

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

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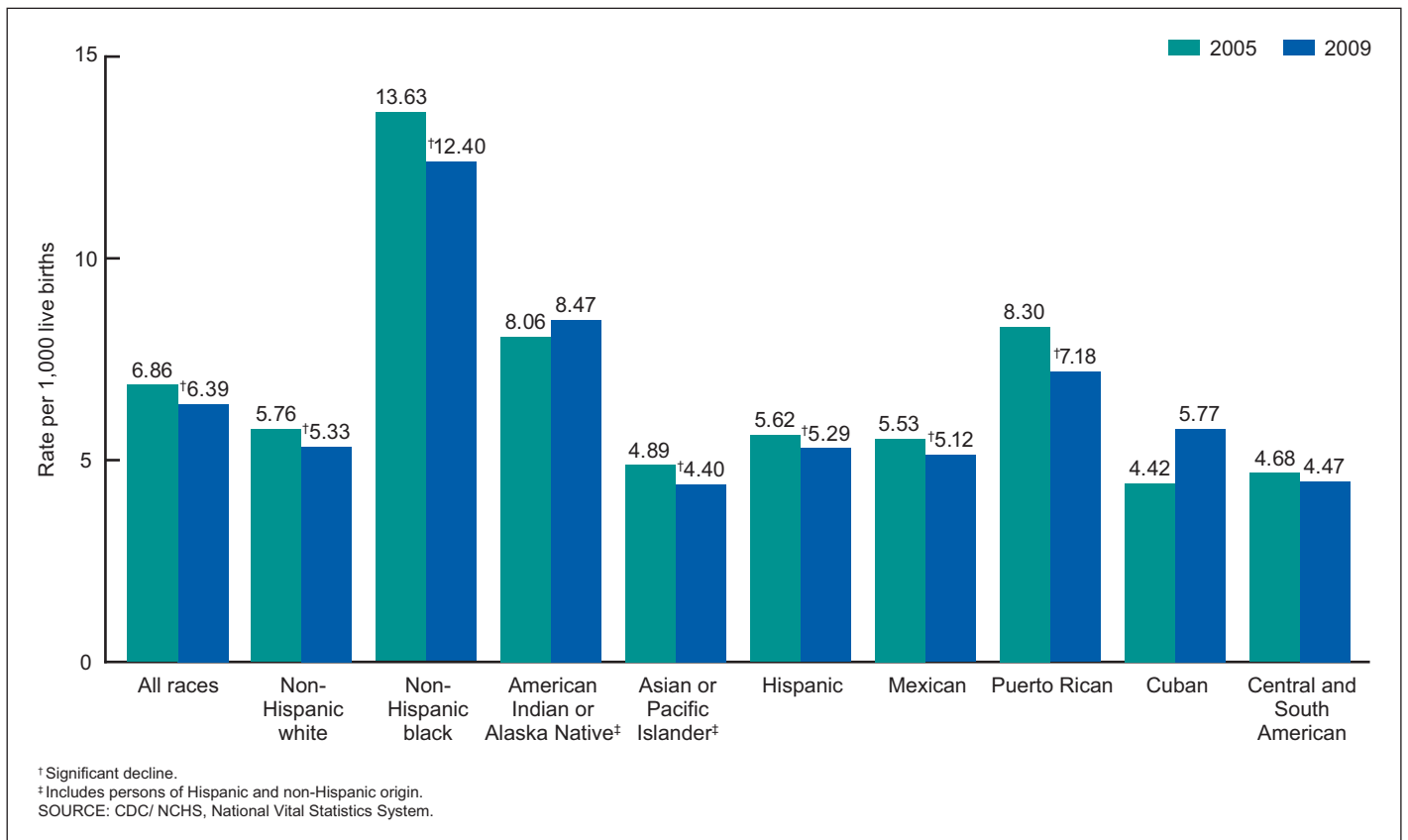


Figure 1. Infant mortality rates, by race and ethnicity of mother: United States, 2005 and 2009

## 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 infant mortality rate in the United States in 2009 was 6.39 infant deaths per 1,000 live births, 3% 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. Infant mortality rates were also higher for those infants 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 (under age 28 days) declined 3% to 4.18 neonatal deaths per 1,000 live births, while the postneonatal mortality rate (aged 28 days to under 1 year) declined 5% to 2.21. Preterm and low birthweight infants had the highest infant mortality rates and contributed greatly to overall U.S. infant mortality. The three leading causes of infant death—congenital malformations, low birthweight, and sudden infant death syndrome—accounted for 46% of all infant deaths. In 2009, 35.4% of infant deaths were “preterm-related.”

**Keywords:** 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 age 1 year who died in the 50 states, the District of Columbia (DC), 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 1–6 and A–D, and Figures 1–6).

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, DC, 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 age 1 year who died in the state during 2009 to the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). If 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% of all infant death records were successfully linked to their corresponding birth records. These records were weighted to adjust for the 1.4% of infant death records that were not linked to their corresponding birth certificates (see [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% 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 for 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 noncomparable 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](#)).

## 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, teen 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 untangling 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 ethnicity-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 data are 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, birth-weight, 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% lower than the rate of 6.61 in 2008 and 7% 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% and for Mexican women it declined 8% ([Table B](#)).

Several groups had declines between 2005 and 2009: Puerto Rican (13%), API (10%), non-Hispanic black (9%), and non-Hispanic white (7%) women ([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 API mothers. Rates were also higher for infants of AIAN (8.47) and Puerto Rican (7.18) mothers. Rates were intermediate, but below the U.S. rate for infants of Cuban (5.77), non-Hispanic white (5.33), and Mexican (5.12) mothers ([Tables A](#) and [B](#)). Central and South American mothers also had a low rate (4.47). 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 by race and ethnicity.”

