

## Infant Mortality Statistics from the 2004 Period Linked Birth/Infant Death Data Set

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### Abstract

**Objectives**—This report presents 2004 period infant mortality statistics from the linked birth/infant death data file by a variety of 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. Excluding rates by cause of death, the infant mortality rate is now published with two decimal places.

**Results**—The U.S. infant mortality rate was 6.78 infant deaths per 1,000 live births in 2004 compared with 6.84 in 2003. Infant mortality rates ranged from 4.67 per 1,000 live births for Asian and Pacific

Islander mothers to 13.60 for non-Hispanic black mothers. Among Hispanics, rates ranged from 4.55 for Cuban mothers to 7.82 for Puerto Rican mothers. Infant mortality rates were higher for those infants whose mothers were born in the 50 states and the District of Columbia, were unmarried, or were born in multiple births. Infant mortality was also higher for male infants and infants born preterm or at low birthweight. The neonatal mortality rate declined from 4.63 in 2003 to 4.52 in 2004 while the postneonatal mortality rate was essentially unchanged. Infants born at the lowest gestational ages and birthweights have a large impact on overall U.S. infant mortality. More than one-half (55 percent) of all infant deaths in the United States in 2004 occurred to the

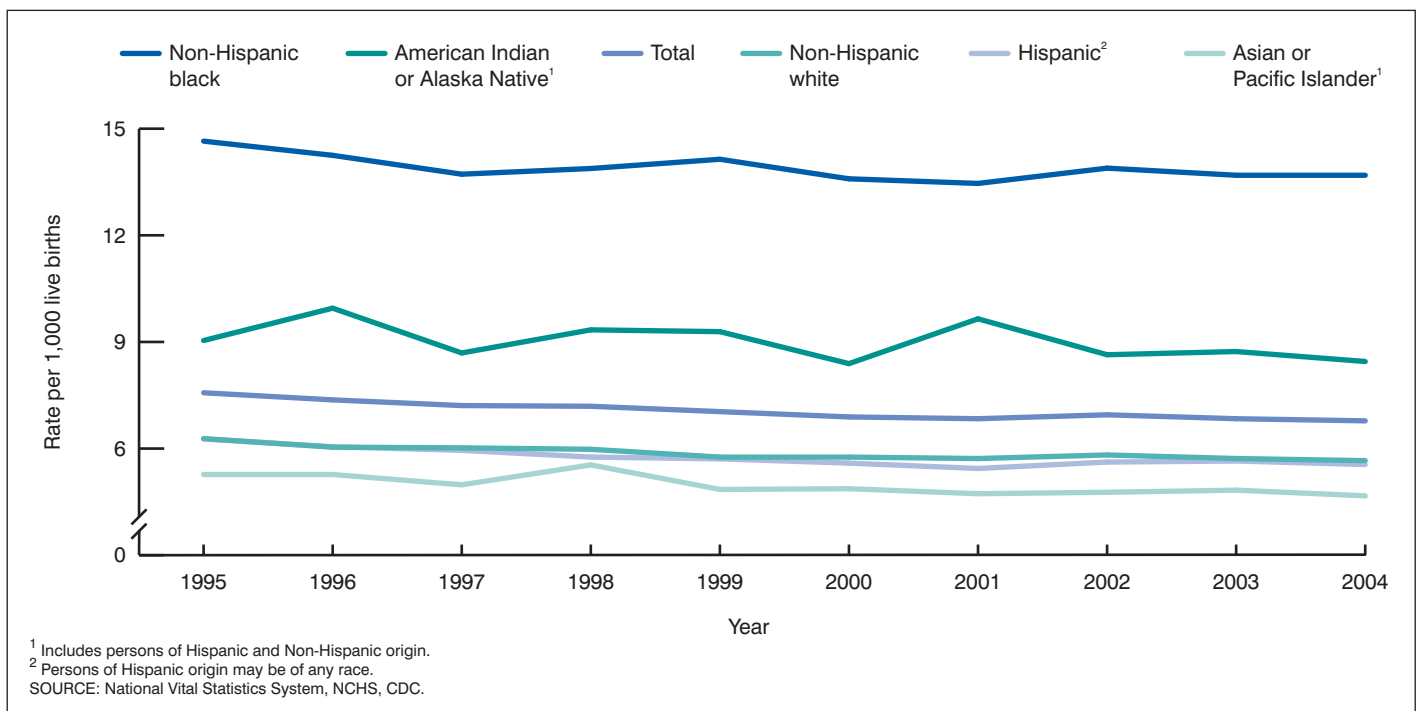


Figure 1. Infant mortality rates by race and ethnicity, 1995–2004

2 percent of infants born at less than 32 weeks of gestation. Still, infant mortality rates for late preterm (34–36 weeks of gestation) infants were three times those for term (37–41 week) infants. The three leading causes of infant death—Congenital malformations, low birthweight, and SIDS—taken together accounted for 45 percent all infant deaths. Results from a new analysis of preterm-related causes of death show that 36.5 percent of infant deaths in 2004 were due to preterm-related causes. The preterm-related infant mortality rate for non-Hispanic black mothers was 3.5 times higher, and the rate for Puerto Rican mothers was 75 percent higher than for non-Hispanic white mothers.

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

## Introduction

This report presents infant mortality data from the 2004 period linked file. In the linked file the information from the death certificate is linked to information from the birth certificate for each infant under 1 year of age who died in the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, or Guam during 2004. 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. 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 1–8, A–E, and Figures 1–4). Other variables available in the linked file data set (1), but which are not discussed in this report, include: father’s age, race, and Hispanic origin; birth attendant; place of delivery; mother’s weight gain during pregnancy; and many medical and health measurements. Several states have implemented the 2003 revised 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). They are not shown or discussed in the same detail as in previous years. Another report, based on data from the vital statistics mortality file, provides further information on trends in infant mortality and on causes of infant death (3). Some rates calculated from the mortality file differ from those published using the linked birth/infant death file (linked file). The linked file is used for analysis and for calculating infant mortality rates by race and ethnicity, which are more accurately measured from the birth certificate. A more detailed discussion of the differences in the number of infant deaths and infant mortality rates between the linked file and the mortality file is presented in the “Technical Notes.”

