.C.	3,134,234	2,073,785	527,891	45,130	52,747	423,968	258,198	50,360	8,085	20,879
Born elsewhere	982,942	133,648	77,549	3,442	196,873	573,921	386,545	17,644	8,538	127,492
Not stated	13,489	5,119	4,144	93	1,469	1,659	554	482	18	276

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and by race and Hispanic origin of mother: United States, 2009 linked file--Con.

Characteristics	All races and origins <sup>1</sup>	Non-Hispanic				Hispanic				
		White	Black	American Indian or Alaska Native <sup>2</sup>	Asian or Pacific Islander	Total	Mexican	Puerto Rican	Cuban	Central and South American
Total	26,408	11,785	7,560	412	1,105	5,285	3,302	492	96	665
Infant deaths										
Age at death										
Total neonatal	17,261	7,515	4,957	213	780	3,554	2,223	326	60	471
Early neonatal (< 7 days)	13,768	5,884	3,973	163	642	2,875	1,794	267	49	390
Late neonatal (7-27 days)	3,493	1,631	984	50	138	679	429	59	11	81
Postneonatal	9,148	4,271	2,603	199	324	1,731	1,080	166	35	193
Sex										
Male	14,811	6,630	4,282	232	605	2,900	1,801	277	47	382
Female	11,597	5,156	3,277	180	499	2,385	1,501	216	48	282
Plurality										
Single births	22,477	9,856	6,426	380	919	4,678	2,967	420	77	575
Plural births	3,932	1,929	1,134	32	185	607	335	72	19	90
Birthweight										
Less than 2,500 grams	17,919	7,371	5,692	221	786	3,637	2,227	367	71	478
Less than 1,500 grams	14,086	5,539	4,795	158	620	2,788	1,668	301	61	379
1,500-2,499 grams	3,833	1,832	897	63	167	849	559	66	10	99
2,500 grams or more	8,380	4,375	1,823	191	314	1,641	1,070	123	24	187
Not stated	109	40	44	1	5	7	5	2	*	*
Period of gestation										
Less than 37 weeks	17,550	7,219	5,622	228	752	3,526	2,148	358	71	473
Less than 32 weeks	13,976	5,507	4,760	159	597	2,761	1,654	299	58	379
32-33 weeks	1,025	468	248	12	47	248	165	17	5	31
34-36 weeks	2,549	1,244	614	57	108	517	329	42	8	63
37-41 weeks	7,995	4,168	1,722	161	307	1,595	1,043	124	22	175
37-38 weeks	3,521	1,843	771	70	143	671	442	57	8	69
39-41 weeks	4,474	2,325	951	91	164	924	601	67	14	106
42 weeks or more	654	317	144	21	37	138	96	7	2	16
Not stated	209	81	73	2	9	26	16	3	*	1
Age of mother										
Under 20 years	3,754	1,436	1,262	77	67	890	579	90	7	68
20-24 years	7,472	3,257	2,432	157	166	1,417	866	152	24	166
25-29 years	6,682	3,096	1,841	88	281	1,305	820	136	25	176
30-34 years	4,844	2,312	1,170	60	324	917	569	67	23	129
35-39 years	2,759	1,273	667	19	204	547	342	34	12	85
40-54 years	898	412	188	11	63	207	126	13	4	41
Live-birth order										
1	10,654	4,850	3,030	129	497	2,055	1,229	224	42	250
2	7,234	3,494	1,887	114	334	1,350	850	107	28	197
3	4,213	1,879	1,204	76	153	870	556	79	13	114
4	2,153	852	641	52	56	528	360	39	8	51
5 or more	1,784	593	653	41	55	424	284	41	*	37
Not stated	370	117	145	1	10	58	23	2	4	17
Marital status										
Married	11,877	6,858	1,697	106	841	2,253	1,484	146	47	278
Unmarried	14,531	4,928	5,862	306	264	3,032	1,819	346	48	386
Mother's place of birth										
Born in the 50 States and D.C	21,318	11,142	6,804	396	311	2,537	1,465	359	59	117
Born elsewhere	4,644	526	604	13	779	2,713	1,826	124	37	548
Not stated	446	118	152	3	15	35	10	9	*	*

\* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator.

- Quantity zero.

1 Includes other and unknown Hispanic origin not stated, not shown separately.

2 Includes Aleuts and Eskimos.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Not stated responses were included in totals but not distributed among groups for rate computations. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 for 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 2. Infant mortality rates by race and Hispanic origin of mother: United States and each State, Puerto Rico, Virgin Islands, and Guam, 2007-2009 linked files

[By place of residence]