### Age at death

Both neonatal and postneonatal mortality declined from 2008 to 2009. The neonatal (aged under 28 days) mortality rate declined 3% from 4.29 to 4.18 deaths per 1,000 live births ([Table B](#)). From 2008 to 2009, neonatal mortality rates declined for Mexican women. The postneonatal (aged 28 days to under 1 year) mortality rate declined 5% from 2.32 to 2.21 deaths 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

**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 <sup>1</sup>                 | 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         |

<sup>1</sup>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 under 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 the District of Columbia 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 and 2000–2009 linked files**

| Race and Hispanic origin of mother         | 1995  | 2000  | 2001  | 2002  | 2003  | 2004  | 2005  | 2006  | 2007  | 2008  | 2009  | Percent change<br>2005 to 2009 | Percent change<br>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  | <sup>†</sup> -6.9              | <sup>†</sup> -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  | <sup>†</sup> -7.5              | <sup>†</sup> -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 | <sup>†</sup> -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  | <sup>†</sup> -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  | <sup>†</sup> -5.9              | <sup>†</sup> -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  | <sup>†</sup> -7.4              | <sup>†</sup> -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  | <sup>†</sup> -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  | <sup>†</sup> -7.9              | <sup>†</sup> -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  | <sup>†</sup> -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  | <sup>†</sup> -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  | <sup>†</sup> -7.8              | <sup>†</sup> -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  | <sup>†</sup> -9.0              | <sup>†</sup> -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  | <sup>†</sup> -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  | <sup>†</sup> -4.7              | <sup>†</sup> -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  | <sup>†</sup> -5.9              | <sup>†</sup> -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  | <sup>†</sup> -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                          | <sup>†</sup> -17.2             |

<sup>†</sup> Significant at  $p < 0.05$ .

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

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 the District of Columbia 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 references 2 and 3.

other groups were not significant. In 2009, nearly two-thirds (65%) 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) women 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 (1.29) women were 14%–33% lower than for non-Hispanic white women (Table A).

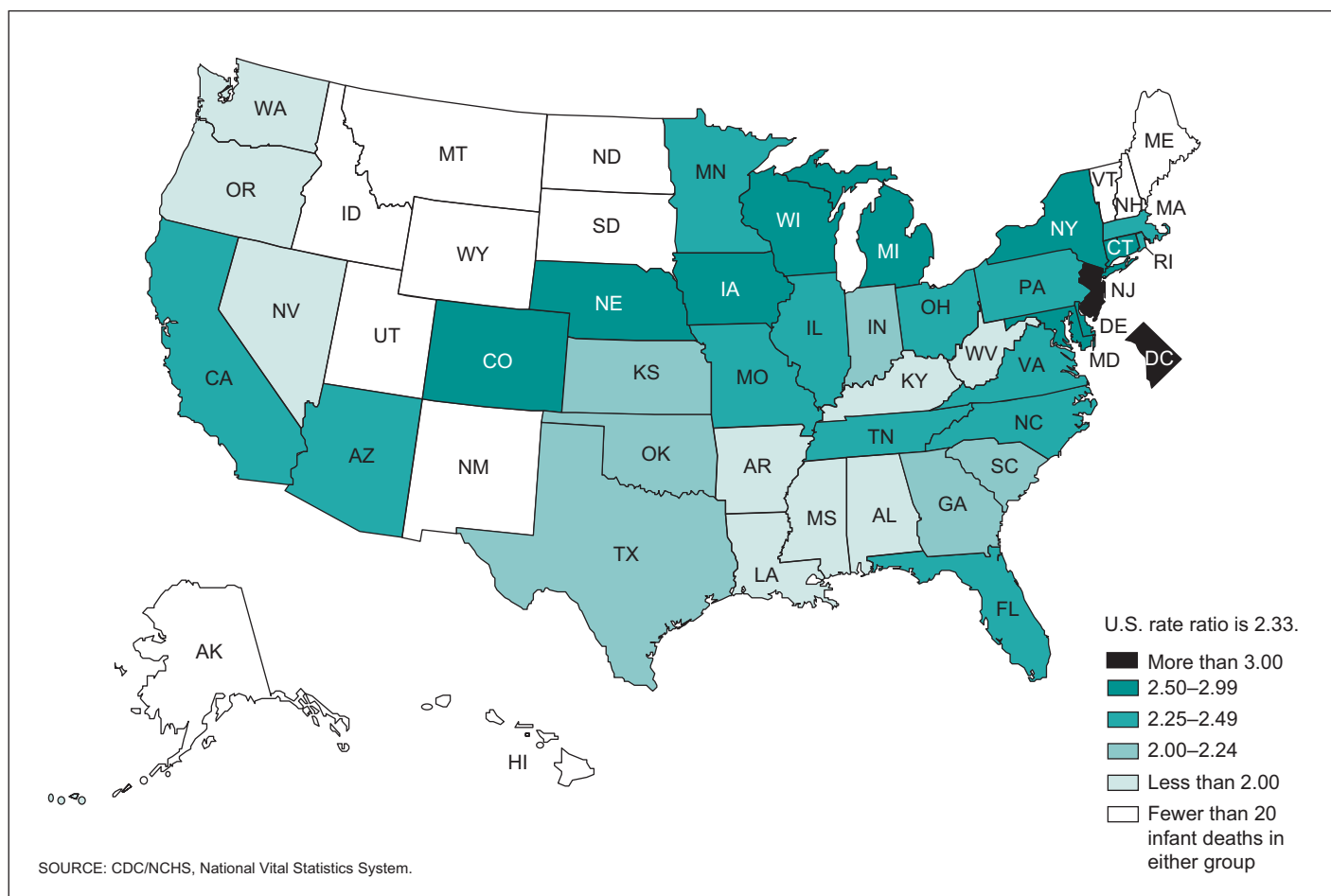
From 2005 to 2009, the neonatal mortality rate declined more (by 8%) than the postneonatal mortality rate (by 5%) (Table B). Declines in neonatal mortality from 2005 to 2009 were observed for non-Hispanic white, non-Hispanic black, Mexican, and Puerto Rican

women (Table B), while declines in postneonatal mortality were observed for non-Hispanic white and API women.