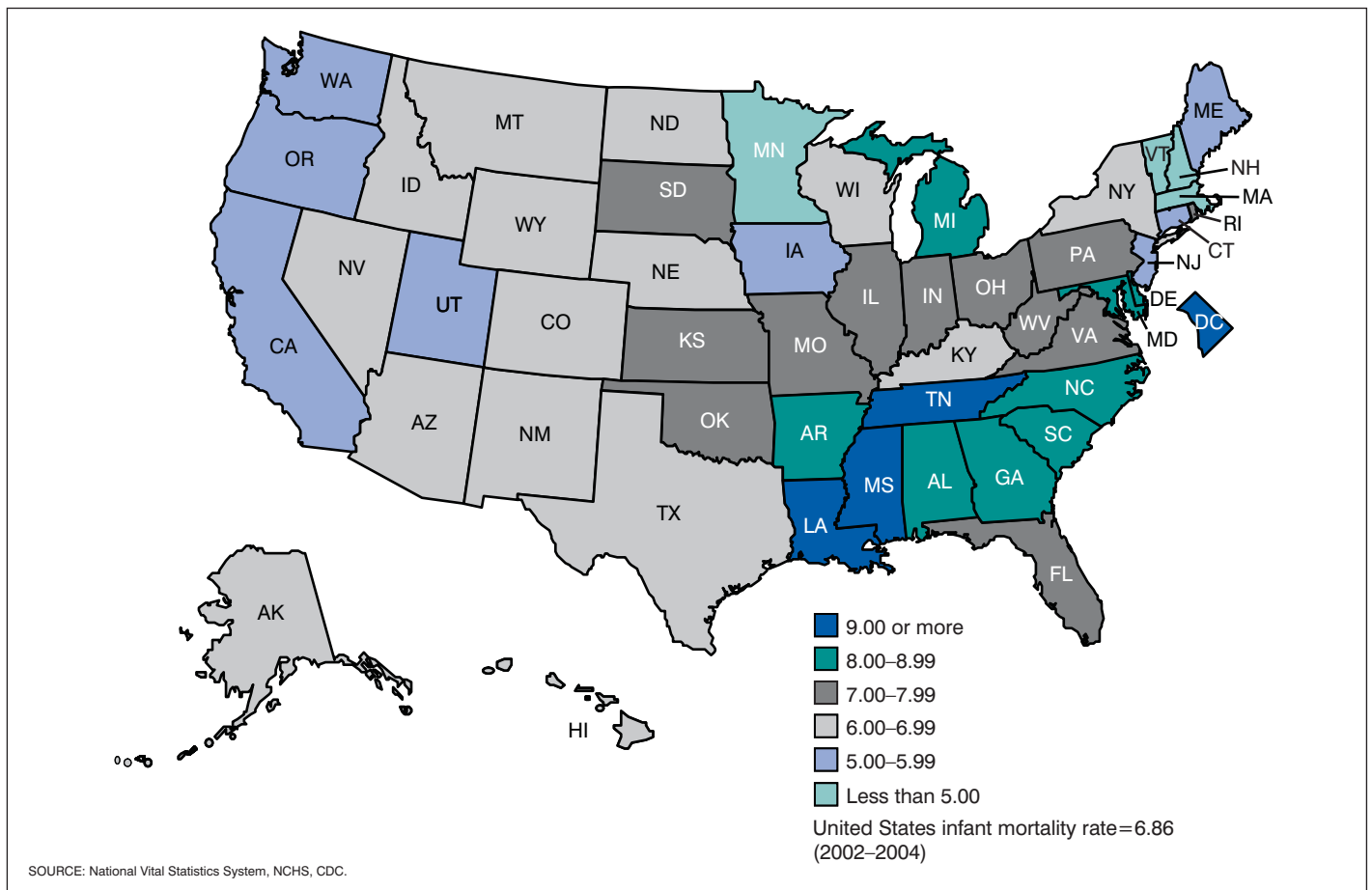


Figure 2. Infant mortality rates by state, 2002–2004

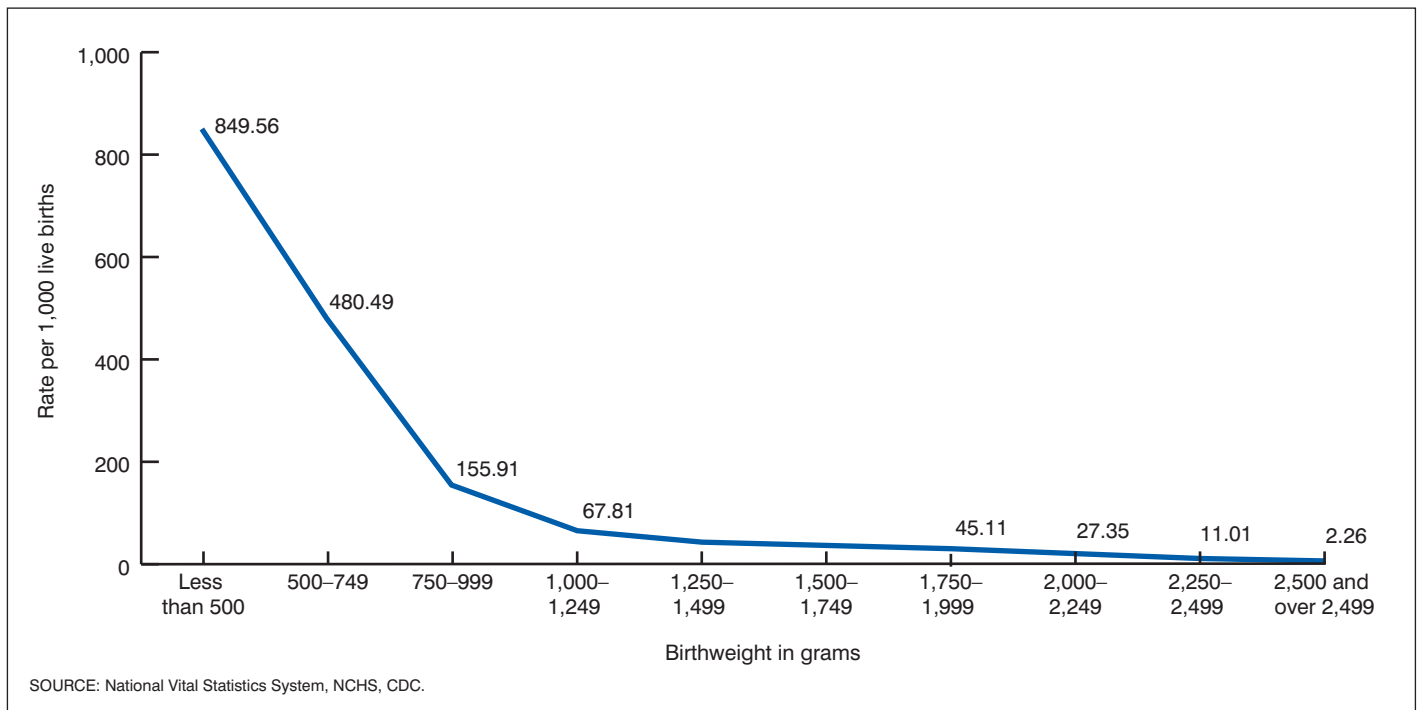


Figure 3. Infant mortality rates by birthweight: United States, 2004

## Methods

Data shown in this report are based on birth and infant death certificates registered in all states, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam. As part of the Vital Statistics Cooperative Program (VSCP), each state provided to the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS) matching birth and death certificate numbers for each infant under 1 year of age who died in the state during 2004. When the birth and death occurred in different states, the state of death was responsible for contacting the state of birth identified on the death certificate to obtain the original birth certificate number. NCHS used the matching birth and death certificate numbers provided by the states to extract final edited data from the NCHS natality and mortality statistical files. These data were linked to form a single statistical record, thereby establishing a national linked record file.

After the initial linkage, NCHS returned computer 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 2004, 98.9 percent of all infant death records were successfully matched to their corresponding birth records. Records were weighted to adjust for the 1.1 percent of infant death records that were not linked to their corresponding birth certificates (see the "Technical Notes").

Information on births by age, race, or marital status of mother is imputed if it is not reported on the birth certificate. These items were not reported for less than 1 percent of U.S. births in 2004 (2).

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 and Asian or Pacific Islander (API) births are not shown separately by Hispanic origin because the vast majority of these populations are non-Hispanic.

Starting with data year 1999 cause-of-death statistics in this and similar publications are classified in accordance with the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD-10) (4). Issues of this report for data years previous to 1999 included causes of death classified according to the *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Ninth Revision* (ICD-9) (5). Issues related to comparability between ICD revisions are discussed in the "Technical Notes." A new grouping of preterm-related causes of death was added to the report this year; see "Technical Notes."

This report includes data for seven states, Idaho, Kentucky, New York (but not New York City), Pennsylvania, South Carolina, Tennessee, and Washington, that implemented the 2003 revision of the U.S. Standard Certificate of Live Birth on either January 1, 2003, or January 1, 2004, (revised). Two additional States, Florida and New Hampshire, implemented the revision in 2004 but after January 1. The remaining reporting areas include data that are based on the 1989 revision of the U.S. Standard Certificate of Live Birth (unrevised). Revised and unrevised data are combined when comparable. See *Births: Final Data for 2004* for more information (2).

Data for educational attainment, prenatal care, and tobacco use, although collected on both the revised and unrevised certificates are not considered to be comparable between revisions. For educational attainment and prenatal care, unrevised data for 41 States, New York City, and the District of Columbia are included in this report. For tobacco use, unrevised data for 40 states, New York City, and the District of Columbia are included as California did not report tobacco use in 2004; see "Technical Notes."

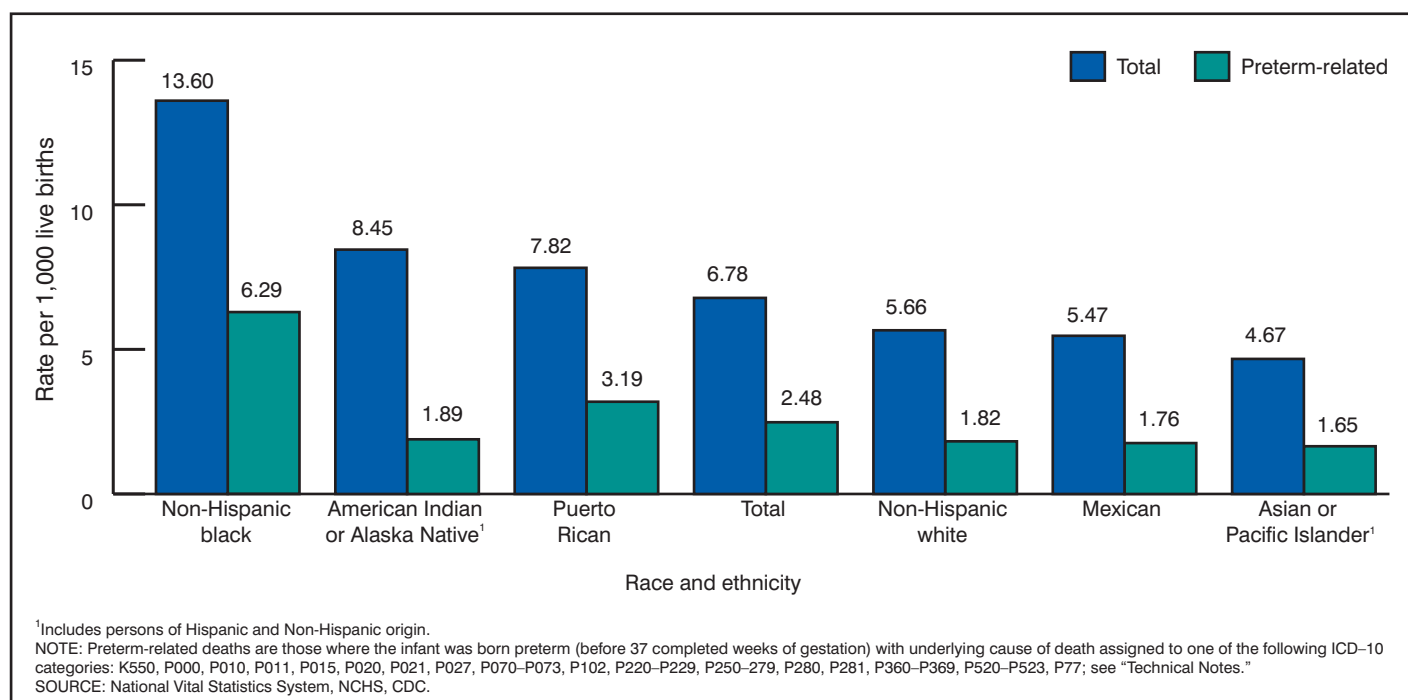


Figure 4. Total and preterm-related infant mortality rates by race and ethnicity of mother: United States, 2004

## Data by maternal and infant characteristics

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

**Race and Hispanic origin data**—Infant mortality rates are presented here by race and detailed Hispanic origin of mother. The linked file is particularly useful for computing accurate infant mortality rates for this purpose because the race and Hispanic origin of the mother from the birth certificate is 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 (1,6). Thus, standard infant mortality rates can be based on inconsistent race information. In addition, race information from the birth certificate reported by the mother is generally considered to be more reliable than that from the death certificate where the race and ethnicity of the deceased infant is reported by the funeral director based on information provided by an informant or on observation. These different reporting methods can lead to differences in race and ethnic specific infant mortality rates between the two data files (3,6).

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 (7). Information on this change is presented in a recent report (2). Fifteen states reported multiple race on their birth certificate for either part or all of 2004. To provide uniformity and comparability of the data, multiple race is imputed to a single race see "Technical Notes."

**Statistical significance**—Text statements have been tested for statistical significance, and a statement that a given infant mortality rate is higher or lower than another rate indicates that the rates are significantly different. Information on the methods used to test for statistical significance, as well as information on differences between period and cohort data, the weighting of the linked file, and a comparison of infant mortality data between the linked file and the vital statistics mortality file are presented in the "Technical Notes." Additional information on maternal age, marital status, period of gestation, birthweight, and cause-of-death classification is also presented in the "Technical Notes."

## Results and Discussion

### Trends in Infant mortality

The overall 2004 infant mortality rate from the linked file was 6.78 infant deaths per 1,000 live births, lower but not significantly than the rate in 2003 (6.84) but the lowest rate ever reported (Table C) (the overall rate in 2004 was 6.79 from the mortality file). Infant mortality rates for race and Hispanic origin groups were not significantly different in 2004 compared with 2003 (Figure 1 and Table C). The neonatal mortality rate declined from 4.63 in 2003 to 4.52 in 2004. The postneonatal mortality rate was essentially unchanged over the same time period.

Although the infant mortality rate was 10 percent lower in 2004 than in 1995 (7.57), the rate has not declined much since 2000 (6.89)

(Table C). During this 9-year period, decreases have been observed for all race and ethnic groups, although not all had significant declines. Significant declines were observed for infants of Central and South American (16 percent), Puerto Rican (12 percent), Asian or Pacific Islander (11 percent), non-Hispanic white (10 percent), Mexican (9 percent), and non-Hispanic black mothers (7 percent).

## Infant mortality by race and Hispanic origin of mother

As in past years, there continues to be a wide variation in infant mortality rates by race and Hispanic origin of mother (8). The highest rate, 13.60 per 1,000 live births, was for infants of non-Hispanic black mothers, nearly three times greater than the lowest rate of 4.55 for infants of Cuban mothers. Rates were also fairly high for infants of American Indian (8.45) and Puerto Rican (7.82) mothers (Tables A–C). Rates were intermediate, but all below the U.S. rate, for infants of non-Hispanic white (5.66) and Mexican mothers (5.47). Central and South American (4.65) and Asian or Pacific Islanders mothers (4.67) also had low rates (Tables A–C).

## Infant mortality by state

Between 2003 and 2004 an equal number of states had decreases and increases in the infant mortality rate, although almost all these changes were not statistically significant. One state had a significant increase, Louisiana (12 percent), and two, Hawaii and Michigan, had significant declines of 24 and 12 percent, respectively (detailed data not shown). To obtain statistically reliable rates by race and Hispanic origin, 3 years of data were combined (Figure 2 and Table 3). Infant mortality rates ranged from 10.32 for Mississippi to 4.68 for Vermont. The highest rate noted (11.42) was for the District of Columbia (DC); however, the rate for the District of Columbia is more appropriately compared with rates for other large U.S. cities, because of the high concentrations of high-risk women in these areas.

For infants of non-Hispanic black mothers, mortality rates ranged from 17.57 in Wisconsin to 8.75 in Minnesota. For infants of non-Hispanic white mothers, West Virginia had the highest infant mortality rate (7.67) and New Jersey had the lowest rate (3.80). The rate for DC was 3.76. For infants of American Indian and Asian or Pacific Islander mothers, mortality rates could be reliably computed for only 15 and 29 states, respectively.

For infants of American Indian mothers, mortality rates ranged from 13.51 in South Dakota to 6.29 in California. Overall, infant mortality rates for infants of Asian or Pacific Islander mothers were the lowest, ranging from 7.76 in South Carolina to 3.46 in Massachusetts.