	Total	Race and Hispanic origin of mother					Ratio of rate, non-Hispanic black and non-Hispanic white
		Non-Hispanic White	Non-Hispanic Black	American Indian or Alaska Native <sup>1</sup>	Asian or Pacific Islander	Hispanic	
Infant mortality rates per 1,000 live births in specified group							
United States <sup>2</sup>	6.59	5.49	12.80	8.71	4.57	5.46	2.33
Alabama	9.24	7.53	13.33	*	*	7.30	1.77
Alaska	6.51	4.12	*	11.67	*	*	*
Arizona	6.42	5.96	14.42	8.27	6.96	5.73	2.42
Arkansas	7.59	6.60	12.59	*	*	5.11	1.91
California	5.08	4.31	10.37	6.80	4.42	4.88	2.41
Colorado	6.19	5.15	12.95	*	4.41	7.20	2.51
Connecticut	6.07	4.58	12.59	*	5.89	6.35	2.75
Delaware	7.99	5.33	14.77	*	*	6.86	2.77
District of Columbia	11.48	4.34	16.53	*	*	6.73	3.81
Florida	7.09	5.48	12.74	*	5.64	5.30	2.32
Georgia	7.78	5.71	12.31	*	3.94	4.95	2.16
Hawaii	6.07	4.89	*	*	6.54	5.73	*
Idaho	6.03	5.61	*	*	*	7.62	*
Illinois	6.97	5.51	13.64	*	5.07	5.79	2.48
Indiana	7.41	6.46	14.47	*	5.27	6.81	2.24
Iowa	5.27	4.89	12.24	*	*	6.49	2.50
Kansas	7.49	6.89	15.28	*	5.85	6.68	2.22
Kentucky	6.81	6.51	11.15	*	*	4.49	1.71
Louisiana	9.01	6.89	12.76	*	*	3.84	1.85
Maine	5.85	5.74	*	*	*	*	*
Maryland	7.74	4.82	13.29	*	4.93	5.05	2.76
Massachusetts	5.02	4.02	9.89	*	3.63	6.87	2.46
Michigan	7.65	5.92	14.86	9.36	5.35	6.88	2.51
Minnesota	5.36	4.60	11.04	8.67	5.61	4.58	2.40
Mississippi	10.01	7.23	13.38	*	*	6.25	1.85
Missouri	7.21	6.10	14.10	*	3.95	5.15	2.31
Montana	6.55	6.11	*	8.91	*	*	*
Nebraska	5.87	5.19	13.44	11.01	*	5.50	2.59
Nevada	5.83	5.48	9.88	*	4.91	5.38	1.80
New Hampshire	4.76	4.68	*	*	*	*	*
New Jersey	5.27	3.71	12.07	*	2.68	5.04	3.25
New Mexico	5.69	5.83	*	5.90	*	5.31	*
New York	5.48	4.26	11.05	*	3.16	4.92	2.59
North Carolina	8.23	5.98	14.67	15.48	5.54	6.34	2.45
North Dakota	6.57	5.37	*	15.60	*	*	*
Ohio	7.72	6.31	14.54	*	4.75	7.28	2.30
Oklahoma	7.83	7.16	14.74	8.78	*	6.07	2.06
Oregon	5.24	5.15	8.87	10.02	4.90	4.74	1.72
Pennsylvania	7.34	5.50	13.42	*	5.73	8.32	2.44
Rhode Island	6.36	4.66	10.86	*	*	5.62	2.33
South Carolina	7.86	5.88	12.14	*	*	5.51	2.06
South Dakota	7.09	5.71	*	12.43	*	*	*
Tennessee	8.15	6.38	14.90	*	4.88	6.48	2.34
Texas	6.15	5.47	11.41	7.11	4.18	5.56	2.09
Utah	4.99	4.68	*	*	6.60	5.62	*
Vermont	5.28	5.06	*	*	*	*	*
Virginia	7.26	5.57	13.07	*	4.54	6.27	2.35
Washington	5.08	4.65	7.80	9.00	4.15	5.32	1.68
West Virginia	7.57	7.46	11.59	*	*	*	1.55
Wisconsin	6.44	5.36	14.07	9.05	6.88	6.22	2.63
Wyoming	6.78	6.07	*	*	*	7.35	*
Puerto Rico	8.19	---	---	---	---	---	---
Virgin Islands	5.61	*	*	*	*	*	*
Guam	9.50	*	*	*	10.14	*	*

\* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator.

--- Data not available.

1 Includes Aleuts and Eskimos.

2 Excludes data for Puerto Rico, Virgin Islands, and Guam.

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management & Standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 for 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.



Table 3. Percentage of live births with selected maternal and infant characteristics by race and Hispanic origin of mother: United States, 2009 linked file

Characteristic	All races and origins <sup>1</sup>	Non-Hispanic				Hispanic				
		White	Black	American Indian <sup>2</sup>	Asian or Pacific Islander	Total <sup>1</sup>	Mexican	Puerto Rican	Cuban	Central and South American
Birthweight:										
Less than 1,500 grams	1.48	1.18	3.11	1.34	1.15	1.20	1.10	1.91	1.47	1.13
Less than 2,500 grams	8.2	7.2	13.7	7.3	8.3	7.0	6.5	9.6	7.6	6.7
Preterm births <sup>3</sup>	12.2	10.9	17.5	13.5	10.8	12.0	11.5	13.8	13.2	12.0
Births to mothers under 20 years	10.0	7.3	16.4	17.3	2.8	13.8	14.5	16.5	7.0	7.8
Fourth and higher order births	11.5	9.4	15.2	19.3	6.6	15.0	16.7	12.5	5.3	12.3
Births to unmarried mothers	41.0	29.0	72.8	65.4	17.2	53.2	51.8	65.2	46.0	52.4
Mothers born in the 50 States and D.C.	76.1	93.9	87.2	92.9	21.1	42.5	40.0	74.1	48.6	14.1

1 Includes other and unknown Hispanic and origin not stated not shown separately.

2 Includes Aleuts and Eskimos.

3 Born prior to 37 completed weeks of gestation.

NOTES: D.C. is District of Columbia. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 for 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 4. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2009 linked file, and percent change in birthweight-specific infant mortality, 2005-2009 linked file

Race and birthweight in grams	Number in 2009				Mortality rate per 1,000 live births in 2009			Percent change in infant mortality rate 2005-2009
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races and origins	4,130,665	26,408	17,261	9,148	6.39	4.18	2.21	-6.9 **
Less than 2,500	337,989	17,919	14,460	3,459	53.02	42.78	10.23	-7.6 **
Less than 1,500	60,917	14,086	12,270	1,816	231.23	201.42	29.81	-5.6 **
Less than 500	6,937	5,918	5,788	130	853.11	834.37	18.74	-0.4
500-749	11,009	4,735	3,991	744	430.10	362.52	67.58	-8.1 **
750-999	11,990	1,683	1,222	461	140.37	101.92	38.45	-6.7
1,000-1,249	14,193	990	733	257	69.75	51.65	18.11	-2.1
1,250-1,499	16,788	759	535	224	45.21	31.87	13.34	-3.1
1,500-1,999	65,687	1,664	1,069	594	25.33	16.27	9.04	-5.7
2,000-2,499	211,385	2,170	1,121	1,049	10.27	5.30	4.96	-5.7 **
2,500 or more	3,791,721	8,380	2,693	5,687	2.21	0.71	1.50	-3.9 **
2,500-2,999	767,690	2,932	1,085	1,847	3.82	1.41	2.41	-8.8 **
3,000-3,499	1,619,238	3,414	974	2,440	2.11	0.60	1.51	-1.9
3,500-3,999	1,091,173	1,579	465	1,114	1.45	0.43	1.02	-1.4
4,000-4,499	271,434	374	126	249	1.38	0.46	0.92	-4.8
4,500-4,999	37,926	53	22	30	1.40	0.58	0.79	-36.7
5,000 or more	4,260	27	20	7	6.34	4.69	*	42.5
Not stated	955	109	107	2	...	...	...	...
Non-Hispanic White	2,212,552	11,785	7,515	4,271	5.33	3.40	1.93	-7.5 **
Less than 2,500	159,421	7,371	6,047	1,323	46.24	37.93	8.30	-8.0 **
Less than 1,500	26,039	5,539	4,941	598	212.72	189.75	22.97	-6.4 **
Less than 500	2,556	2,200	2,159	41	860.72	844.68	16.04	0.0
500-749	4,200	1,810	1,589	221	430.95	378.33	52.62	-8.7 **
750-999	4,910	705	567	138	143.58	115.48	28.11	-11.9 **
1,000-1,249	6,576	471	368	104	71.62	55.96	15.82	-4.3
1,250-1,499	7,797	352	258	94	45.15	33.09	12.06	2.0
1,500-1,999	31,753	789	532	257	24.85	16.75	8.09	-3.3
2,000-2,499	101,629	1,042	574	468	10.25	5.65	4.60	-7.3
2,500 or more	2,052,711	4,375	1,430	2,945	2.13	0.70	1.43	-4.5 **
2,500-2,999	359,567	1,395	516	879	3.88	1.44	2.44	-10.4 **
3,000-3,499	844,295	1,783	540	1,243	2.11	0.64	1.47	-3.2
3,500-3,999	647,557	906	267	639	1.40	0.41	0.99	-0.7
4,000-4,499	174,247	248	82	166	1.42	0.47	0.95	6.0
4,500-4,999	24,553	28	12	16	1.14	*	*	-38.4
5,000 or more	2,492	15	12	3	*	*	*	*
Not stated	420	40	38	2	...	...	...	...
Non-Hispanic Black	609,584	7,560	4,957	2,603	12.40	8.13	4.27	-9.0 **
Less than 2,500	83,278	5,692	4,452	1,240	68.35	53.46	14.89	-8.5 **
Less than 1,500	18,949	4,795	4,056	739	253.05	214.05	39.00	-4.8 **
Less than 500	2,585	2,184	2,135	49	844.87	825.92	18.96	-0.8
500-749	3,982	1,637	1,301	336	411.10	326.72	84.38	-7.7 **
750-999	3,878	515	320	195	132.80	82.52	50.28	-1.2
1,000-1,249	3,995	268	184	84	67.08	46.06	21.03	5.7
1,250-1,499	4,509	191	116	75	42.36	25.73	16.63	-9.2
1,500-1,999	15,940	393	190	203	24.65	11.92	12.74	-8.4
2,000-2,499	48,389	505	206	298	10.44	4.26	6.16	-7.1
2,500 or more	526,217	1,823	460	1,363	3.46	0.87	2.59	-1.7
2,500-2,999	155,000	755	222	533	4.87	1.43	3.44	-3.9
3,000-3,499	236,140	735	153	582	3.11	0.65	2.46	-0.6
3,500-3,999	110,344	281	70	211	2.55	0.63	1.91	5.4
4,000-4,499	21,472	41	11	30	1.91	*	1.40	-25.7
4,500-4,999	2,885	9	3	6	*	*	*	*
5,000 or more	376	2	1	1	*	*	*	*
Not stated	89	44	44	-	...	...	...	...