## Infant mortality by state, and by race and 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 and Puerto Rico. Four of these states were in the southeastern United States. These declines ranged from 26% for South Carolina to 8% for California. California had the highest number of infant deaths (2,590) and Vermont had 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, 3 years of data were combined (Table 2). Across the United States, 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



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

New Hampshire. The highest rate noted (11.48) was for DC; however, the rate for DC 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 DC; 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 AIAN mothers, mortality rates could be reliably computed for only 16 states, and for 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 racial and ethnic disparities in infant mortality

is to calculate the ratio between the infant mortality rates of two different racial and ethnic groups. The U.S. infant mortality rate ratio for non-Hispanic black populations relative to non-Hispanic white populations for the 3 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 women due to fewer than 20 infant deaths do not have a rate ratio shown here ([Figure 2](#)).

Areas with the highest rate ratios of 2.7 or greater for 2007–2009 were DC (3.8), New Jersey (3.3), Delaware (2.8), Maryland (2.8), and Connecticut (2.7). Nine areas had ratios less than 2.0: Arkansas (1.9), Louisiana (1.9), Mississippi (1.9), Alabama (1.8), Nevada (1.8), Kentucky (1.7), Oregon (1.7), Washington (1.7), and West Virginia (1.6) (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,



**Table C. Infant mortality rates, number of infant deaths, and percent change by state: United States, 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 <sup>1</sup>   | 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.

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

the overall infant mortality rate for male infants was 7.01 per 1,000 live births, 22% 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, 5 times the rate of 5.64 for singleton births (Table 1). From 2008–2009, infant mortality rates declined by 3% for single births and declined by 5% 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 increase 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% of all live births, but for 15% of all infant deaths in the United States (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 percentage 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 U.S. infant mortality rate. In 2009, two-thirds (67.0%) of all infant deaths occurred to the 12.2% of infants who were born preterm (Table D and Figure 3). Infant mortality rates are highest for very preterm (under 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, 7 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 through 2009, the infant mortality rate declined significantly for gestational age groupings under 37, 32–33, 37–41, and 39–41 weeks. Infant mortality rates for other gestational age groupings were essentially unchanged from 2008–2009.

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

|  | All gestational ages | Preterm (under 37 weeks) |                                |                |             |                             | Term (37–41 weeks) |             |             | Post-term (42 weeks or over) |
|--|----------------------|--------------------------|--------------------------------|----------------|-------------|-----------------------------|--------------------|-------------|-------------|------------------------------|
|  |                      | Total                    | Early preterm (under 34 weeks) |                |             | Late preterm<br>34–36 weeks | Total              | Early term  |             |                              |
|  |                      |                          | Total                          | Under 32 weeks | 32–33 weeks |                             |                    | 37–38 weeks | 39–41 weeks |                              |
| Infant mortality rate <sup>1</sup>                 |                      |                          |                                |                |             |                             |                    |             |             |                              |
| 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 <sup>2</sup> |                      |                          |                                |                |             |                             |                    |             |             |                              |
| 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 <sup>2</sup>   |                      |                          |                                |                |             |                             |                    |             |             |                              |
| 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                     | 3.6                            | 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>Deaths occurring at age 1 year or under per 1,000 live births in specified group.

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

There were large differences in the percentage of preterm births by race and ethnicity, and these differences have a large impact on infant mortality rates (14, 29–30). In 2009, the percentage of preterm births ranged from 10.8% of births to API women to 17.5% 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 under 32 weeks 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 over for Central and South American women. Patterns were mixed for Mexican and Puerto Rican women.

The percentage of preterm births increased 36%, from 9.4% in 1984 to a high of 12.8 in 2006 (2). However since 2006, the trend has reversed and the percentage of preterm births declined to 12.2% in 2009, a 5% decrease (Table D). The decline in the percentage of preterm births occurred during both the early (under 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% in

2006 to 67.0% in 2009, while the percentage of infant deaths that were term increased from 29.5% in 2006 to 30.5% 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 pound, 1 ounce or less)] (Table 4), 85% 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% of births, but nearly one-half (47%) of all infant deaths in the United States in 2009 (Table 4). Conversely, 91.8% of infants born in the United States in 2009 weighed 2,500 grams or more,