## Sex of infant

In 2004, the overall infant mortality rate for female infants was 6.08 per 1,000, 18 percent lower than the rate for male infants (7.44). Infant mortality rates were higher for male than female infants in each race group (Table 1). Among Hispanics, this difference was not significant for infants of Central and South American mothers (Table 2).

## Multiple births

For multiple births, the infant mortality rate was 30.46, more than five times the rate of 5.94 for single births (Tables 1 and 2). Infant mortality rates for multiple births were higher than rates for single births for all race and Hispanic-origin groups, except for Cubans for whom rates could not be reliably computed due to small numbers of events.

The risk of infant death increases with the increasing number of infants in the pregnancy. In 2004, the infant mortality rate for twins (28.70) was nearly five times the rate for single births (5.94). The rate for triplets (55.53) was nine times, and the rate for quadruplets (166.74) was 28 times higher than the rate for single births (tabular data not shown). A reliable infant mortality rate for quintuplet and higher order births could not be computed due to small numbers of infant deaths for that category. Changes in infant mortality rates from 2003–2004 for specific plurality categories were not statistically significant.

Multiple pregnancy can lead to an accentuation of maternal risks and complications associated with pregnancy (2,9,10). For example, multiple births are much more likely to be born preterm and at low birthweight than single births (2,9,10). The higher risk profile of multiple births has a substantial impact on overall infant mortality (9,11,12). For example, in 2004 multiples accounted for 3 percent of all live births, but 15 percent of all infant deaths in the United States (Table 1).

## Age at death

In 2004, more than two-thirds of all infant deaths (18,602 out of 27,860) occurred during the neonatal period (from birth through 27 days of age). In 2004, the neonatal mortality rate of 4.52 deaths per 1,000 live births was more than 2 percent lower than the 2003 rate of 4.63. The 2004 postneonatal (28 days to under 1 year) mortality rate (2.25) was essentially unchanged from the previous year (2.22).

The neonatal mortality rate for infants of non-Hispanic black mothers (9.13) was more than twice those for non-Hispanic white (3.70), Asian or Pacific Islander (3.20), Mexican (3.74), Central and South American (3.43), and Cuban women (2.81). Neonatal mortality rates for Puerto Rican (5.34) and American Indian (4.26) women were intermediate between these two groups. Infants of non-Hispanic black and American Indian mothers had the highest postneonatal mortality rates of any group (4.47 and 4.19, respectively)—more than twice those for non-Hispanic white, Asian or Pacific Islander, Mexican, and Central and South American women. Postneonatal mortality rates were intermediate for Puerto Rican women (2.48) (Tables A and B).

## Birthweight and period of gestation

Birthweight and period of gestation are the two most important predictors of an infant's subsequent health and survival. Infants born too small and/or 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) or with birthweights of 2,500 grams or more (13–17).

Because of their much greater risk of death, infants born at the lowest birthweights and gestational ages have a large impact on overall U.S. infant mortality. For example, infants born weighing less than 1,000



**Table A. Infant, neonatal, and postneonatal deaths and mortality rates by race of mother: United States, 2004 linked file**

Race of mother	Live births	Number of deaths			Mortality rate per 1,000 live births		
		Infant	Neonatal	Postneonatal	Infant	Neonatal	Postneonatal
All races . . . . .	4,112,055	27,860	18,602	9,258	6.78	4.52	2.25
White . . . . .	3,222,929	18,257	12,178	6,080	5.66	3.78	1.89
Black . . . . .	616,076	8,162	5,505	2,657	13.25	8.94	4.31
American Indian <sup>1</sup> . . . . .	43,927	371	187	184	8.45	4.26	4.19
Asian or Pacific Islander . . . . .	229,123	1,070	733	337	4.67	3.20	1.47

<sup>1</sup>Includes Aleuts and Eskimos.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

**Table B. Infant, neonatal, and postneonatal deaths and mortality rates by Hispanic origin of mother and by race of mother for mothers of non-Hispanic origin: United States, 2004 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
All origins <sup>1</sup> . . . . .	4,112,055	27,860	18,602	9,258	6.78	4.52	2.25
Total Hispanic . . . . .	946,349	5,248	3,627	1,621	5.55	3.83	1.71
Mexican . . . . .	677,621	3,705	2,535	1,170	5.47	3.74	1.73
Puerto Rican . . . . .	61,221	479	327	152	7.82	5.34	2.48
Cuban . . . . .	14,943	68	42	26	4.55	2.81	1.74
Central and South American . . . . .	143,520	667	492	175	4.65	3.43	1.22
Other and unknown Hispanic . . . . .	49,044	330	232	98	6.73	4.73	2.00
Non-Hispanic total <sup>2</sup> . . . . .	3,133,128	22,203	14,633	7,570	7.09	4.67	2.42
Non-Hispanic white . . . . .	2,296,684	13,001	8,499	4,502	5.66	3.70	1.96
Non-Hispanic black . . . . .	578,774	7,869	5,283	2,586	13.60	9.13	4.47
Not stated . . . . .	32,578	409	341	68	...	...	...

... Category not applicable.

<sup>1</sup>Origin of mother not stated included in "All origins" but not distributed among origins.

<sup>2</sup>Includes races other than white or black.

NOTE: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race; see reference 2.

**Table C. Infant mortality rates by race and Hispanic origin of mother: United States, 1995–2004 linked files**

Race and Hispanic origin of mother	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Percent Change	
											1995 to 2004	2003 to 2004
All races . . . . .	7.57	7.30	7.21	7.19	7.04	6.89	6.84	6.95	6.84	6.78	-10.4**	-0.9
White . . . . .	6.30	6.07	6.05	5.96	5.79	5.71	5.69	5.79	5.72	5.66	-10.2**	-1.0
Black . . . . .	14.58	14.13	13.69	13.80	13.99	13.48	13.34	13.81	13.50	13.25	-9.1**	-1.9
American Indian <sup>1</sup> . . . . .	9.04	9.95	8.69	9.34	9.29	8.30	9.65	8.64	8.73	8.45	-6.5	-3.2
Asian or Pacific Islander . . . . .	5.27	5.20	4.98	5.54	4.85	4.87	4.73	4.77	4.83	4.67	-11.4**	-3.3
Hispanic . . . . .	6.27	6.05	5.95	5.76	5.71	5.59	5.44	5.62	5.65	5.55	-11.5**	-1.8
Mexican . . . . .	6.03	5.84	5.83	5.60	5.51	5.43	5.22	5.42	5.49	5.47	-9.3**	-0.4
Puerto Rican . . . . .	8.88	8.60	7.86	7.78	8.35	8.21	8.53	8.20	8.18	7.82	-11.9**	-4.4
Cuban . . . . .	5.29	5.07	5.51	3.63	4.66	4.54	4.28	3.72	4.57	4.55	-14.0	-0.4
Central and South American . . . . .	5.52	5.02	5.45	5.28	4.68	4.64	4.98	5.06	5.04	4.65	-15.8**	-7.7
Non-Hispanic white . . . . .	6.28	6.04	6.02	5.98	5.76	5.70	5.72	5.80	5.70	5.66	-9.9**	-0.7
Non-Hispanic black . . . . .	14.65	14.20	13.72	13.88	14.14	13.59	13.46	13.89	13.60	13.60	-7.2**	0.0

\*\* Significant at  $p < .05$ .

<sup>1</sup>Includes Aleuts and Eskimos.

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. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

grams accounted for only 0.8 percent of births, but nearly one-half (48.4 percent) of all infant deaths in the United States in 2004 (Table D). Conversely, 91.9 percent of infants born in the United States in 2004 weighed 2,500 grams or more, but these infants accounted for only 30.7 percent of infant deaths. A similar pattern is found when data by period of gestation were examined. Births at less than 28 weeks of gestation accounted for 0.8 percent of all live births, and 46.3 percent of all infant deaths in the United States in 2004 (tabular data not shown).

The percent of preterm and low birthweight births has been increasing steadily since the mid-1980s (2). A portion of the increase is related to an increase in multiple births (in part due to increases in the use of assisted reproductive therapies (ART)), and to changes in the medical management of pregnancy (i.e., increases in cesarean section and induction of labor for preterm infants) (2, 18–20).

The percentage of infants born at low birthweight (less than 2,500 grams) varied greatly by race and ethnicity, from a low of 6.5 percent for births to Mexican mothers to a high of 13.8 percent for births to non-Hispanic black mothers (Tables 4 and 5). The percent of preterm births (those born before 37 completed weeks of gestation) ranged from 10.5 percent for births to Asian or Pacific Islander mothers to 17.9 percent for births to non-Hispanic black mothers. These differences in low birthweight and preterm births in turn are major factors in the differences in infant mortality rates.

For all race and ethnic groups studied, infant mortality rates were much higher for low birthweight infants (57.64) than for infants with birthweights of 2,500 grams or more (2.26). Overall, the infant mortality rate for very low birthweight infants (those with birthweights of less than 1,500 grams) was 244.50, more than 100 times the rate for infants with birthweights of 2,500 grams or more (Table 6). At least 85 percent of infants with birthweights of less than 500 grams (1 lb. 1 oz. or less) died within the first year of life (Figure 3 and Table 6). Reporting of deaths among these very small infants may be incomplete (data not shown). An infant's chances of survival increase rapidly with increasing birthweight. Infant mortality rates were lowest at birthweights of 3,000–4,999 grams (Table 6).

The infant mortality rate for very low birthweight infants declined by 3 percent from 252.00 in 2003 to 244.50 in 2004. Previously, the infant mortality rate for very low birthweight infants had increased from 2000–2003. The rate in 2004 was similar to the rate in 2000 and 2001. The percentage of live births born at very low birthweight has been edging upwards, from 1.45 percent of live births in 2000 to 1.51 percent of births in 2004, as has the percentage of infant deaths (from 52.1 percent in 2000 to 54.4 percent in 2004) (Table D). Trends in birthweight specific infant mortality rates for the period 1995 to 2004 are shown in Table 6. Overall rates have generally declined during this period; declines were larger for higher birthweights. For the total population, non-Hispanic white, non-Hispanic black, and Hispanic mothers, declines were generally largest for infants weighing 2,500–4,499 grams (Table 6).

In 2004, the infant mortality rate for very preterm infants (less than 32 weeks of gestation) was 182.45, 76 times the rate of 2.39 for term infants (Tables 1 and 2). The infant mortality rate for very preterm infants declined by 3 percent from 188.24 in 2003. Previously, the infant mortality rate for very preterm infants had increased by 4 percent from 180.95 in 2000 (12). Although the highest risk of death is found for the most preterm infants, infants born shortly before term (at 34–36 weeks of gestation) have mortality rates three times those for term infants (37–41 weeks). Even within the term period, infants born at 37–39

weeks of gestation have mortality rates 30 percent higher than those born at 40–41 weeks of gestation.

## Prenatal care

This report includes data on the timing of prenatal care based on the 1989 Revision of the U.S. Standard Certificate of Live Birth (unrevised data) as reported by 41 States, New York City, and the District of Columbia; see “Technical Notes.”

Although difficult to measure, the timing and quality of prenatal care received by the mother during pregnancy can be important to the infant's subsequent health and survival (21–24). Early comprehensive prenatal care can promote healthier pregnancies by providing health behavior advice, early detection and treatment of risk factors and symptoms, and monitoring (21,22). The initiation and subsequent utilization of prenatal care is also viewed as an indicator for access to care (24).

In 2004, for the 41-state reporting area for which comparable data are available, the mortality rate for infants of mothers who began prenatal care after the first trimester of pregnancy or had no care at all, was 8.35 per 1,000 (Table E). This rate was 37 percent higher than the rate for infants of mothers whose care began in the first trimester (6.11).