See footnotes at end of table.

Table 4. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2009 linked file, and percent change in birthweight-specific infant mortality, 2005-2009 linked file--Con

Race and birthweight in grams	Number in 2009					Mortality rate per 1,000 live births in 2009			Percent change in infant mortality rate 2005-2009
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal		
American Indian or Alaska native/1	48,665	412	213	199	8.47	4.38	4.09	5.1	
Less than 2,500	3,556	221	161	59	62.15	45.28	16.59	16.3	
Less than 1,500	650	158	133	25	243.08	204.62	38.46	2.8	
Less than 500	72	64	62	2	888.89	861.11	*	12.1	
500-749	89	41	34	7	460.67	382.02	*	2.2	
750-999	139	29	21	8	208.63	151.08	*	*	
1,000-1,249	153	13	10	3	*	*	*	*	
1,250-1,499	197	11	6	5	*	*	*	*	
1,500-1,999	696	24	16	8	34.48	*	*	12.2	
2,000-2,499	2,210	39	12	26	17.65	*	11.76	29.3	
2,500 or more	45,104	191	51	140	4.23	1.13	3.10	-4.5	
2,500-2,999	8,192	55	17	38	6.71	*	4.64	-6.4	
3,000-3,499	18,494	84	18	66	4.54	*	3.57	9.7	
3,500-3,999	13,679	40	11	28	2.92	*	2.05	-9.0	
4,000-4,499	3,943	11	3	8	*	*	*	*	
4,500-4,999	679	-	-	-	*	*	*	*	
5,000 or more	117	1	1	-	*	*	*	*	
Not stated	5	1	1	-	...	...	...	...	
Asian/Pacific Islander	251,089	1,105	780	324	4.40	3.11	1.29	-10.0 **	
Less than 2,500	20,824	786	649	137	37.74	31.17	6.58	-14.5 **	
Less than 1,500	2,888	620	541	79	214.68	187.33	27.35	-9.7	
Less than 500	294	265	259	6	901.36	880.95	*	6.0	
500-749	459	204	170	33	444.44	370.37	71.90	-12.1	
750-999	586	75	56	19	127.99	95.56	*	-11.3	
1,000-1,249	655	34	24	10	51.91	36.64	*	-29.1	
1,250-1,499	894	41	31	10	45.86	34.68	*	-5.2	
1,500-1,999	3,756	80	60	20	21.30	15.97	5.32	-19.5	
2,000-2,499	14,180	86	48	38	6.06	3.39	2.68	-15.4	
2,500 or more	230,222	314	127	187	1.36	0.55	0.81	-5.6	
2,500-2,999	58,788	120	60	60	2.04	1.02	1.02	-17.4	
3,000-3,499	105,765	136	49	87	1.29	0.46	0.82	2.4	
3,500-3,999	54,062	47	13	33	0.87	*	0.61	3.6	
4,000-4,499	10,108	10	3	7	*	*	*	*	
4,500-4,999	1,318	-	-	-	*	*	*	*	
5,000 or more	181	1	1	-	*	*	*	*	
Not stated	43	5	5	-	...	...	...	...	
Hispanic	999,548	5,285	3,554	1,731	5.29	3.56	1.73	-5.9 **	
Less than 2,500	69,581	3,637	2,945	692	52.27	42.32	9.95	-6.2 **	
Less than 1,500	12,033	2,788	2,414	374	231.70	200.61	31.08	-5.5	
Less than 500	1,317	1,100	1,069	31	835.23	811.69	23.54	-2.5	
500-749	2,195	982	834	148	447.38	379.95	67.43	-6.9	
750-999	2,434	348	248	99	142.97	101.89	40.67	-4.5	
1,000-1,249	2,780	199	145	55	71.58	52.16	19.78	0.8	
1,250-1,499	3,307	158	118	40	47.78	35.68	12.10	-5.9	
1,500-1,999	13,265	367	263	104	27.67	19.83	7.84	-8.3	
2,000-2,499	44,283	482	268	214	10.88	6.05	4.83	-0.4	
2,500 or more	929,883	1,641	602	1,039	1.76	0.65	1.12	-6.4	
2,500-2,999	184,387	591	263	328	3.21	1.43	1.78	-10.3	
3,000-3,499	411,660	672	203	469	1.63	0.49	1.14	-0.6	
3,500-3,999	263,321	301	101	200	1.14	0.38	0.76	-8.8	
4,000-4,499	61,045	57	24	33	0.93	0.39	0.54	-25.0	
4,500-4,999	8,383	13	7	6	*	*	*	*	
5,000 or more	1,087	7	4	3	*	*	*	*	
Not stated	84	7	7	-	...	...	...	...	