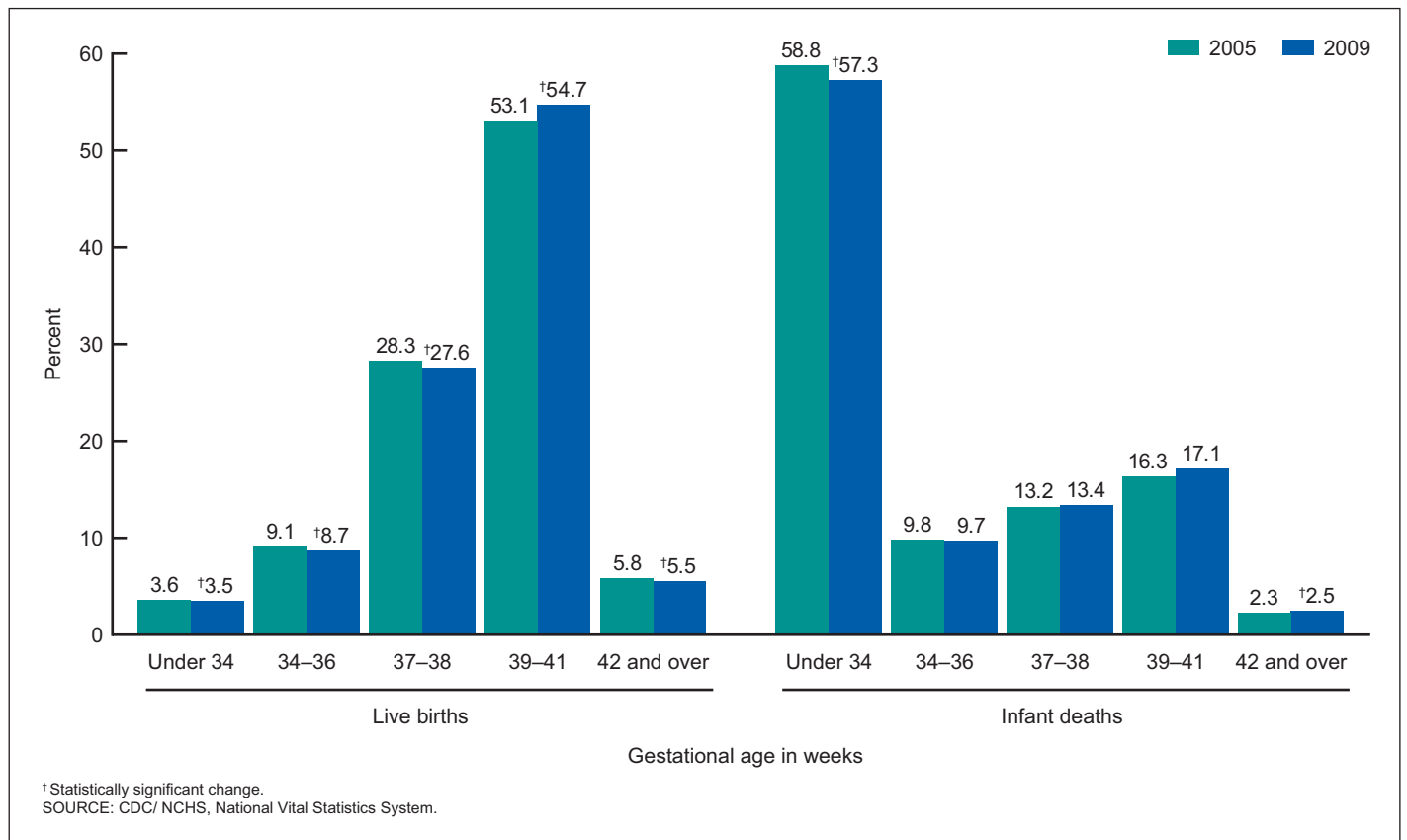


Figure 3. Percent distribution of live births and infant deaths, by gestational age: United States, 2005 and 2009

but these infants accounted for less than one-third (31.9%) of infant deaths. The large race and Hispanic-origin variations in the percentage of births at low birthweight (less than 2,500 grams) (from 6.5% for Mexican women to 13.7% for non-Hispanic black women) mean that some racial and ethnic groups are affected disproportionately by the high infant mortality rates for low birthweight infants (Table 3).

From 2005 through 2009, infant mortality rates for the total population declined for the broader birthweight categories of less than 2,500 grams, less than 1,500 grams, and 2,500 grams or more, and for detailed birthweight categories of 500–749, 2,000–2,499, and 2,500–2,999 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 30s (Table 1).

In 2009, among births to teenagers, infants of the youngest mothers (under age 15) had the highest mortality rate (15.31); the rate was 14.92 in 2008. The rate for infants of mothers aged 15–17 was 9.47 in 2009, 8% lower than in 2008 (10.33); the rate for infants of mothers aged 18–19 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% lower than in 2008 (6.19) (14).

Infant mortality rates for births to non-Hispanic white mothers aged 20 and under were 29% higher than for mothers aged 40 and

over. In contrast, for Mexican mothers, rates for births to the oldest mothers were 51% 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% higher than for second births (5.60). The higher parities, and therefore the highest-order births (fifth 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 live births, 76% 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 DC (6.80 per 1,000) was 44% higher than the rate for