## Maternal age

Infant mortality rates vary with maternal age; infants of teenage mothers and mothers aged 40 and over have the highest rates (9.75 and 8.81, respectively). The lowest rates are for infants of mothers in their late twenties and early thirties (Tables 1 and 2).

In 2004, among births to teenagers, infants of the youngest mothers (under 15 years) had the highest rate (17.11). The rate for infants of mothers aged 15–17 years was 10.37; the rate for infants of mothers aged 18–19 years was 9.28 (tabular data not shown).

Within racial and ethnic subgroups, among groups for which rates could be reliably computed, infant mortality rates for births to non-Hispanic white mothers under 20 years of age were higher than for mothers aged 40 and over. In contrast, for Mexican mothers, rates for births to the oldest mothers were higher than rates for infants of teenagers.

Studies suggest that the higher mortality risk for infants of younger mothers may be related to socioeconomic factors as well as biologic immaturity (25); young maternal age might be a marker for poverty (26). Among older mothers, especially for those having a first-time birth, infants are at an increased risk of prematurity and low birthweight and thus tend to have higher infant mortality rates (27). Multiple births are also a well known risk factor for infant mortality in older mothers (2).

## Maternal education

Information on educational attainment is reported on both the 2003 Standard Certificate of Live Birth (revised) and 1989 Standard Certificate of Live Birth (unrevised) (2). However, the format of the education item on the revised standard certificate substantively differs from that of the unrevised standard certificate leading to non-comparable data (see “Technical Notes”). For 2004, unrevised data are available for 41 states, New York City, and the District of Columbia (80 percent of all 2004 births).

**Table D. Selected perinatal events by birthweight: United States, 1999–2004 linked files**

Year	Low birthweight											
	Total	Very low birthweight						Moderately low birthweight				
		Total low birthweight	Total very low birthweight	Less than 500 grams	500–749 grams	750–999 grams	1,000–1,249 grams	1,250–1,499 grams	Total moderately low birthweight	1,500–1,999 grams	2,000–2,499 grams	2,500 grams or more
Infant mortality rate <sup>1</sup>												
2004.	6.78	57.64	244.50	849.56	480.49	155.91	67.81	45.11	14.97	27.35	11.01	2.26
2003.	6.84	59.04	252.00	865.44	476.68	163.72	69.31	46.03	14.99	27.88	10.90	2.29
2002.	6.95	59.54	250.75	861.95	489.64	155.13	70.30	45.69	15.15	26.51	11.53	2.39
2001.	6.84	58.60	244.37	855.04	476.76	154.13	73.75	45.64	15.16	27.24	11.29	2.42
2000.	6.89	59.40	244.26	846.08	476.25	155.84	77.35	45.59	15.78	28.28	11.74	2.47
1999.	7.04	60.48	246.96	855.97	485.45	151.56	69.85	48.73	15.96	28.76	11.82	2.52
Number of infant deaths <sup>2</sup>												
2004.	27,860	19,218	15,155	5,907	5,602	1,921	966	758	4,064	1,800	2,264	8,528
2003.	27,995	19,223	15,247	6,110	5,489	1,947	945	755	3,975	1,781	2,194	8,603
2002.	27,970	18,758	14,885	5,844	5,528	1,831	956	726	3,873	1,636	2,237	8,840
2001.	27,523	18,151	14,345	5,515	5,283	1,826	1,001	719	3,806	1,658	2,148	8,989
2000.	27,960	18,299	14,365	5,420	5,325	1,861	1,033	726	3,933	1,721	2,212	9,259
1999.	27,864	18,273	14,380	5,408	5,507	1,779	930	756	3,893	1,714	2,179	9,197
Percent distribution of infant deaths <sup>3</sup>												
2004.	100.0	68.98	54.40	21.20	20.11	6.90	3.47	2.72	14.59	6.46	8.13	30.61
2003.	100.0	68.67	54.46	21.83	19.61	6.95	3.38	2.70	14.20	6.36	7.84	30.73
2002.	100.0	67.97	53.93	21.17	20.03	6.63	3.46	2.63	14.03	5.93	8.11	32.03
2001.	100.0	66.88	52.86	20.32	19.47	6.73	3.69	2.65	14.02	6.11	7.91	33.12
2000.	100.0	66.40	52.13	19.67	19.32	6.75	3.75	2.63	14.27	6.25	8.03	33.60
1999.	100.0	66.52	52.35	19.69	20.05	6.48	3.39	2.75	14.17	6.24	7.93	33.48
Number of births <sup>2</sup>												
2004.	4,112,055	333,427	61,983	6,953	11,659	12,321	14,245	16,805	271,444	65,821	205,623	3,778,051
2003.	4,090,007	325,619	60,505	7,060	11,515	11,892	13,635	16,403	265,114	63,891	201,223	3,763,758
2002.	4,021,825	315,028	59,361	6,780	11,290	11,803	13,599	15,889	255,667	61,705	193,962	3,705,556
2001.	4,026,036	309,760	58,702	6,450	11,081	11,847	13,572	15,752	251,058	60,858	190,200	3,714,965
2000.	4,058,882	308,074	58,810	6,406	11,181	11,942	13,355	15,926	249,264	60,864	188,400	3,748,046
1999.	3,959,417	302,113	58,227	6,318	11,344	11,738	13,314	15,513	243,886	59,599	184,287	3,654,764
Percent distribution of births <sup>3</sup>												
2004.	100.0	8.11	1.51	0.17	0.28	0.30	0.35	0.41	6.60	1.60	5.00	91.88
2003.	100.0	7.96	1.48	0.17	0.28	0.29	0.33	0.40	6.48	1.56	4.92	92.02
2002.	100.0	7.84	1.48	0.17	0.28	0.29	0.34	0.40	6.36	1.53	4.82	92.16
2001.	100.0	7.70	1.46	0.16	0.28	0.29	0.34	0.39	6.24	1.51	4.73	92.30
2000.	100.0	7.60	1.45	0.16	0.28	0.29	0.33	0.39	6.15	1.50	4.64	92.40
1999.	100.0	7.64	1.47	0.16	0.29	0.30	0.34	0.39	6.16	1.51	4.66	92.36

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

<sup>2</sup>Infant deaths and births with not stated birthweight included in totals.

<sup>3</sup>Infant deaths and births with not stated birthweight are subtracted from the total number of events used as denominators for percentage computations.



For the 41-state reporting area described previously, the infant mortality rate for mothers who completed 16 or more years of school was 4.17 in 2004. This rate was 49 percent lower than the rate for mothers who completed less than 12 years of education (8.12) (Table E).

Infant mortality rates generally decreased with increasing educational level. This pattern may reflect the effects of more education as well as socioeconomic differences; women with more education tend to have higher income levels (28).

## Live birth order

Infant mortality rates were generally higher for first births than for second births, and then generally increased as birth order increased (Tables 1 and 2). Overall, the infant mortality rate for first births (6.74) was 13 percent higher than for second births (5.99). The rate for fifth and higher order births (10.64) was 72 percent higher than the rate for second births. The higher parities and therefore the highest order births (5th child and above) are more likely to be associated with older maternal age, multiple births, and lower socioeconomic status (2,29).

## Marital status

Marital status may be a marker for the presence or absence of social, emotional, and financial resources (30, 31). Infants of mothers who are not married have been shown to be at higher risk for poor outcomes (32,33). In 2004, infants of married mothers had an infant mortality rate of 5.30 per 1,000, 44 percent lower than the rate for infants of unmarried mothers (9.43) (Tables 1 and 2). Within each race and Hispanic origin group, infants of unmarried mothers had higher rates of mortality and with the exception of Cuban and Central and South American infants, these differences were significant.

## Nativity

In 2004 the infant mortality rate for mothers born in the 50 states and the District of Columbia (7.14) was 39 percent higher than the rate for mothers born elsewhere (5.12). Among race and Hispanic origin groups for whom infant mortality rates could be calculated all had higher infant mortality rates for mothers born in the 50 states and the District of Columbia (the difference was not significant for Puerto Rican, Cuban, and Central and South American mothers—the latter two have almost no difference) (Tables 1 and 2).

A variety of different hypotheses have been advanced to account for the lower infant mortality rate among infants of mothers born outside the 50 states and the District of Columbia, including possible differences in migration selectivity, social support, and risk behaviors (34). Also, women born outside the 50 states and the District of Columbia have been shown to have different characteristics than their U.S. born counterparts with regard to socioeconomic and educational status (35).

## Maternal smoking

Data on maternal smoking during pregnancy are shown for 40 states, New York City, and the District of Columbia (unrevised data); see “Technical Notes.” For this area, the infant mortality rate for

infants of mothers who smoked was 11.14, 70 percent higher than the rate of 6.54 for nonsmokers (Table E).

Tobacco use during pregnancy causes the passage of substances such as nicotine, hydrogen cyanide, and carbon monoxide from the placenta into the fetal blood supply. These substances restrict the growing infant’s access to oxygen and can lead to adverse pregnancy and birth outcomes such as low birthweight, preterm delivery, intrauterine growth retardation, and infant mortality (36,37). Maternal smoking has also been shown to increase the risk of respiratory infections and inhibit allergic immune responses in infants (38,39).

## Leading causes of infant death

Infant mortality rates for the five leading causes of infant death are presented in Table 7 by race and Hispanic origin of mother. The leading cause of infant death in the United States in 2004 was Congenital malformations, deformations and chromosomal abnormalities (congenital malformations), accounting for 20 percent of all infant deaths. Disorders relating to short gestation and low birthweight, not elsewhere classified (low birthweight) was second, accounting for 17 percent of all infant deaths, followed by Sudden infant death syndrome (SIDS) accounting for 8 percent of infant deaths. The fourth and fifth leading causes—Newborn affected by maternal complications of pregnancy (maternal complications), and Accidents (unintentional injuries), accounted for 6 and 4 percent, respectively, of all infant deaths in 2004. Together the five leading causes accounted for 55 percent of all infant deaths in the United States in 2003. The order of the top four leading causes was the same as in 2003. The fifth leading cause of death in 2004 was unintentional injuries, which was ranked sixth in 2003. Complications of placenta, cord and membranes (cord complications) was the fifth leading cause in 2003, but dropped to sixth in 2004.

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.

Infant mortality rates for Congenital malformations, SIDS, and maternal complications were basically unchanged from 2003–2004. The rate for low birthweight decreased by 5 percent, while the rate for unintentional injuries increased by 11 percent from 2003 to 2004. Much of the increase for unintentional injuries was in the accidental suffocation subcategories, although changes in reporting might have also had an impact on these categories (40–42).

When examined by race and ethnicity, none of the race and ethnic groups shown in Table 7 had significant changes in cause-specific infant mortality rates from 2003–2004, except for unintentional injuries, which increased for infants of Mexican mothers, although their rates were still substantially lower than those for non-Hispanic white women.

When differences between cause-specific infant mortality rates were examined by race and ethnicity, infant mortality rates from Congenital malformations were 30 percent higher for non-Hispanic black, 57 percent higher for American Indian, and 11 percent higher for Mexican than for non-Hispanic white women, while the rate for Asian or Pacific Islander women was 19 percent lower.