See footnotes at end of table.

\* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator.

\*\* Not significant at p<.05.

... Category not applicable.

- Quantity zero

1 Includes Aleuts and Eskimos.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 for 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 5. Infant deaths and mortality rates for the five leading causes of infant death by race and Hispanic origin of mother: United States, 2009 linked file

[Rates per 100,000 live births in specified group]															
Cause of death (Based on the Tenth Revision, International Classification of Diseases, 1992)	All races			Non-Hispanic White			Non-Hispanic Black			American Indian or Alaska native			Asian or Pacific Islander <sup>1</sup>		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes	...	26,408	639.3	...	11,785	532.6	...	7,560	1,240.2	...	412	846.6	...	1,105	440.1
Congenital malformations, deformations, and chromosomal abnormalities (Q00-Q99)	1	5,358	129.7	1	2,638	119.2	2	960	157.5	1	85	174.7	1	260	103.5
Disorders related to short gestation and low birth weight, not elsewhere classified (P07)	2	4,528	109.6	2	1,629	73.6	1	1,734	284.5	3	45	92.5	2	189	75.3
Sudden infant death syndrome (R95)	3	2,231	54.0	3	1,213	54.8	3	614	100.7	2	58	119.2	4	51	20.3
Newborn affected by maternal complications of pregnancy (P01)	4	1,614	39.1	4	682	30.8	4	515	84.5	5	21	43.2	3	74	29.5
Accidents (unintentional injuries) (V01-X59)	5	1,172	28.4	5	602	27.2	5	338	55.4	4	32	65.8	9	26	10.4
Cause of death (Based on the Tenth Revision, International Classification of Diseases, 1992)	Total Hispanic <sup>3</sup>			Mexican <sup>4</sup>			Puerto Rican <sup>5</sup>			Central and South American <sup>6</sup>					
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate			
All causes	...	5,285	528.7	...	3,302	511.7	...	492	718.4	...	665	447.4			
Congenital malformations, deformations, and chromosomal abnormalities (Q00-Q99)	1	1,374	137.5	1	949	147.1	2	69	100.8	1	174	117.1			
Disorders related to short gestation and low birth weight, not elsewhere classified (P07)	2	848	84.8	2	474	73.5	1	113	165.0	2	119	80.1			
Sudden infant death syndrome (R95)	3	285	28.5	4	166	25.7	3	35	51.1	4	31	20.9			
Newborn affected by maternal complications of pregnancy (P01)	4	282	28.2	3	173	26.8	4	34	49.6	3	34	22.9			
Accidents (unintentional injuries) (V01-X59)	6	172	17.2	6	116	18.0	7	15	*	13	11	*			

... Category not applicable.

\* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator.

1 For Asian or Pacific Islanders, Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death with 49 deaths and a rate of 19.5.

2 For Hispanics, Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death with 214 deaths and a rate of 21.4.

3 For Mexicans, Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death with 136 deaths and a rate of 21.1.

4 For Puerto Ricans, Respiratory distress of newborn (P22) was the fifth leading cause of death with 22 deaths and a rate of 32.1.

5 For Central and South Americans, Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death with 27 deaths and a rate of 18.2.

NOTE: Reliable cause-specific infant mortality rates cannot be computed for Cubans because of the small number of infant deaths (96). Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty three states and DC reported multiple-race data on the birth certificate for 2009. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other States; see references 2 and 3.

Table 6. Number of and percentage of preterm-related infant deaths and preterm-related infant mortality rates by race and Hispanic origin of mother, United States, 2000-2009 linked files

Year	All races and origins	Non-Hispanic white	Non-Hispanic black	American Indian or Alaska native	Asian or Pacific Islander	Total Hispanic <sup>1</sup>	Mexican	Puerto Rican	Central and South American
Number of preterm-related infant deaths									
2009	9,341	3,624	3,294	108	386	1,781	1,045	210	252
2008	9,952	3,843	3,466	97	418	2,009	1,303	222	229
2007	10,498	4,104	3,755	111	430	1,956	1,276	208	269
2006	10,303	4,134	3,709	100	358	1,868	1,229	221	252
2005	10,364	4,206	3,655	86	401	1,880	1,266	218	241
2004	10,180	4,171	3,641	83	378	1,752	1,192	195	238
2003	10,331	4,358	3,615	91	364	1,761	1,163	200	256
2002	9,965	4,342	3,581	90	321	1,540	1,018	190	192
2001	9,767	4,289	3,561	79	280	1,436	951	196	189
2000	9,673	4,141	3,586	96	298	1,411	929	189	170
Percent of total infant deaths that are preterm-related									
2009	35.4	30.8	43.6	26.2	34.9	33.7	31.6	42.7	37.9
2008	35.4	30.7	43.9	23.3	36.6	34.5	34.1	44.1	30.9
2007	36.0	31.6	45.0	24.3	35.4	33.4	32.6	39.4	34.6
2006	36.1	32.1	45.0	25.3	32.6	33.2	32.0	41.2	33.7
2005	36.5	32.0	45.9	23.8	35.5	34.0	33.0	41.4	34.0
2004	36.5	32.1	46.3	22.4	35.3	33.4	32.2	40.7	35.7
2003	36.9	32.9	46.1	24.2	34.1	34.2	32.4	41.8	37.4
2002	35.6	32.6	44.6	24.6	31.9	31.3	29.9	40.3	30.1
2001	35.5	32.2	44.9	19.6	29.6	31.0	29.8	39.9	31.3
2000	34.6	30.8	43.7	27.7	30.5	30.9	29.4	39.6	32.3
Preterm-related infant mortality rate <sup>2</sup>									
2009	226.1	163.8	540.4	221.9	153.7	178.2	161.9	306.6	169.5
2008	234.3	169.5	556.3	195.8	165.1	192.9	190.3	321.7	147.2
2007	243.2	177.6	598.7	224.5	169.0	184.0	176.7	303.7	158.4
2006	241.5	179.1	600.9	209.6	148.5	179.8	171.1	330.2	152.4
2005	250.4	184.5	626.1	191.9	173.5	190.8	182.6	344.2	159.4
2004	247.6	181.6	629.1	188.9	165.0	185.1	175.9	318.5	165.8
2003	252.6	187.7	627.6	211.4	164.6	193.0	177.7	342.5	188.8
2002	247.8	188.9	619.2	212.4	152.2	175.7	162.2	330.6	152.4
2001	242.6	184.3	603.6	188.7	139.8	168.6	155.6	340.5	155.7
2000	238.3	175.2	593.3	230.4	148.6	172.9	159.6	325.2	150.0

<sup>1</sup> Includes Cuban and other and unknown Hispanic. Cuban data were not shown separately because of small numbers of infant deaths.