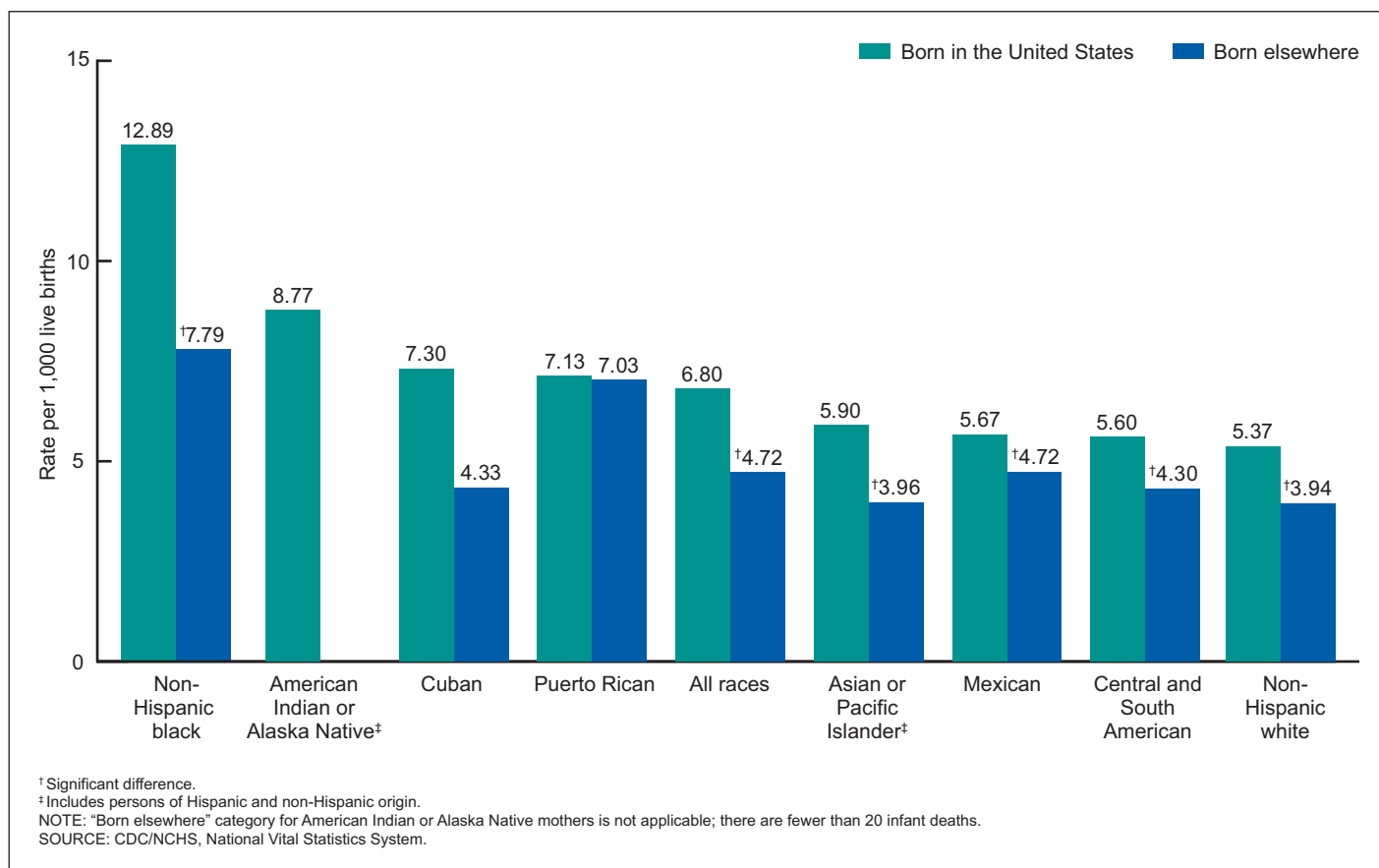


Figure 4. Infant mortality rates, by place of birth and by race and ethnicity of mother: United States, 2009

mothers born elsewhere (4.72) (Table 1). Among race and Hispanic origin groups, mothers born in the 50 states and DC had higher infant mortality rates than mothers born elsewhere for non-Hispanic black (65%), API (49%), non-Hispanic white (36%), Central and South American (30%), and Mexican mothers (20%) (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 DC, including possible differences in migration selectivity, social support, and risk behaviors (36,37). Also, women born outside the 50 states and DC 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% of all infant deaths. Disorders relating to short gestation and low birthweight, not elsewhere classified (low birthweight) was the second-leading cause, accounting for 17% of all infant deaths; followed by Sudden infant death syndrome (SIDS), accounting for 8% of infant deaths. The fourth and fifth leading causes in 2009 were Newborn affected by

maternal complications of pregnancy (maternal complications) (6%), and Accidents (unintentional injuries) (4%). Together the five leading causes accounted for 56% of all infant deaths in the United States in 2009. The order of the top five leading causes was the same in 2008 and 2007. From 2005 through 2009, the infant mortality rate from maternal complications declined 8%, 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% higher for AIAN women, 32% higher for non-Hispanic black women, and 23% higher for Mexican women than for non-Hispanic white women. Infant mortality rates from congenital malformations were 13% lower for API women 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 3 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

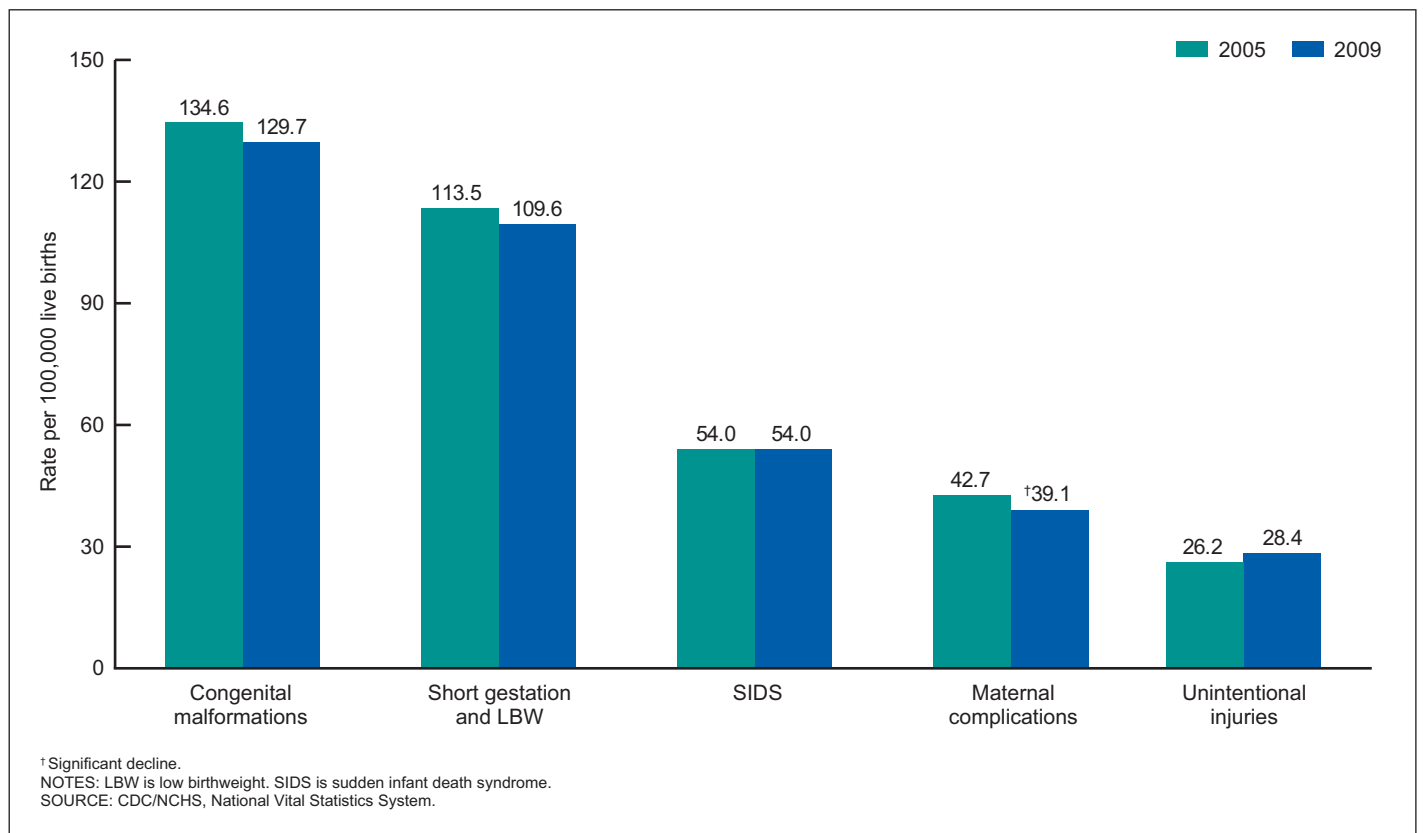


Figure 5. Infant mortality rates for the five leading causes of infant death: United States, 2005 and 2009