Infants of non-Hispanic black mothers had the highest mortality rates from low birthweight. The rate for non-Hispanic black mothers was

**Table E. Infant mortality rates for trimester of pregnancy prenatal care began, smoking status during pregnancy, and education of mother: 41 states, the District of Columbia, and New York City for 2003 and 2004**

Characteristic	2004	2003
Prenatal care:		
Prenatal care beginning in the 1st trimester . . . . .	6.11	6.13
Prenatal care beginning after the 1st trimester or no care . . . . .	8.35	8.67
Prenatal care beginning in the 2nd or 3rd trimester . . . . .	6.62	7.01
No prenatal care . . . . .	33.68	33.15
Smoking status: <sup>1</sup>		
Smoker . . . . .	10.95	11.14
Nonsmoker . . . . .	6.47	6.54
Education of mother:		
0–11 years . . . . .	8.12	8.36
12 years . . . . .	7.55	7.58
13–15 years . . . . .	6.21	6.19
16 or more years . . . . .	4.17	4.23

<sup>1</sup>Excludes data for California, which did not report smoking status on the birth certificate.

NOTE: Data are based on the 1989 Revision of the U.S. Standard Certificate of Live Birth and exclude data from Florida, Idaho, Kentucky, New Hampshire, New York State, (excluding New York City), Pennsylvania, South Carolina, Tennessee and Washington.

nearly four times the rate for non-Hispanic white mothers. The rate for Puerto Rican mothers was nearly double the rate for non-Hispanic white mothers.

SIDS rates were highest for non-Hispanic black and American Indian mothers—2.1 and 1.9 times those for non-Hispanic white mothers, respectively. As most SIDS deaths occur during the post-neonatal period, the high SIDS rates for infants of non-Hispanic black and American Indian mothers accounted for much of their elevated risk of postneonatal mortality. Compared with non-Hispanic white mothers, SIDS rates were 49 percent lower for Asian or Pacific Islander mothers, 51 percent lower for Mexican mothers, and 70 percent lower for Central and South American mothers.

For maternal complications (which include incompetent cervix, premature rupture of membranes, and multiple pregnancy, for example), infants of non-Hispanic black mothers had the highest mortality rates—3.2 times those for non-Hispanic white mothers. The higher percent of non-Hispanic black infants born at low birthweight may help to explain their higher infant mortality rates from these causes, which occur predominantly among low birthweight infants. Infant mortality rates from maternal complications were 23 percent lower for Mexican than for non-Hispanic white women.

Compared with non-Hispanic white women, infant mortality rates from unintentional injuries were 87 percent and 83 percent higher for American Indian and non-Hispanic black women, respectively, while infant mortality rates from unintentional injuries were 44 percent and 36 percent lower for Asian or Pacific Islander and Mexican women, respectively.

An examination of cause-specific differences in infant mortality rates among race and Hispanic origin groups can help the researcher to understand overall differences in infant mortality rates among these groups. For example, 28 percent of the elevated infant mortality rate for non-Hispanic black mothers, when compared with non-Hispanic white mothers, can be accounted for by their higher rate from low birthweight, 9 percent by differences in maternal complications, and 7 percent by differences in SIDS. In other words, if non-Hispanic black infant mortality rates for these three causes could be reduced to the levels for non-Hispanic white infants, the difference in the infant

mortality rate between non-Hispanic black and non-Hispanic white mothers would be reduced by 44 percent.

For American Indian mothers, 26 percent of their elevated infant mortality rate, when compared with non-Hispanic white mothers, can be accounted for by their higher rate of Congenital malformations, 17 percent by differences in SIDS, and 8 percent by differences in unintentional injuries. Thus, if American Indian infant mortality rates for these three causes could be reduced to non-Hispanic white levels, the difference in the infant mortality rate between American Indian and non-Hispanic white mothers would be reduced by 51 percent.

Similarly, 35 percent of the difference between Puerto Rican and non-Hispanic white infant mortality rates can be accounted for by differences in low birthweight. Thus, if Puerto Rican infant mortality from low birthweight could be reduced to non-Hispanic white levels, the difference in the infant mortality rate between Puerto Rican and non-Hispanic white infants would be reduced by 35 percent. In addition to helping to explain differences in infant mortality rates between various groups, comparisons such as these can be helpful in targeting prevention efforts.

## Preterm-related causes of death

A new table has been added to this report to monitor infant mortality for preterm-related causes of death (Table 8). It is difficult, using traditional analyses of the leading causes of infant death, to assess the overall impact of preterm related infant deaths on infant mortality. In particular, the category “Disorders related to short gestation and low birthweight, not elsewhere classified” includes the phrase “not elsewhere classified” thereby indicating that many other preterm-related infant deaths are classified to other ICD categories. In 2006, CDC authors published an article that attempted to capture this impact by examining the 20 leading causes of infant death and identifying and grouping together causes with a direct, etiological connection to preterm birth (43). For an underlying cause of death to be considered preterm-related, 75 percent or more of infants whose deaths were attributed to that cause had to be born at less than 37

weeks of gestation, and the cause of death had to be a direct consequence of preterm birth based on a clinical evaluation and review of the literature (43).

For the purposes of this report, the previous analysis was extended by examining all of the remaining categories of infant death (outside of the 20 leading causes) to develop a comprehensive list of preterm-related causes of death. The comprehensive list of preterm-related ICD codes is shown in [Table 8](#). Please note that even this more comprehensive listing is probably an underestimate of the total impact of preterm-related infant death, as some ICD categories (notably those beginning with the words “Other” and “All other”) had a high percentage of preterm infant deaths but lacked sufficient specificity to be able to establish the etiologic connection to prematurity with any degree of certainty.

[Table 8](#) shows trends in preterm-related infant mortality by race and Hispanic origin of mother from 1999 (the first year that ICD-10 was implemented in the United States) to 2004. In 2004, 36.5 percent of all infant deaths in the United States were preterm related. Preterm-related infant deaths accounted for 10,180 of the total of 27,860 infant deaths that year. In 1999, 35.4 percent of all infant deaths in the United States were preterm-related.

The impact of preterm-related infant deaths varied considerably by maternal race and ethnicity. In 2004, nearly one-half (46 percent) of infant deaths to non-Hispanic black women, and 41 percent of infant deaths to Puerto Rican women were due to preterm-related causes, while the percentage was somewhat lower for other race and ethnic groups ([Table 8](#)).

Preterm-related infant mortality rates varied considerably by race and ethnicity of the mother ([Figure 4](#) and [Table 8](#)). Preterm-related infant mortality rates were 3.5 times higher for non-Hispanic black (6.29) than for non-Hispanic white (1.82) mothers. It is important to note that, in 2004, the preterm-related infant mortality rate for non-Hispanic black mothers was higher than the total infant mortality rate for non-Hispanic white, Mexican, and Asian or Pacific Islander women. The preterm-related infant mortality rate for Puerto Rican (3.19) mothers was 75 percent higher than for non-Hispanic white mothers. Preterm-related infant mortality rates for American Indian (1.89), Mexican (1.76), and Asian or Pacific Islander (1.65) women were not significantly different from those for non-Hispanic white women.

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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 race of mother: United States, 2004 linked file**

Characteristics	All races	Race of mother			
		White	Black	American Indian <sup>1</sup>	Asian or Pacific Islander
Infant mortality rates per 1,000 live births in specified group					
Total . . . . .	6.78	5.66	13.25	8.45	4.67
Age at death:					
Total neonatal . . . . .	4.52	3.78	8.94	4.26	3.20
Early neonatal (less than 7 days) . . . . .	3.61	3.00	7.16	3.39	2.62
Late neonatal (7–27 days) . . . . .	0.92	0.78	1.77	0.87	0.58
Postneonatal . . . . .	2.25	1.89	4.31	4.19	1.47
Sex:					
Male . . . . .	7.44	6.23	14.59	9.51	4.95
Female . . . . .	6.08	5.08	11.85	7.30	4.37
Plurality:					
Single births . . . . .	5.94	4.96	11.67	7.68	4.14
Plural births . . . . .	30.46	25.77	55.35	37.00	23.13
Birthweight:					
Less than 2,500 grams . . . . .	57.64	52.32	75.57	58.57	42.26
Less than 1,500 grams . . . . .	244.50	231.92	273.97	216.87	222.73
1,500–2,499 grams . . . . .	14.97	14.93	15.55	24.69	11.37
2,500 grams or more . . . . .	2.26	2.08	3.45	4.38	1.42
Period of gestation:					
Less than 32 weeks . . . . .	182.45	168.40	216.28	139.21	173.24
32–33 weeks . . . . .	16.06	15.52	17.37	24.45	15.90
34–36 weeks . . . . .	7.32	6.83	9.19	13.61	5.85
37–41 weeks . . . . .	2.39	2.19	3.71	4.23	1.56
37–39 weeks . . . . .	2.61	2.40	3.93	4.49	1.75
40–41 weeks . . . . .	2.00	1.82	3.28	3.77	1.20
42 weeks or more . . . . .	2.87	2.68	4.19	*	1.76
Age of mother:					
Under 20 years . . . . .	9.75	8.31	13.90	8.80	9.84
20–24 years . . . . .	7.69	6.45	12.81	8.86	5.51
25–29 years . . . . .	5.95	4.89	12.89	7.74	4.32
30–34 years . . . . .	5.47	4.62	13.30	7.86	3.90
35–39 years . . . . .	6.24	5.43	13.85	7.35	4.38
40–54 years . . . . .	8.81	7.72	16.14	*	8.29
Live-birth order:					
1 . . . . .	6.74	5.69	13.41	7.07	4.69
2 . . . . .	5.99	5.06	11.94	8.47	4.49
3 . . . . .	6.48	5.52	11.82	6.75	4.58
4 . . . . .	8.17	6.59	14.89	12.83	4.34
5 or more . . . . .	10.64	8.38	17.79	11.16	7.03
Marital status:					
Married . . . . .	5.30	4.86	11.26	6.71	4.28
Unmarried . . . . .	9.43	7.49	14.15	9.50	6.78
Mother's place of birth:					
Born in the 50 states and DC . . . . .	7.14	5.76	13.77	8.58	5.94
Born elsewhere . . . . .	5.12	4.88	8.50	*	4.33

See footnotes at end of table.

**Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and race of mother: United States, 2004 linked file—Con.**

Characteristics	All races	Race of mother			
		White	Black	American Indian <sup>1</sup>	Asian or Pacific Islander
		Live births			
Total . . . . .	4,112,055	3,222,929	616,076	43,927	229,123
Sex:					
Male . . . . .	2,104,663	1,650,698	313,897	22,293	117,775
Female . . . . .	2,007,392	1,572,231	302,179	21,634	111,348
Plurality:					
Single births . . . . .	3,972,560	3,113,164	593,853	42,819	222,724
Plural births . . . . .	139,495	109,765	22,223	1,108	6,399
Birthweight:					
Less than 2,500 grams . . . . .	333,427	228,756	83,252	3,295	18,124
Less than 1,500 grams . . . . .	61,983	39,419	19,334	581	2,649
1,500–2,499 grams . . . . .	271,444	189,337	63,918	2,714	15,475
2,500 grams or more . . . . .	3,778,051	2,993,755	532,699	40,622	210,975
Not stated . . . . .	577	418	125	10	24
Period of gestation:					
Less than 32 weeks . . . . .	81,648	53,140	24,219	941	3,348
32–33 weeks . . . . .	64,766	46,258	14,734	818	2,956
34–36 weeks . . . . .	361,945	271,250	69,074	4,189	17,432
37–41 weeks . . . . .	3,308,179	2,617,214	467,851	34,291	188,823
37–39 weeks . . . . .	2,130,486	1,674,287	310,684	21,811	123,704
40–41 weeks . . . . .	1,177,693	942,927	157,167	12,480	65,119
42 weeks or more . . . . .	252,543	200,659	36,068	3,312	12,504
Not stated . . . . .	42,974	34,408	4,130	376	4,060
Age of mother:					
Under 20 years . . . . .	422,043	300,858	105,620	7,843	7,722
20–24 years . . . . .	1,034,455	788,264	200,399	15,130	30,662
25–29 years . . . . .	1,104,486	880,871	147,858	10,717	65,040
30–34 years . . . . .	965,663	780,368	99,083	6,488	79,724
35–39 years . . . . .	475,607	384,917	50,044	2,994	37,652
40–54 years . . . . .	109,801	87,651	13,072	755	8,323
Live-birth order:					
1 . . . . .	1,630,923	1,276,937	233,028	15,270	105,688
2 . . . . .	1,319,426	1,050,100	177,850	12,036	79,440
3 . . . . .	693,933	549,428	108,509	7,849	28,147
4 . . . . .	273,589	209,194	51,113	4,287	8,995
5 or more . . . . .	175,551	124,065	41,585	4,213	5,688
Not stated . . . . .	18,633	13,205	3,991	272	1,165
Marital status:					
Married . . . . .	2,641,864	2,239,470	192,124	16,551	193,719
Unmarried . . . . .	1,470,191	983,459	423,952	27,376	35,404
Mother's place of birth:					
Born in the 50 states and DC . . . . .	3,103,356	2,506,578	515,905	41,470	39,403
Born elsewhere . . . . .	992,227	706,019	95,413	2,317	188,478
Not stated . . . . .	16,472	10,332	4,758	140	1,242

See footnotes at end of table.

**Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and race of mother: United States, 2004 linked file—Con.**

Characteristics	All races	Race of mother			
		White	Black	American Indian <sup>1</sup>	Asian or Pacific Islander
		Infant deaths			
Total	27,860	18,257	8,162	371	1,070
Age at death:					
Total neonatal	18,602	12,178	5,505	187	733
Early neonatal (less than 7 days)	14,836	9,674	4,413	149	601
Late neonatal (7–27 days)	3,766	2,504	1,092	38	132
Postneonatal	9,258	6,080	2,657	184	337
Sex:					
Male	15,653	10,277	4,581	212	583
Female	12,207	7,981	3,581	158	487
Plurality:					
Single births	23,611	15,428	6,932	329	922
Plural births	4,249	2,829	1,230	41	148
Birthweight:					
Less than 2,500 grams	19,218	11,968	6,291	193	766
Less than 1,500 grams	15,155	9,142	5,297	126	590
1,500–2,499 grams	4,064	2,826	994	67	176
2,500 grams or more	8,528	6,213	1,839	178	299
Not stated	113	77	32	–	4
Period of gestation:					
Less than 32 weeks	14,897	8,949	5,238	131	580
32–33 weeks	1,040	718	256	20	47
34–36 weeks	2,648	1,853	635	57	102
37–41 weeks	7,918	5,741	1,737	145	294
37–39 weeks	5,561	4,026	1,221	98	216
40–41 weeks	2,357	1,715	516	47	78
42 weeks or more	725	538	151	14	22
Not stated	631	459	145	3	25
Age of mother:					
Under 20 years	4,114	2,501	1,468	69	76
20–24 years	7,953	5,082	2,568	134	169
25–29 years	6,576	4,307	1,906	83	281
30–34 years	5,281	3,602	1,318	51	311
35–39 years	2,969	2,089	693	22	165
40–54 years	967	677	211	11	69
Live-birth order:					
1	10,994	7,265	3,126	108	496
2	7,898	5,317	2,123	102	357
3	4,498	3,033	1,283	53	129
4	2,234	1,379	761	55	39
5 or more	1,867	1,040	740	47	40
Not stated	368	224	129	5	10
Marital status:					
Married	13,999	10,894	2,164	111	830
Unmarried	13,861	7,364	5,998	260	240
Mother's place of birth:					
Born in the 50 states and DC	22,143	14,449	7,105	356	234
Born elsewhere	5,083	3,447	811	10	816
Not stated	634	362	247	5	20

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

– Quantity zero.

<sup>1</sup>Includes Aleuts and Eskimos.

NOTE: 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 group 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. In this table all women (including Hispanic women) are classified only according to their race. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

**Table 2. Infant mortality rates, live births, and infant deaths, by selected characteristics and Hispanic origin of mother and by race of mother for mothers of non-Hispanic origin: United States, 2004 linked file**

Characteristics	All origins <sup>1</sup>	Hispanic						Non-Hispanic		
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total <sup>2</sup>	White	Black
Infant mortality rates per 1,000 live births in specified group										
Total . . . . .	6.78	5.55	5.47	7.82	4.55	4.65	6.73	7.09	5.66	13.60
Age at death:										
Total neonatal . . . . .	4.52	3.83	3.74	5.34	2.81	3.43	4.73	4.67	3.70	9.13
Early neonatal (less than 7 days) . . . . .	3.61	3.04	2.98	4.02	2.28	2.71	3.83	3.72	2.93	7.31
Late neonatal (7–27 days) . . . . .	0.92	0.80	0.76	1.32	*	0.72	0.90	0.95	0.77	1.82
Postneonatal . . . . .	2.25	1.71	1.73	2.48	1.74	1.22	2.00	2.42	1.96	4.47
Sex:										
Male . . . . .	7.44	6.04	5.96	9.09	4.51	4.99	6.93	7.79	6.24	15.00
Female . . . . .	6.08	5.03	4.95	6.48	4.60	4.29	6.51	6.35	5.05	12.14
Plurality:										
Single births . . . . .	5.94	5.01	4.95	7.06	3.41	4.13	6.35	6.18	4.89	12.00
Plural births . . . . .	30.46	28.90	29.85	32.22	*	25.23	21.26	30.48	24.89	55.71
Birthweight:										
Less than 2,500 grams . . . . .	57.64	56.45	58.25	55.92	45.89	50.20	55.63	57.38	50.05	76.01
Less than 1,500 grams . . . . .	244.50	245.41	251.93	229.94	235.90	224.22	255.49	242.04	222.98	274.34
1,500–2,499 grams . . . . .	14.97	15.16	16.36	12.25	*	12.26	15.67	14.89	14.79	15.67
2,500 grams or more . . . . .	2.26	1.81	1.80	2.56	*	1.35	2.52	2.39	2.18	3.54
Period of gestation:										
Less than 32 weeks . . . . .	182.45	162.52	163.32	172.65	181.47	150.52	161.01	185.81	168.29	217.31
32–33 weeks . . . . .	16.06	14.65	15.16	*	*	12.68	*	16.42	15.73	17.60
34–36 weeks . . . . .	7.32	6.20	6.38	7.57	*	4.72	7.21	7.60	7.05	9.25
37–41 weeks . . . . .	2.39	1.96	1.95	2.82	*	1.60	2.44	2.52	2.28	3.82
37–39 weeks . . . . .	2.61	2.18	2.16	2.92	*	1.79	2.70	2.73	2.50	4.04
40–41 weeks . . . . .	2.00	1.60	1.59	2.64	*	1.28	1.88	2.11	1.89	3.39
42 weeks or more . . . . .	2.87	2.41	2.47	*	*	2.07	*	3.03	2.80	4.35
Age of mother:										
Under 20 years . . . . .	9.75	6.67	6.41	9.85	*	4.96	8.18	11.17	9.56	14.19
20–24 years . . . . .	7.69	5.34	5.31	7.42	*	4.25	5.93	8.49	6.94	13.15
25–29 years . . . . .	5.95	4.82	4.60	7.75	*	4.46	5.93	6.26	4.88	13.31
30–34 years . . . . .	5.47	5.28	5.39	6.86	*	4.34	6.67	5.45	4.37	13.66
35–39 years . . . . .	6.24	6.26	6.50	5.92	*	5.33	7.55	6.15	5.15	14.08
40–54 years . . . . .	8.81	10.02	9.94	*	*	8.45	*	8.58	7.12	16.49
Live-birth order:										
1 . . . . .	6.74	5.80	5.84	8.86	3.58	4.16	7.21	6.94	5.61	13.77
2 . . . . .	5.99	4.81	4.81	6.01	4.77	4.39	4.62	6.28	5.13	12.28
3 . . . . .	6.48	4.89	4.77	6.14	*	4.49	6.37	7.02	5.79	12.18
4 . . . . .	8.17	6.09	5.68	8.38	*	6.55	9.45	9.01	6.83	15.39
5 or more . . . . .	10.64	8.63	8.15	14.32	*	8.24	10.44	11.44	8.20	18.11
Marital status:										
Married . . . . .	5.30	5.08	5.16	6.70	4.01	4.36	4.97	5.30	4.76	11.58
Unmarried . . . . .	9.43	6.08	5.85	8.54	5.65	4.95	8.70	10.78	8.42	14.49
Mother's place of birth:										
Born in the 50 states and DC . . . . .	7.14	6.19	6.02	8.08	4.55	4.57	6.32	7.25	5.69	13.91
Born elsewhere . . . . .	5.12	5.05	5.10	7.05	4.56	4.64	4.66	5.12	3.96	9.40

See footnotes at end of table.





**Table 2. Infant mortality rates, live births, and infant deaths, by selected characteristics and Hispanic origin of mother and by race of mother for mothers of non-Hispanic origin: United States, 2004 linked file—Con.**

Characteristics	All origins <sup>1</sup>	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total <sup>2</sup>	White	Black	
Infant deaths											
Total	27,860	5,248	3,705	479	68	667	330	22,203	13,001	7,869	409
Age at death:											
Total neonatal	18,602	3,627	2,535	327	42	492	232	14,634	8,499	5,283	341
Early neonatal (less than 7 days)	14,836	2,874	2,018	246	34	389	188	11,652	6,727	4,230	310
Late neonatal (7–27 days)	3,766	753	517	81	8	103	44	2,982	1,772	1,053	31
Postneonatal	9,258	1,621	1,170	152	26	175	98	7,570	4,502	2,586	68
Sex:											
Male	15,653	2,918	2,058	286	35	366	174	12,502	7,349	4,420	233
Female	12,207	2,329	1,646	193	33	301	156	9,701	5,651	3,449	176
Plurality:											
Single births	23,611	4,639	3,288	419	49	579	304	18,630	10,787	6,689	342
Plural births	4,249	609	417	60	19	88	25	3,573	2,214	1,180	67
Birthweight:											
Less than 2,500 grams	19,219	3,638	2,551	337	53	484	213	15,270	8,309	6,074	310
Less than 1,500 grams	15,155	2,836	1,962	278	46	387	163	12,048	6,269	5,114	271
1,500–2,499 grams	4,064	802	589	59	7	97	50	3,222	2,040	960	39
2,500 grams or more	8,528	1,593	1,142	141	15	181	114	6,854	4,642	1,768	82
Not stated	113	17	11	1	–	2	3	79	50	26	17
Period of gestation:											
Less than 32 weeks	14,897	2,658	1,831	274	47	359	147	11,989	6,268	5,062	250
32–33 weeks	1,040	211	154	12	2	27	16	819	508	247	10
34–36 weeks	2,648	497	360	44	4	57	32	2,121	1,362	607	30
37–41 weeks	7,918	1,472	1,044	136	14	184	95	6,373	4,297	1,675	73
37–39 weeks	5,561	1,030	729	90	13	129	68	4,489	3,024	1,180	42
40–41 weeks	2,357	443	315	46	1	55	26	1,884	1,273	495	30
42 weeks or more	725	154	113	8	1	20	12	566	388	146	5
Not stated	631	254	203	4	–	20	27	336	178	133	41
Age of mother:											
Under 20 years	4,114	903	663	106	9	60	65	3,170	1,628	1,419	41
20–24 years	7,953	1,493	1,102	145	9	149	88	6,344	3,590	2,482	116
25–29 years	6,576	1,225	838	118	15	181	73	5,267	3,085	1,838	83
30–34 years	5,281	938	654	68	14	145	58	4,246	2,637	1,266	97
35–39 years	2,969	507	338	28	14	95	32	2,401	1,567	661	61
40–54 years	967	181	109	14	7	38	13	776	494	203	10
Live-birth order:											
1	10,994	1,966	1,358	210	25	234	139	8,879	5,304	3,011	149
2	7,898	1,389	979	114	25	201	70	6,413	3,936	2,046	97
3	4,498	900	655	66	12	114	54	3,547	2,140	1,241	51
4	2,234	495	357	38	2	64	34	1,715	887	744	24
5 or more	1,867	435	320	43	2	47	23	1,414	613	720	18
Not stated	368	62	36	8	2	7	9	236	121	107	69
Marital status:											
Married	13,999	2,574	1,916	160	40	328	130	11,213	8,263	2,059	211
Unmarried	13,861	2,673	1,789	319	28	338	199	10,990	4,738	5,810	198
Mother's place of birth:											
Born in the 50 states and DC	22,143	2,152	1,481	331	32	83	225	19,791	12,274	6,985	200
Born elsewhere	5,083	3,015	2,198	140	36	581	60	1,993	526	683	76
Not stated	634	81	26	7	–	3	45	420	201	202	133

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

– Quantity zero.