<sup>2</sup> Rate per 100,000 live births in specified group.

NOTES: Preterm-related deaths are those where the infant was born preterm (before 37 completed weeks of gestation) with the underlying cause of death assigned to one of the following ICD-10 categories: K550, P000, P010, P011, P015, P020, P021, P027, P070-P073, P102, P220-229, P250-279, P280, P281, P360-369, P520-523, P77. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Thirty-three states and DC reported multiple-race data on the birth certificate for 2009 and 30 for 2008. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table I. Percent of infant death records which were linked to their corresponding birth records: United States and each state, Puerto Rico, Virgin Islands, and Guam, 2009 linked file

State	Percent linked by State of occurrence of death
United States <sup>1</sup>	98.6
Alabama	100.0
Alaska	100.0
Arizona	97.6
Arkansas	100.0
California	96.7
Colorado	100.0
Connecticut	98.1
Delaware	100.0
District of Columbia	99.5
Florida	99.9
Georgia	99.2
Hawaii	100.0
Idaho	100.0
Illinois	98.0
Indiana	99.2
Iowa	100.0
Kansas	99.6
Kentucky	97.8
Louisiana	97.4
Maine	98.7
Maryland	100.0
Massachusetts	99.5
Michigan	99.8
Minnesota	99.7
Mississippi	99.7
Missouri	99.5
Montana	100.0
Nebraska	100.0
Nevada	99.5
New Hampshire	100.0
New Jersey	97.7
New Mexico	96.3
New York State	98.9
New York City	99.7
North Carolina	99.7
North Dakota	100.0
Ohio	97.7
Oklahoma	98.8
Oregon	100.0
Pennsylvania	99.5
Rhode Island	98.9
South Carolina	100.0
South Dakota	100.0
Tennessee	100.0
Texas	95.3
Utah	99.3
Vermont	100.0
Virginia	99.9
Washington	99.8
West Virginia	100.0
Wisconsin	100.0
Wyoming	100.0
Puerto Rico	98.0
Virgin Islands	90.9
Guam	100.0

<sup>1</sup>Excludes data for Puerto Rico, Virgin Islands, and Guam.

Table II. Infant mortality rates for 2009 by trimester when pregnancy prenatal care began, smoking status during pregnancy, and education of mother: 27 state reporting area as of January 1, 2008

[Rates per 1,000 live births in specified group.]

Characteristic	Rate
Prenatal care	
Prenatal care beginning in the 1st trimester	5.24
Prenatal care beginning after the 1st trimester or no care	7.36
Prenatal care beginning in the 2nd trimester	6.19
Prenatal care beginning in the 3rd trimester	5.21
No prenatal care	26.93
Smoking status	
Smoker	9.73
Nonsmoker	5.50
Educational Attainment	
Less than High School Diploma	7.65
High school Diploma	7.15
Some college/technical school	5.82
Bachelor's degree or higher	3.73

NOTES: Includes data from California, Colorado, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Michigan, Montana, New Mexico, Nebraska, New Hampshire, New York, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Vermont, Washington and Wyoming. These states are those that revised as of January 1, 2008. Information on smoking status excludes data for Florida, Georgia, and Michigan. See "Methods" and "Technical Notes".

Table III. Values of L and U for calculating 95-percent confidence limits for numbers of events and rates when the number of events is less than 100

<i>N</i>	<i>L</i>	<i>U</i>	<i>N</i>	<i>L</i>	<i>U</i>
1	0.02532	5.57164	51	0.74457	1.31482
2	0.12110	3.61234	52	0.74685	1.31137
3	0.20622	2.92242	53	0.74907	1.30802
4	0.27247	2.56040	54	0.75123	1.30478
5	0.32470	2.33367	55	0.75334	1.30164
6	0.36698	2.17658	56	0.75539	1.29858
7	0.40205	2.06038	57	0.75739	1.29562
8	0.43173	1.97040	58	0.75934	1.29273
9	0.45726	1.89831	59	0.76125	1.28993
10	0.47954	1.83904	60	0.76311	1.28720
11	0.49920	1.78928	61	0.76492	1.28454
12	0.51671	1.74680	62	0.76669	1.28195
13	0.53246	1.71003	63	0.76843	1.27943
14	0.54671	1.67783	64	0.77012	1.27698
15	0.55969	1.64935	65	0.77178	1.27458
16	0.57159	1.62394	66	0.77340	1.27225
17	0.58254	1.60110	67	0.77499	1.26996
18	0.59266	1.58043	68	0.77654	1.26774
19	0.60207	1.56162	69	0.77806	1.26556
20	0.61083	1.54442	70	0.77955	1.26344
21	0.61902	1.52861	71	0.78101	1.26136
22	0.62669	1.51401	72	0.78244	1.25933
23	0.63391	1.50049	73	0.78384	1.25735
24	0.64072	1.48792	74	0.78522	1.25541
25	0.64715	1.47620	75	0.78656	1.25351
26	0.65323	1.46523	76	0.78789	1.25165
27	0.65901	1.45495	77	0.78918	1.24983
28	0.66449	1.44528	78	0.79046	1.24805
29	0.66972	1.43617	79	0.79171	1.24630
30	0.67470	1.42756	80	0.79294	1.24459
31	0.67945	1.41942	81	0.79414	1.24291
32	0.68400	1.41170	82	0.79533	1.24126
33	0.68835	1.40437	83	0.79649	1.23965
34	0.69253	1.39740	84	0.79764	1.23807
35	0.69654	1.39076	85	0.79876	1.23652
36	0.70039	1.38442	86	0.79987	1.23499
37	0.70409	1.37837	87	0.80096	1.23350
38	0.70766	1.37258	88	0.80203	1.23203
39	0.71110	1.36703	89	0.80308	1.23059
40	0.71441	1.36172	90	0.80412	1.22917
41	0.71762	1.35661	91	0.80514	1.22778
42	0.72071	1.35171	92	0.80614	1.22641
43	0.72370	1.34699	93	0.80713	1.22507
44	0.72660	1.34245	94	0.80810	1.22375
45	0.72941	1.33808	95	0.80906	1.22245
46	0.73213	1.33386	96	0.81000	1.22117
47	0.73476	1.32979	97	0.81093	1.21992
48	0.73732	1.32585	98	0.81185	1.21868
49	0.73981	1.32205	99	0.81275	1.21746
50	0.74222	1.31838			



Figure 2. Infant mortality rate ratio of non-Hispanic black and non-Hispanic white populations, by State: United States, 2007-2009