were 84% 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, or 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 had a much higher percentage of preterm births (Table 3), which may help 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% higher for Puerto Rican women 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% lower for Mexican women and 62% 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% or more of infants whose deaths were

attributed to that cause were born at under 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 Table 6. Even this comprehensive grouping likely 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 establish the etiological 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 through 2009. In 2009, 9,341 out of a total of 26,408 U.S. infant deaths (35.4%) were preterm-related. The percentage of infant deaths that were preterm-related increased from 34.6% in 2000 to a high of 36.9% in 2003. However, since 2003, the percentage of infant deaths that were preterm-related declined to 35.4% in 2009.

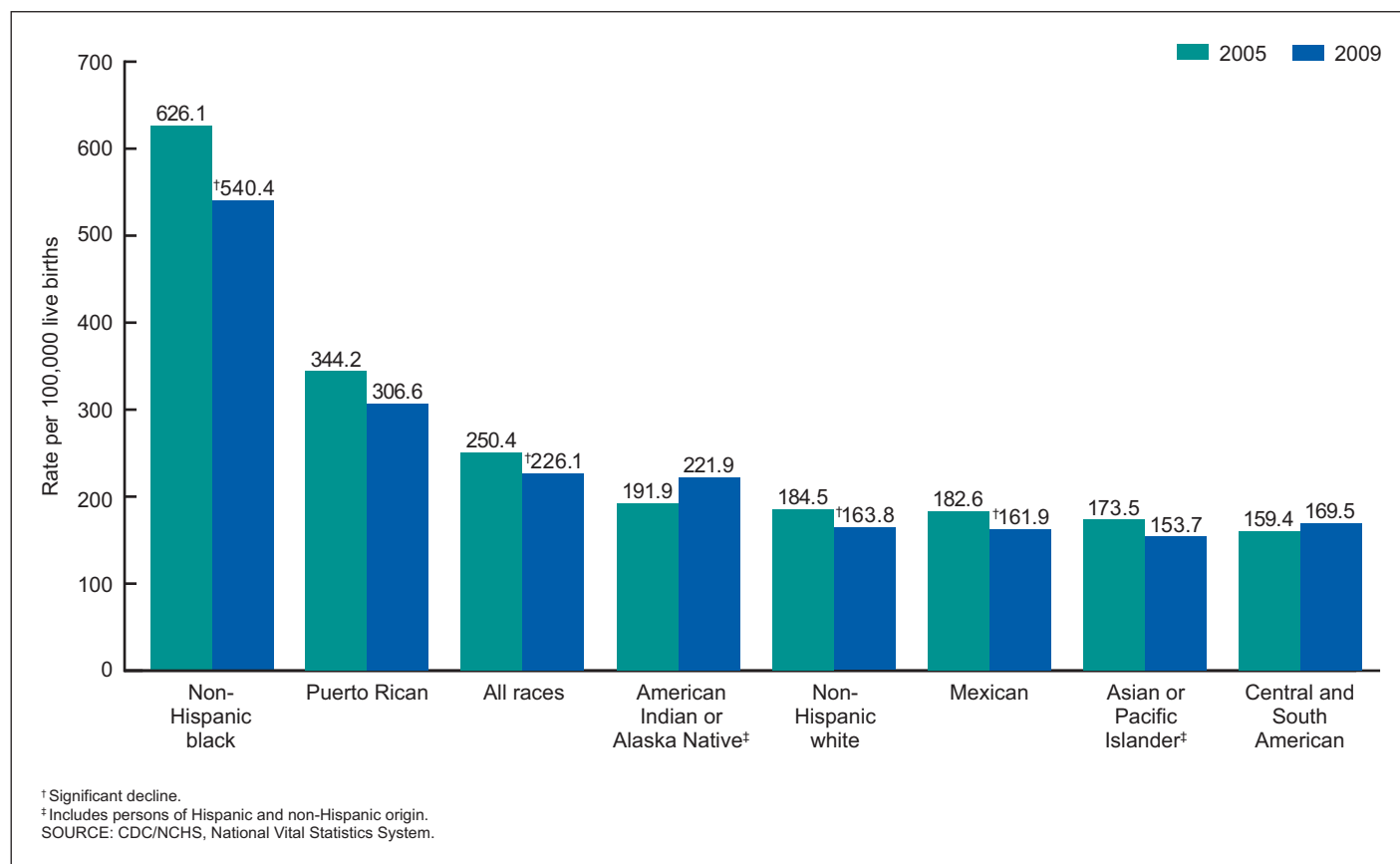


Figure 6. Preterm-related infant mortality rates, by race and Hispanic origin of mother: United States, 2005 and 2009

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% higher for Puerto Rican women (306.6) and 35% higher for AIAN women (221.9) than for non-Hispanic white women. In 2009, 43%–44% of infant deaths to non-Hispanic black and Puerto Rican women were due to preterm-related causes, while the percentage was lower for other racial and ethnic groups (Table 6).

From 2005 through 2009, preterm-related infant mortality rates declined 10% for the total population, by 11% for non-Hispanic white and Mexican women, and by 14% for non-Hispanic black women (Table 6 and Figure 6). Changes for other racial 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 with non-Hispanic white women. In 2009, 77% 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% 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% of the difference in infant mortality rates between AIAN and non-Hispanic white women, while SIDS accounted for 21%, congenital malformations for 18%, and unintentional injuries for 12% of the difference.