<sup>1</sup>Includes origin not stated.<sup>2</sup>Includes races other than black or white.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Not stated responses were included in totals but not distributed among groups for rate computations. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2.

**Table 3. Infant mortality rates by race and Hispanic origin of mother: United States and each state, Puerto Rico, Virgin Islands, and Guam, 2002–2004 linked files**

[By place of residence]

State	Race and Hispanic origin of mother							
	Total	Race				Hispanic origin		
		White	Black	American Indian <sup>1</sup>	Asian or Pacific Islander	Hispanic	Non-Hispanic white	Non-Hispanic black
Infant mortality rates per 1,000 live births in specified group								
United States <sup>2</sup>	6.86	5.73	13.51	8.60	4.76	5.60	5.72	13.70
Alabama	8.82	6.74	13.50	*	*	7.94	6.67	13.49
Alaska	6.36	4.93	*	9.41	*	*	5.11	*
Arizona	6.55	6.22	10.62	8.25	6.69	6.46	6.00	11.06
Arkansas	8.47	7.37	13.11	*	*	6.02	7.56	13.17
California	5.25	4.84	11.32	6.29	4.21	5.05	4.59	11.33
Colorado	6.11	5.58	16.52	*	6.39	6.67	5.14	16.30
Connecticut	5.75	4.98	12.00	*	*	7.13	4.39	12.14
Delaware	8.88	6.92	14.91	*	*	6.16	7.07	15.03
District of Columbia	11.42	5.08	14.81	*	*	7.93	3.76	15.49
Florida	7.33	5.67	12.79	8.27	5.99	5.11	5.84	13.12
Georgia	8.65	6.32	13.70	*	5.80	6.17	6.32	13.64
Hawaii	6.95	5.06	14.82	*	7.34	7.06	4.60	15.04
Idaho	6.14	6.09	*	*	*	6.15	6.08	*
Illinois	7.53	5.87	15.52	*	4.58	6.04	5.90	15.51
Indiana	7.78	6.78	14.94	*	5.36	6.93	6.93	15.00
Iowa	5.36	5.14	10.47	*	*	5.83	5.11	10.37
Kansas	7.04	6.44	13.91	*	6.20	6.22	6.57	14.05
Kentucky	6.94	6.46	11.52	*	*	6.25	6.51	11.57
Louisiana	9.95	6.96	14.03	*	6.99	5.09	7.20	14.01
Maine	5.01	4.95	*	*	*	*	4.91	*
Maryland	8.09	5.51	13.33	*	4.16	5.67	5.46	13.62
Massachusetts	4.80	4.24	9.53	*	3.46	6.59	3.87	10.23
Michigan	8.09	6.33	16.81	*	5.05	7.31	6.21	16.76
Minnesota	4.85	4.46	8.86	8.81	3.55	4.97	4.39	8.75
Mississippi	10.32	6.82	14.69	*	*	*	6.93	14.69
Missouri	7.95	6.77	14.72	*	6.83	8.23	6.68	14.79
Montana	6.42	6.00	*	8.39	*	*	5.79	*
Nebraska	6.34	5.70	15.86	*	*	6.18	5.46	16.18
Nevada	6.00	5.27	13.22	*	5.16	4.52	5.78	12.98
New Hampshire	4.93	4.79	*	*	*	*	4.75	*
New Jersey	5.62	4.31	11.48	*	4.23	5.76	3.80	12.22
New Mexico	6.11	5.82	*	6.96	*	5.52	6.46	*
New York	6.08	4.89	11.18	11.03	3.77	5.52	4.71	11.72
North Carolina	8.35	6.15	15.44	11.10	5.20	6.63	6.06	15.37
North Dakota	6.48	6.00	*	8.69	*	*	5.94	*
Ohio	7.74	6.31	15.50	*	4.66	7.92	6.27	15.57
Oklahoma	7.95	7.21	13.98	7.81	*	6.06	7.46	13.79
Oregon	5.59	5.37	9.98	11.07	5.28	4.55	5.58	10.06
Pennsylvania	7.40	6.25	14.04	*	4.69	7.46	5.98	13.89
Rhode Island	6.40	5.83	10.41	*	*	6.27	5.41	11.57
South Carolina	8.98	6.24	14.26	*	7.76	6.36	6.25	14.40
South Dakota	7.11	5.79	*	13.51	*	*	5.84	*
Tennessee	9.05	6.91	17.02	*	6.16	5.96	7.02	17.34
Texas	6.37	5.51	12.22	*	4.22	5.51	5.87	12.21
Utah	5.26	5.07	*	*	7.33	6.58	4.83	*
Vermont	4.68	4.67	*	*	*	*	4.71	*
Virginia	7.48	5.77	13.67	*	4.83	5.15	5.82	13.86
Washington	5.62	5.28	9.20	10.53	5.23	5.44	5.07	9.24
West Virginia	7.98	7.74	14.02	*	*	*	7.67	13.61
Wisconsin	6.43	5.16	17.56	9.66	6.47	6.05	5.09	17.57
Wyoming	6.99	6.65	*	*	*	*	6.77	*
Puerto Rico	9.05	8.88	10.54	---	---	---	---	---
Virgin Islands	6.13	*	5.95	*	*	*	*	*
Guam	9.63	*	*	*	10.03	*	*	*

\* 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 Aleuts and Eskimos. <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. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

**Table 4. Percent of live births with selected maternal and infant characteristics by race of mother: United States, 2004 linked file**

Characteristic	All races	White	Black	American Indian <sup>1</sup>	Asian or Pacific Islander
Birthweight: . . . . .					
Less than 1,500 grams . . . . .	1.5	1.2	3.2	1.3	1.2
Less than 2,500 grams . . . . .	8.1	7.1	13.7	7.5	7.9
Preterm births <sup>2</sup> . . . . .	12.5	11.6	17.8	13.7	10.5
Births to mothers under 20 years . . . . .	10.3	9.3	17.2	17.9	3.2
Fourth and higher order births . . . . .	11.0	10.3	15.2	19.6	6.3
Births to unmarried mothers . . . . .	35.8	30.2	69.2	62.6	14.8
Mothers born in the 50 states and DC . . . . .	75.8	79.1	86.3	96.2	16.9

<sup>1</sup>Includes births to Aleuts and Eskimos.<sup>2</sup>Born prior to 37 completed weeks of gestation.

NOTE: Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

**Table 5. Percent of live births with selected maternal and infant characteristics by Hispanic origin of mother and race of mother for mothers of non-Hispanic origin: United States, 2004 linked file**

Characteristic	All origins <sup>1</sup>	Hispanic						Non-Hispanic		
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total <sup>2</sup>	White	Black
Birthweight: . . . . .										
Less than 1,500 grams . . . . .	1.5	1.2	1.1	2.0	1.3	1.2	1.3	1.6	1.2	3.2
Less than 2,500 grams . . . . .	8.1	6.8	6.5	9.8	7.7	6.7	7.8	8.5	7.2	13.8
Preterm births <sup>3</sup> . . . . .	12.5	12.0	11.8	14.0	12.8	11.7	12.6	12.6	11.5	17.9
Births to mothers under 20 years . . . . .	10.3	14.3	15.3	17.6	7.8	8.4	16.2	9.1	7.4	17.3
Fourth and higher order births . . . . .	11.0	14.0	15.1	12.4	5.1	10.8	11.9	10.1	8.9	15.3
Births to unmarried mothers . . . . .	35.8	46.4	45.2	61.0	33.2	47.6	46.6	32.6	24.5	69.3
Mothers born in the 50 states and DC . . . . .	75.8	36.8	36.4	67.4	47.1	12.7	73.4	87.4	94.2	87.4

<sup>1</sup>Includes origin not stated<sup>2</sup>Includes races other than black or white.<sup>3</sup>Born prior to 37 completed weeks of gestation.

**Table 6. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2004 linked file, and percentage change in birthweight-specific infant mortality, 1995–2004 linked files**

Race and birthweight	Number in 2004				Mortality rate per 1,000 live births in 2004			Percent change in infant mortality rate 1995–2004
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races <sup>1</sup>	4,112,055	27,860	18,602	9,258	6.78	4.52	2.25	-10.4**
Less than 2,500 grams	333,427	19,218	15,582	3,637	57.64	46.73	10.91	-10.8**
Less than 1,500 grams	61,983	15,155	13,186	1,969	244.50	212.74	31.77	-8.9**
Less than 500 grams	6,953	5,907	5,748	159	849.56	826.69	22.87	-6.0**
500–749 grams	11,659	5,602	4,784	819	480.49	410.33	70.25	-9.0**
750–999 grams	12,321	1,921	1,432	489	155.91	116.22	39.69	-14.4**
1,000–1,249 grams	14,245	966	697	269	67.81	48.93	18.88	-20.7**
1,250–1,499 grams	16,805	758	525	233	45.11	31.24	13.86	-17.4**
1,500–1,999 grams	65,821	1,800	1,195	605	27.35	18.16	9.19	-17.5**
2,000–2,499 grams	205,623	2,264	1,200	1,064	11.01	5.84	5.17	-18.7**
2,500 grams or more	3,778,051	8,528	2,916	5,612	2.26	0.77	1.49	-23.6**
2,500–2,999 grams	730,045	3,039	1,176	1,864	4.16	1.61	2.55	-23.5**
3,000–3,499 grams	1,573,831	3,272	998	2,274	2.08	0.63	1.44	-27.5**
3,500–3,999 grams	1,125,055	1,699	551	1,149	1.51	0.49	1.02	-24.9**
4,000–4,499 grams	299,196	424	143	281	1.42	0.48	0.94	-22.0**
4,500–4,999 grams	44,917	69	34	34	1.54	0.76	0.76	-29.0**
5,000 grams or more	5,007	24	13	11	4.79	*	*	-42.6
Not stated	577	113	104	9	...	...	...	*
White	3,222,929	18,257	12,178	6,080	5.66	3.78	1.89	-10.2**
Less than 2,500 grams	228,756	11,968	9,879	2,089	52.32	43.19	9.13	-12.4**
Less than 1,500 grams	39,419	9,142	8,096	1,046	231.92	205.38	26.54	-11.0**
Less than 500 grams	3,927	3,353	3,278	75	853.83	834.73	19.10	-6.3
500–749 grams	6,914	3,430	3,003	427	496.09	434.34	61.76	-9.2**
750–999 grams	7,800	1,215	956	259	155.77	122.56	33.21	-19.2**
1,000–1,249 grams	9,360	631	487	144	67.41	52.03	15.38	-25.9**
1,250–1,499 grams	11,418	513	373	140	44.93	32.67	12.26	-19.0**
1,500–1,999 grams	45,976	1,291	901	389	28.08	19.60	8.46	-15.4**
2,000–2,499 grams	143,361	1,535	881	654	10.71	6.15	4.56	-21.8**
2,500 grams or more	2,993,755	6,213	2,230	3,983	2.08	0.74	1.33	-22.4**
2,500–2,999 grams	522,822	2,109	868	1,241	4.03	1.66	2.37	-23.7**
3,000–3,499 grams	1,226,188	2,384	770	1,614	1.94	0.63	1.32	-27.1**
3,500–3,999 grams	941,407	1,314	438	876	1.40	0.47	0.93	-23.1**
4,000–4,499 grams	259,811	331	114	217	1.27	0.44	0.84	-20.1**
4,500–4,999 grams	39,286	59	31	27	1.50	0.79	0.69	-26.1
5,000 grams or more	4,241	15	8	7	*	*	*	*
Not stated	418	77	69	8	...	...	...	*
Black	616,076	8,162	5,505	2,657	13.25	8.94	4.31	-9.1**
Less than 2,500 grams	83,252	6,291	4,941	1,350	75.57	59.35	16.22	-4.6**
Less than 1,500 grams	19,334	5,297	4,470	827	273.97	231.20	42.77	-4.1
Less than 500 grams	2,728	2,306	2,227	79	845.31	816.35	28.96	-5.5
500–749 grams	4,199	1,908	1,555	353	454.39	370.33	84.07	-9.0**
750–999 grams	3,893	599	399	199	153.87	102.49	51.12	-5.6
1,000–1,249 grams	4,108	282	171	111	68.65	41.63	27.02	-7.8
1,250–1,499 grams	4,406	202	117	86	45.85	26.55	19.52	-5.6
1,500–1,999 grams	15,912	408	230	178	25.64	14.45	11.19	-20.8**
2,000–2,499 grams	48,006	586	242	345	12.21	5.04	7.19	-9.2
2,500 grams or more	532,699	1,839	532	1,306	3.45	1.00	2.45	-24.0**
2,500–2,999 grams	148,523	753	243	510	5.07	1.64	3.43	-18.5**
3,000–3,499 grams	234,900	709	176	532	3.02	0.75	2.26	-26.3**
3,500–3,999 grams	119,908	291	82	209	2.43	0.68	1.74	-30.2**
4,000–4,499 grams	25,271	72	23	49	2.85	0.91	1.94	-34.5
4,500–4,999 grams	3,602	5	2	3	*	*	*	*
5,000 grams or more	495	8	5	3	*	*	*	*
Not stated	125	32	31	1	...	...	...	*