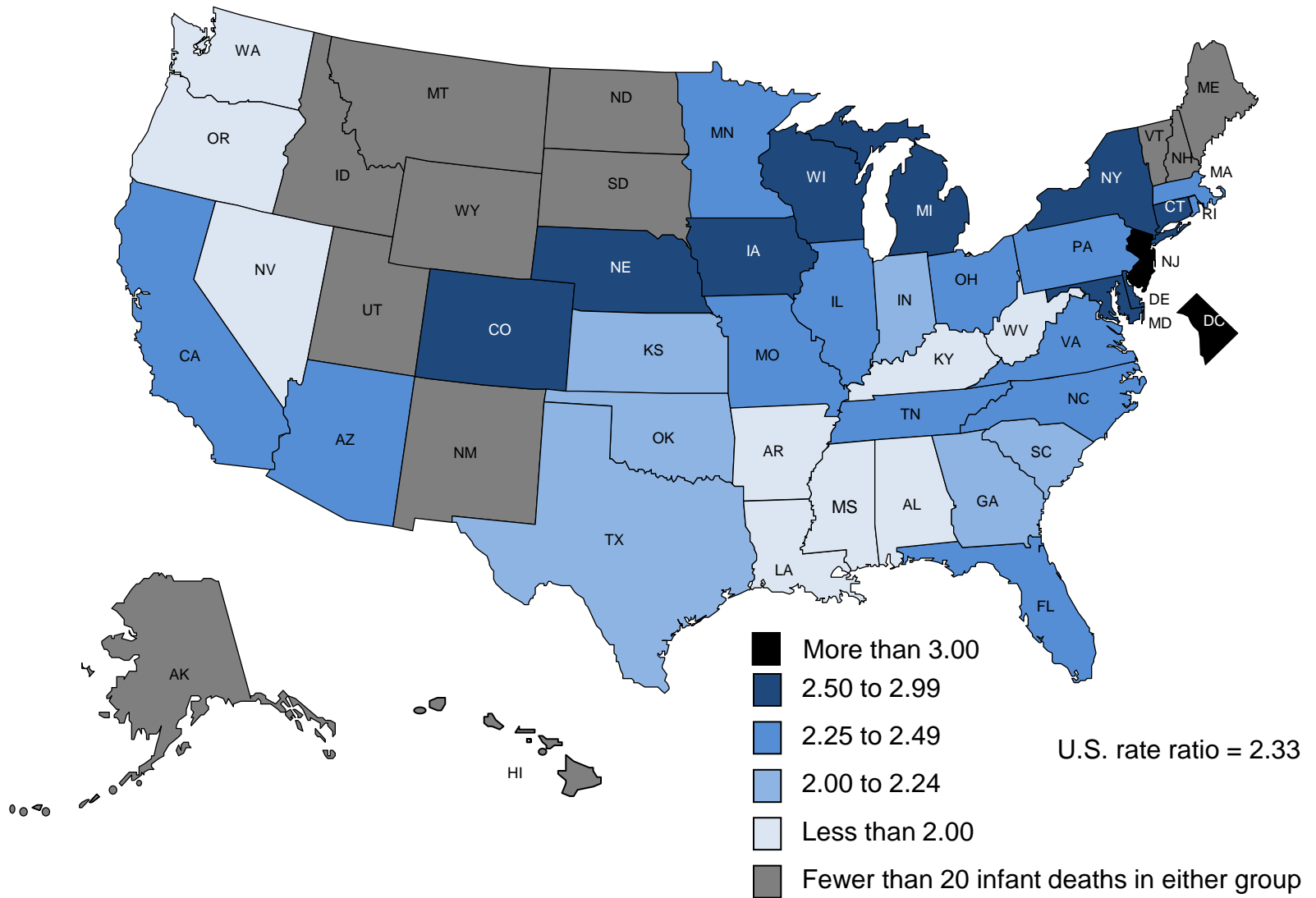
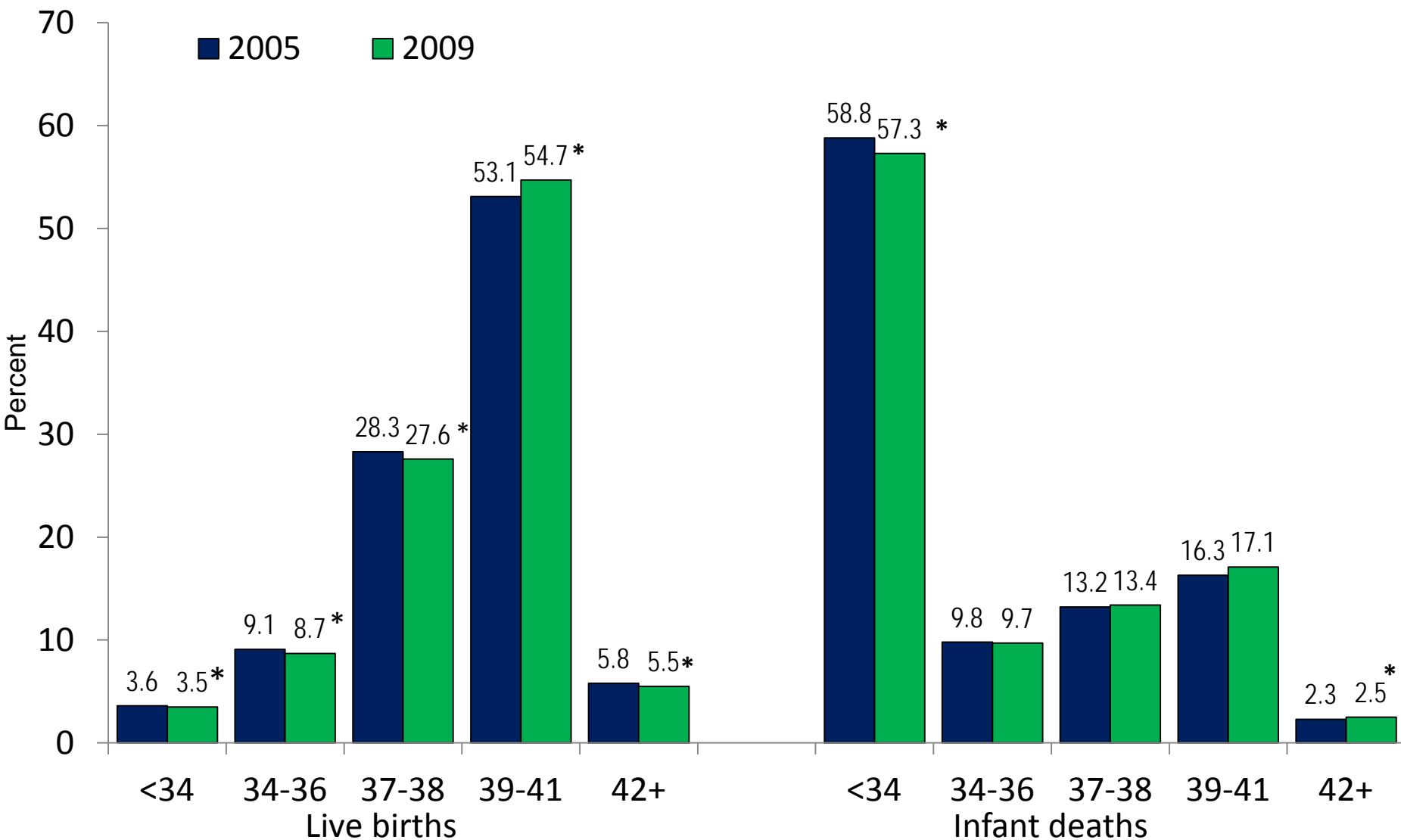