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## List of Detailed Tables

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**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**

| Characteristic   | 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 rate 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 (under 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 DC. . . . .                          | 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.**

| Characteristic                        | Non-Hispanic                       |           |         |   |                           | Hispanic |         |              |        |                            |
|---------------------------------------|------------------------------------|-----------|---------|---|---------------------------|----------|---------|--------------|--------|----------------------------|
|                                       | All races and origins <sup>1</sup> | 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 DC. . . . . | 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.**

| Characteristic                         | 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 deaths                          |                                    |              |       |   |                           |          |         |              |       |                            |
| Total . . . . .                        | 26,408                             | 11,785       | 7,560 | 412   | 1,105                     | 5,285    | 3,302   | 492          | 96    | 665                        |
| Age at death                           |                                    |              |       |   |                           |          |         |              |       |                            |
| Total neonatal. . . . .                | 17,261                             | 7,515        | 4,957 | 213   | 780                       | 3,554    | 2,223   | 326          | 60    | 471                        |
| Early neonatal (under 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 DC . . . . . | 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.

<sup>1</sup>Includes other and unknown Hispanic origin not stated, not shown separately.<sup>2</sup>Includes Aleut and Eskimo persons.

NOTES: DC is District of Columbia. 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]

| Area   | Total | Race and Hispanic origin of mother |                       |  |                                 |          | Ratio of rate,<br>non-Hispanic<br>black and<br>non-Hispanic<br>white |
|--|-------|------------------------------------|-----------------------|--|---------------------------------|----------|--|
|  |       | Non-Hispanic<br>white              | Non-Hispanic<br>black | American<br>Indian or<br>Alaska<br>Native <sup>1</sup> | Asian or<br>Pacific<br>Islander | Hispanic |  |
| Infant mortality rate 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.

<sup>1</sup>Includes Aleut and Eskimo persons.<sup>2</sup>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 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 the District of Columbia 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 |       |   |                    | Asian or Pacific Islander | Hispanic |              |       |                            |
|--|------------------------------------|--------------|-------|---|--------------------|---------------------------|----------|--------------|-------|----------------------------|
|  |                                    | White        | Black | American Indian or Alaska Native <sup>2</sup> | 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 age 20 . . . . .       | 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 DC . . . . . | 76.1                               | 93.9         | 87.2  | 92.9  | 21.1               | 42.5                      | 40.0     | 74.1         | 48.6  | 14.1                       |

<sup>1</sup>Includes other and unknown Hispanic and origin not stated not shown separately.

<sup>2</sup>Includes Aleut and Eskimo persons.

<sup>3</sup>Born prior to 37 completed weeks of gestation.

NOTES: DC 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 files**

| 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 files—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 <sup>1</sup> . . . . . | 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 or 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         | <sup>†</sup> -5.9                                 |
| Less than 2,500 . . . . .                               | 69,581         | 3,637         | 2,945           | 692                 | 52.27  | 42.32    | 9.95         | <sup>†</sup> -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               | –                   | ...  | ...      | ...          | ...   |

<sup>†</sup> Not significant at  $p < 0.05$ .

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

... Category not applicable.

– Quantity zero.

<sup>1</sup>Includes Aleut and Eskimo persons.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is under 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 the District of Columbia 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<br><i>International Classification of Diseases, Tenth<br/>Revision, 1992</i> ) | All races |        |       | Non-Hispanic white |        |       | Non-Hispanic black |        |         | American Indian or<br>Alaska Native |        |       | Asian or<br>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<br>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<br>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<br>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<br><i>International Classification of Diseases, Tenth<br/>Revision, 1992</i> ) | Total Hispanic <sup>2</sup> |        |       | Mexican <sup>3</sup> |        |       | Puerto Rican <sup>4</sup> |        |       | Central and South<br>American <sup>5</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<br>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<br>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<br>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.

<sup>1</sup>For Asian or Pacific Islander persons, 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.<sup>2</sup>For Hispanic persons, 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.<sup>3</sup>For Mexican persons, 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.<sup>4</sup>For Puerto Ricans persons, Respiratory distress of newborn (P22) was the fifth leading cause of death with 22 deaths and a rate of 32.1.<sup>5</sup>For Central and South American persons, 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.

NOTES: Reliable cause-specific infant mortality rates cannot be computed for Cuban persons 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 the District of Columbia 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 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     |                       |                    |                    |                                  |                           |                             |         |              |                            |
| 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                       |
| 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, and 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 the District of Columbia 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.

## Technical Notes

### Differences between period and cohort data

From 1983 through 1991, the Centers for Disease Control and Prevention's National Center for Health Statistics (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% 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 percentage of records linked varied by registration area (from 95.3% to 100.0% with all but four areas—California, Louisiana, New Mexico, and Texas at 97.5% or higher) (Table I). The number of infant deaths in the linked file for the 50 states and the District of Columbia (DC) was weighted to equal the sum of the linked plus unlinked infant deaths by state of occurrence of birth and age of death (under 7 days, 7–27 days, and 28 days to under age 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 the 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 deaths per 1,000 live births 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 DC are included regardless of the place of birth of the infant. In contrast, to be included in the U.S. linked file, both the birth and death must occur in the 50 states and DC (the territory linked file is a separate file). Also, weighting of the linked file may

**Table I. Percentage of infant death records that 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.



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. Because 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 were 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 with the 2003 revision or the information 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

**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  |
|--|-------|
| <b>Prenatal care</b>   |       |
| 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 |
| <b>Smoking status</b>  |       |
| Smoker . . . . .   | 9.73  |
| Nonsmoker . . . . .  | 5.50  |
| <b>Educational attainment</b>  |       |
| Less than high school diploma . . . . .                              | 7.65  |
| High school diploma . . . . .  | 7.15  |
| Some college or 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, Nebraska, New Hampshire, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Vermont, Washington, and Wyoming. These states are those that revised their birth certificates as of January 1, 2008. Information on smoking status excludes data for Florida, Georgia, and Michigan; see Methods and Technical Notes.

revised states represent 65% of all births in 2008 (53% 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 those with less than a high school education, those with late or no prenatal care, and smokers (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 DC. New York used inferential procedures to compile birth statistics by marital status; a birth is categorized 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 DC (both revised and nonrevised): California, Colorado, Delaware, District of Columbia (for births after January 31), Florida, Georgia, Hawaii, Idaho, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Montana, Nebraska, Nevada (for births after May 31), New Hampshire, New Mexico, New York, North Dakota, Ohio, Oklahoma (for births after March 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 Office of Management and Budget 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: American Indian or Alaska Native, Asian or Pacific Islander, 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. This measure 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% of births) (2,3).