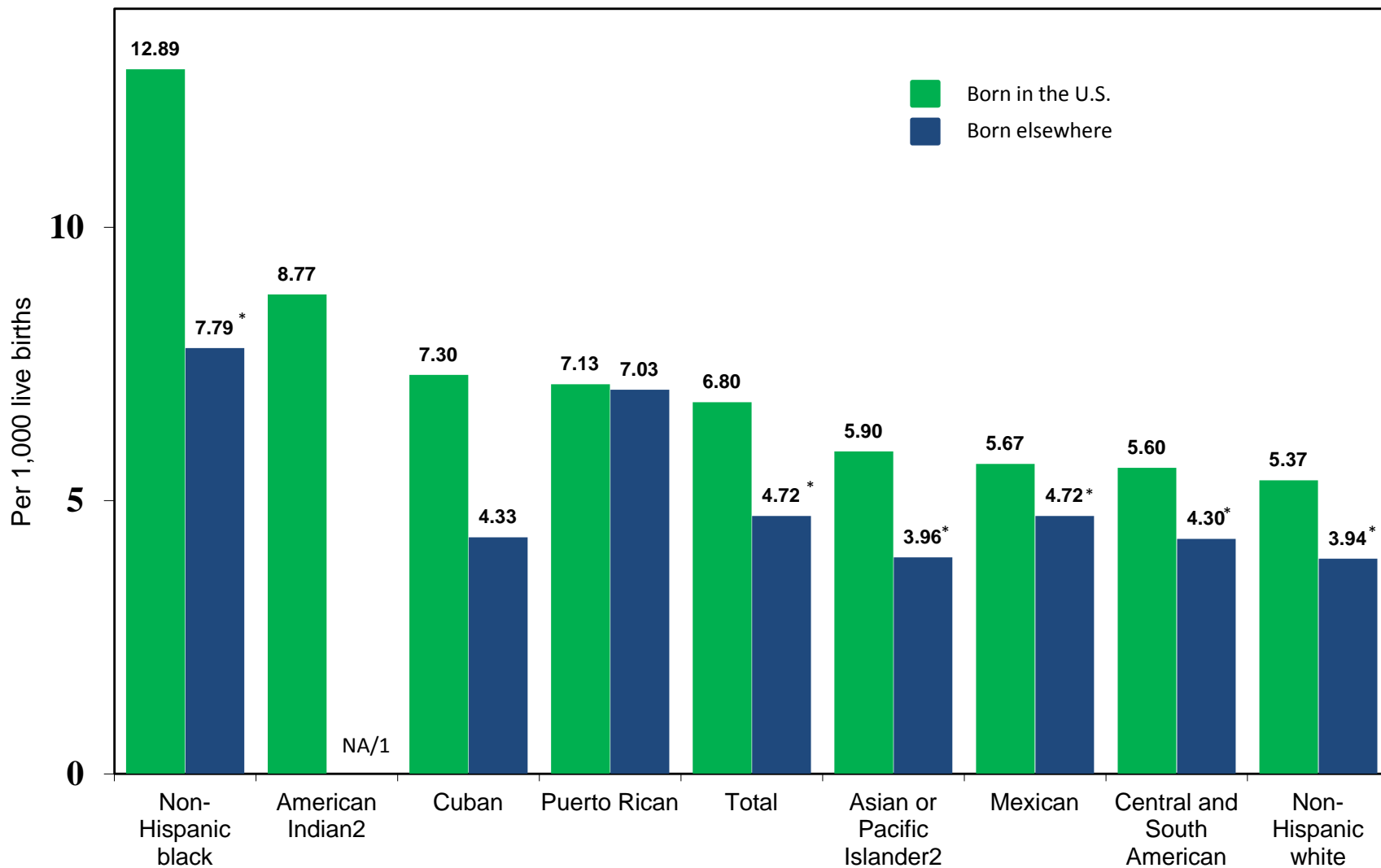
Figure 3. Percent distribution of live births and infant deaths by gestational age, United States, 2005 and 2009



SOURCE: NCHS, linked birth infant death data set.

\* Statistically significant change

Figure 4. Infant mortality rates, by mother's place of birth and race and ethnicity of mother: United States, 2009



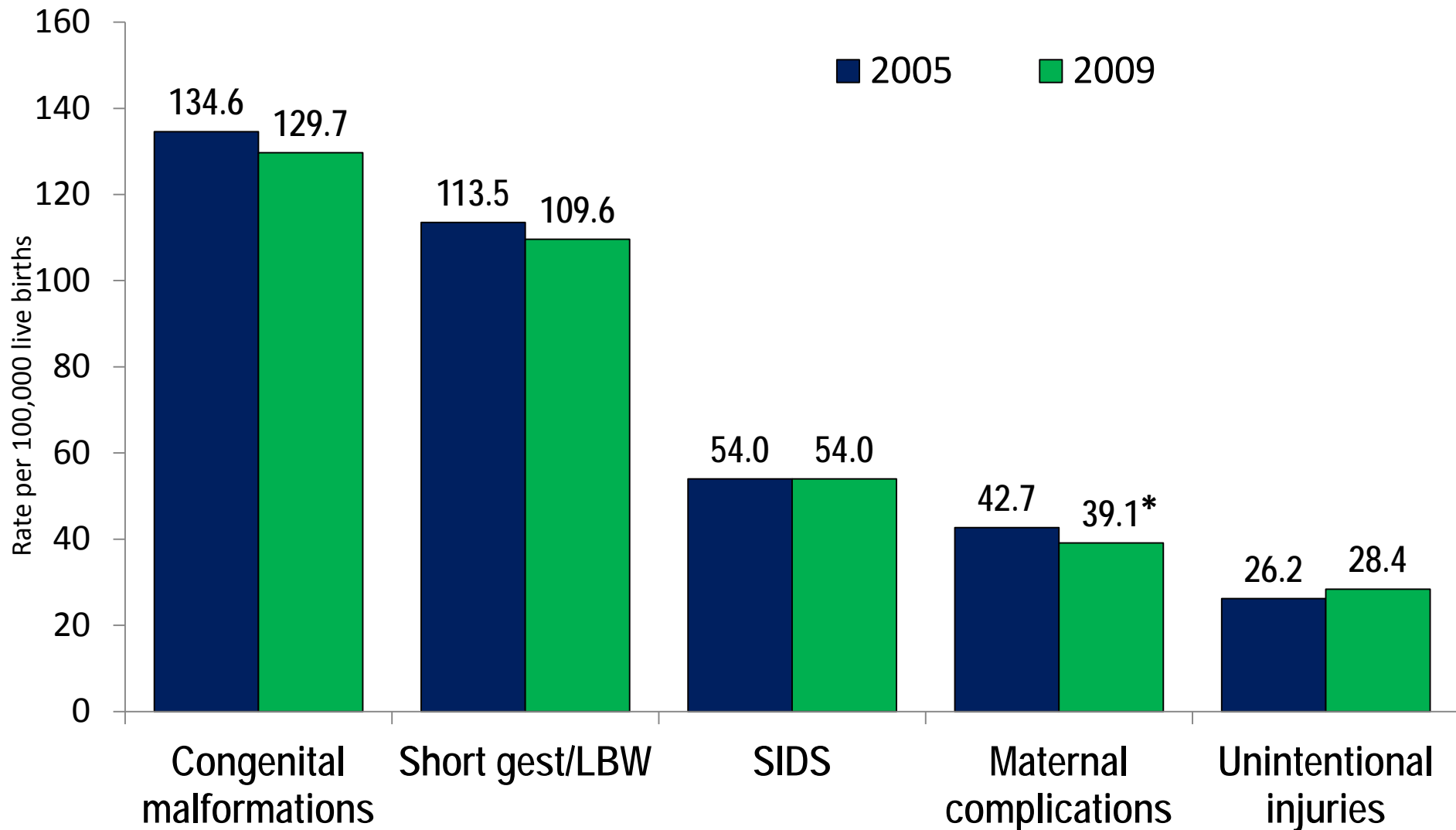
- Significant difference

1/ Not applicable, for mothers born elsewhere there are fewer than 20 infant deaths.

2/ Includes persons of Hispanic and non-Hispanic origin.

SOURCE: National Vital Statistics System, NCHS, CDC

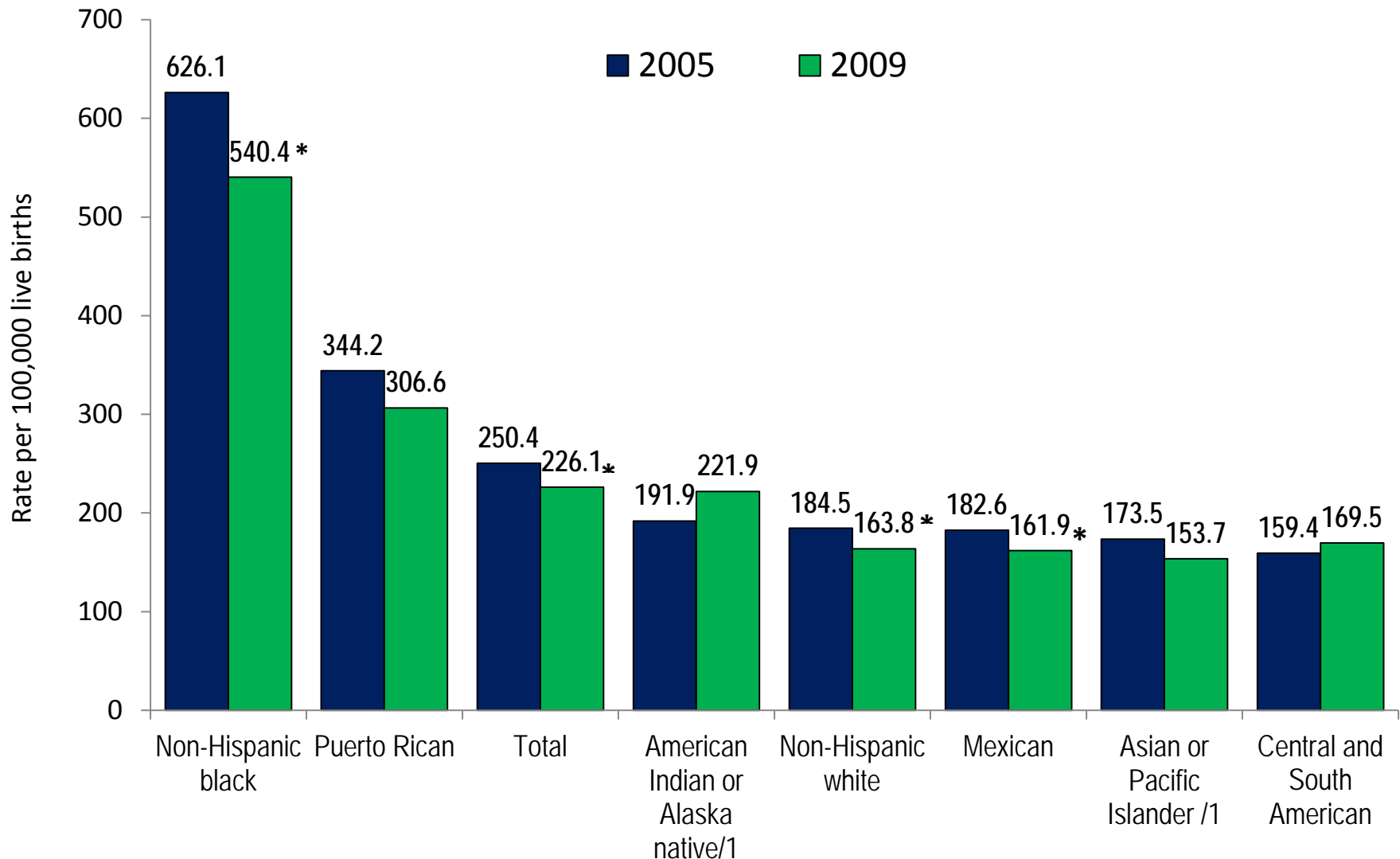
Figure 5. Infant mortality rates for the five leading causes of infant death in 2009; United States, 2005 and 2009



Source: NCHS, linked birth/infant death data set.

\* Significant decline.

Figure 6. Preterm-related infant mortality rates by race and Hispanic origin of mother, United States, 2005 and 2009



1 Includes persons of Hispanic and non-Hispanic origin.

SOURCE: CDC/NCHS National Vital Statistics System.

\* Significant decline.