## Birthweight

For the linked file, birthweight not stated was imputed for 3,077 records or 0.07% 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, then the not-stated value for birthweight was retained. This imputation was done to improve the accuracy of birthweight-specific infant mortality rates, because the percentage of records with not-stated birthweight was higher for infant deaths (3.27% before imputation) than for live births (0.10% before imputation). The imputation reduced the percentage of not-stated records to 0.41% for infant deaths and to 0.02% 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 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* (ICD). 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 Manuals* (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). The underlying cause 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 ICD is revised to take into account advances in medical knowledge. Effective with deaths occurring in 1999, the United States began using the Tenth Revision (ICD–10) (5); during the period 1979–1998, 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–J18)].

## 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% 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 [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 likely 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 establish the etiological 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 data set, rates 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 comparing 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 age 1 year 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 live births does not increase precision as it does for rates per 1,000 live births.

As stated previously, infant death records for the 50 states and DC in the U.S. 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 (RSE) 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 RSEs and 95% confidence intervals are shown below.

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

$$\text{RSE}(D) = 100 \cdot \sqrt{\frac{1}{D}},$$

where  $D$  is the number of deaths, and

$$\text{RSE}(B) = 100 \cdot \sqrt{\frac{1}{B}},$$

where  $B$  is the number of births.

For example, suppose 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.

$$\text{The RSE of the deaths} = 100 \cdot \sqrt{\frac{1}{497}} = 4.49,$$

$$\text{while the RSE of the births} = 100 \cdot \sqrt{\frac{1}{81,555}} = 0.35.$$

The formula for the RSE of the infant mortality rate (IMR) is:

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

The RSE of the IMR for the example above

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

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

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

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

Thus, for Group A:

$$\text{Lower: } 6.09 - \left(1.96 \cdot 6.09 \cdot \frac{4.50}{100}\right) = 5.55.$$

$$\text{Upper: } 6.09 + \left(1.96 \cdot 6.09 \cdot \frac{4.50}{100}\right) = 6.63.$$

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](#).

$$\text{Lower: } \text{IMR} \cdot L(0.95, D_{\text{adj}})$$

$$\text{Upper: } \text{IMR} \cdot U(0.95, D_{\text{adj}}),$$

where  $D_{\text{adj}}$  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:

$$D_{\text{adj}} = \frac{D \cdot B}{D + B}.$$

$L(0.95, D_{\text{adj}})$  and  $U(0.95, D_{\text{adj}})$  refer to the values in [Table III](#) corresponding to the value of  $D_{\text{adj}}$ .

For example, suppose 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.

$$D_{\text{adj}} = \frac{53 \cdot 9,241}{53 + 9,241} = 53.$$

Therefore, the 95% confidence interval (using the formula in [Table III](#) for 1–99 infant deaths) is:

$$\text{Lower: } 5.74 \cdot 0.74907 = 4.30.$$

$$\text{Upper: } 5.74 \cdot 1.30802 = 7.51.$$

*Comparison of two infant mortality rates*—If either of the two rates to be compared is based on fewer than 100 deaths, compute the confidence intervals for both rates and determine whether they overlap. If so, the difference is not statistically significant at the 95% level. If they do not overlap, the difference is statistically significant. If both of the 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:

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

## Availability of linked file data

Linked file data are available for download at: [http://www.cdc.gov/nchs/data\\_access/VitalStatsOnline.htm](http://www.cdc.gov/nchs/data_access/VitalStatsOnline.htm). Beginning with 2005, the public-use file no longer includes geographic detail; such files are available upon special request (see [http://www.cdc.gov/nchs/nvss/dvs\\_data\\_release.htm](http://www.cdc.gov/nchs/nvss/dvs_data_release.htm)). Data are also available in issues of Vital and Health Statistics, Series 20, National Vital Statistics Reports, and Data Briefs from <http://www.cdc.gov/nchs>.

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

| $N$ | $L$     | $U$     | $N$ | $L$     | $U$     |
|-----|---------|---------|-----|---------|---------|
| 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 |     |         |         |

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**Acknowledgments**

This report was prepared under the general direction of Charles J. Rothwell, Director of the Division of Vital Statistics (DVS), and Stephanie J. Ventura, Chief of the Reproductive Statistics Branch (RSB). Nicholas Pace, Chief of Systems, Programming, and Statistical Resources Branch (SPSRB); Steve Steimel; Candace Cosgrove; and Annie Liu (SPSRB) provided computer programming support and statistical tables. Yashu Patel of RSB provided assistance with content review. The Registration Methods staff and the Data Acquisition and Evaluation Branch provided consultation to state vital statistics offices regarding collection of the birth and death certificate data on which this report is based. This report was edited and produced by CDC/OSELS/NCHS/OD/Office of Information Services, Office of Information Design and Publishing Staff: Danielle Woods edited the report; typesetting was done by Annette F. Holman and Kyung Park; and graphics were also produced by Kyung Park.

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**Suggested citation**

Mathews TJ, MacDorman MF. Infant mortality statistics from the 2009 period linked birth/infant death data set. National vital statistics reports; vol 61 no 8. Hyattsville, MD: National Centers for Health Statistics. 2013.

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DHHS Publication No. (PHS) 2013-1120 • CS239262