See footnotes at end of table.

**Table 6. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2004 linked file, and percentage change in birthweight-specific infant mortality, 1995–2004 linked files—Con.**

Race and birthweight	Number in 2004				Mortality rate per 1,000 live births in 2004			Percent change in infant mortality rate 1995–2004
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
American Indian <sup>2</sup> . . . . .	43,927	371	187	184	8.45	4.26	4.19	-6.5
Less than 2,500 grams . . . . .	3,295	193	149	44	58.57	45.22	13.35	1.7
Less than 1,500 grams . . . . .	581	126	112	13	216.87	192.77	*	-8.4
Less than 500 grams . . . . .	54	43	43	-	796.30	796.30	*	-10.4
500–749 grams . . . . .	107	45	39	6	420.56	364.49	*	-31.0
750–999 grams . . . . .	105	22	19	3	209.52	*	*	*
1,000–1,249 grams . . . . .	143	11	9	2	*	*	*	*
1,250–1,499 grams . . . . .	172	4	2	2	*	*	*	*
1,500–1,999 grams . . . . .	653	22	12	10	33.69	*	*	*
2,000–2,499 grams . . . . .	2,061	45	24	21	21.83	11.64	10.19	13.5
2,500 grams or more . . . . .	40,622	178	38	139	4.38	0.94	3.42	-18.1
2,500–2,999 grams . . . . .	7,180	52	15	37	7.24	*	5.15	-31.4
3,000–3,499 grams . . . . .	16,271	70	13	57	4.30	*	3.50	-11.2
3,500–3,999 grams . . . . .	12,571	39	7	32	3.10	*	2.55	-24.2
4,000–4,499 grams . . . . .	3,802	11	2	9	*	*	*	*
4,500–4,999 grams . . . . .	696	4	1	3	*	*	*	*
5,000 grams or more . . . . .	102	1	-	1	*	*	*	*
Not stated . . . . .	10	-	-	-	...	...	...	...
Asian or Pacific Islander . . . . .	229,123	1,070	733	337	4.67	3.20	1.47	-11.6**
Less than 2,500 grams . . . . .	18,124	766	613	153	42.26	33.82	8.44	-8.8
Less than 1,500 grams . . . . .	2,649	590	508	83	222.73	191.77	31.33	-7.1
Less than 500 grams . . . . .	244	206	200	6	844.26	819.67	*	-6.6
500–749 grams . . . . .	439	219	186	33	498.86	423.69	75.17	-3.4
750–999 grams . . . . .	523	85	58	27	162.52	110.90	51.63	-15.0
1,000–1,249 grams . . . . .	634	41	30	11	64.67	47.32	*	-28.9
1,250–1,499 grams . . . . .	809	39	33	5	48.21	40.79	*	-34.9
1,500–1,999 grams . . . . .	3,280	79	52	27	24.09	15.85	8.23	-41.6**
2,000–2,499 grams . . . . .	12,195	97	54	44	7.95	4.43	3.61	-23.7
2,500 grams or more . . . . .	210,975	299	116	184	1.42	0.55	0.87	-34.3**
2,500–2,999 grams . . . . .	51,520	125	50	75	2.43	0.97	1.46	-30.6**
3,000–3,499 grams . . . . .	96,472	110	39	71	1.14	0.40	0.74	-40.9**
3,500–3,999 grams . . . . .	51,169	55	24	31	1.07	0.47	0.61	-23.0
4,000–4,499 grams . . . . .	10,312	9	4	5	*	*	*	*
4,500–4,999 grams . . . . .	1,333	1	-	1	*	*	*	*
5,000 grams or more . . . . .	169	-	-	-	*	*	*	*
Not stated . . . . .	24	4	4	-	...	...	...	*
Hispanic . . . . .	946,349	5,248	3,627	1,621	5.55	3.83	1.71	-11.5**
Less than 2,500 grams . . . . .	64,443	3,638	3,000	638	56.45	46.55	9.90	-8.0**
Less than 1,500 grams . . . . .	11,556	2,836	2,487	349	245.41	215.21	30.20	-6.8**
Less than 500 grams . . . . .	1,194	978	954	24	819.10	798.99	20.10	-6.3
500–749 grams . . . . .	2,257	1,109	982	127	491.36	435.09	56.27	-9.2
750–999 grams . . . . .	2,362	396	296	100	167.65	125.32	42.34	-11.5
1,000–1,249 grams . . . . .	2,656	195	141	55	73.42	53.09	20.71	-14.0
1,250–1,499 grams . . . . .	3,087	158	114	43	51.18	36.93	13.93	-5.9
1,500–1,999 grams . . . . .	12,333	372	262	110	30.16	21.24	8.92	-10.7
2,000–2,499 grams . . . . .	40,554	430	251	179	10.60	6.19	4.41	-18.4**
2,500 grams or more . . . . .	881,852	1,593	610	982	1.81	0.69	1.11	-27.6**
2,500–2,999 grams . . . . .	166,211	531	238	293	3.19	1.43	1.76	-28.8**
3,000–3,499 grams . . . . .	381,777	634	208	426	1.66	0.54	1.12	-27.2**
3,500–3,999 grams . . . . .	259,067	329	119	209	1.27	0.46	0.81	-31.0**
4,000–4,499 grams . . . . .	64,010	75	29	45	1.17	0.45	0.70	-22.5
4,500–4,999 grams . . . . .	9,561	19	13	6	*	*	*	*
5,000 grams or more . . . . .	1,226	5	2	3	*	*	*	*
Not stated . . . . .	54	17	17	-	...	...	...	*

See footnotes at end of table.



**Table 6. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2004 linked file, and percentage change in birthweight-specific infant mortality, 1995–2004 linked files—Con.**

Race and birthweight	Number in 2004				Mortality rate per 1,000 live births in 2004			Percent change in infant mortality rate 1995–2004
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
Non-Hispanic white . . . . .	2,296,684	13,001	8,499	4,502	5.66	3.70	1.96	-9.9**
Less than 2,500 grams . . . . .	166,029	8,309	6,828	1,481	50.05	41.13	8.92	-14.9**
Less than 1,500 grams . . . . .	28,114	6,269	5,559	711	222.98	197.73	25.29	-13.5**
Less than 500 grams . . . . .	2,687	2,326	2,276	51	865.65	847.04	18.98	-6.1
500–749 grams . . . . .	4,717	2,318	2,015	304	491.41	427.18	64.45	-10.3**
750–999 grams . . . . .	5,512	823	660	163	149.31	119.74	29.57	-22.0**
1,000–1,249 grams . . . . .	6,780	444	349	95	65.49	51.47	14.01	-28.9**
1,250–1,499 grams . . . . .	8,418	358	260	98	42.53	30.89	11.64	-23.5**
1,500–1,999 grams . . . . .	33,966	929	642	287	27.35	18.90	8.45	-17.0**
2,000–2,499 grams . . . . .	103,949	1,111	628	483	10.69	6.04	4.65	-23.0**
2,500 grams or more . . . . .	2,130,476	4,642	1,624	3,018	2.18	0.76	1.42	-20.4**
2,500–2,999 grams . . . . .	361,064	1,595	634	961	4.42	1.76	2.66	-20.4**
3,000–3,499 grams . . . . .	853,288	1,752	562	1,191	2.05	0.66	1.40	-26.0**
3,500–3,999 grams . . . . .	686,773	989	320	669	1.44	0.47	0.97	-21.3**
4,000–4,499 grams . . . . .	196,528	255	84	172	1.30	0.43	0.88	-18.2**
4,500–4,999 grams . . . . .	29,796	39	18	21	1.31	*	0.70	-29.6
5,000 grams or more . . . . .	3,027	10	6	4	*	*	*	*
Not stated . . . . .	179	50	47	3	...	...	...	*
Non-Hispanic black . . . . .	578,774	7,869	5,283	2,586	13.60	9.13	4.47	-7.2**
Less than 2,500 grams . . . . .	79,911	6,075	4,759	1,316	76.02	59.55	16.47	-3.8**
Less than 1,500 grams . . . . .	18,641	5,114	4,307	807	274.34	231.05	43.29	-3.8
Less than 500 grams . . . . .	2,628	2,221	2,145	77	845.13	816.21	29.30	-5.6
500–749 grams . . . . .	4,054	1,846	1,499	348	455.35	369.76	85.84	-8.4**
750–999 grams . . . . .	3,756	579	386	193	154.15	102.77	51.38	-5.8
1,000–1,249 grams . . . . .	3,964	271	165	106	68.37	41.62	26.74	-8.1
1,250–1,499 grams . . . . .	4,239	196	113	84	46.24	26.66	19.82	-4.2
1,500–1,999 grams . . . . .	15,313	393	222	171	25.66	14.50	11.17	-20.5**
2,000–2,499 grams . . . . .	45,957	567	230	338	12.34	5.00	7.35	-8.0
2,500 grams or more . . . . .	498,773	1,768	499	1,269	3.54	1.00	2.54	-22.5**
2,500–2,999 grams . . . . .	141,296	723	228	495	5.12	1.61	3.50	-17.8**
3,000–3,499 grams . . . . .	220,220	684	168	515	3.11	0.76	2.34	-24.5**
3,500–3,999 grams . . . . .	110,552	278	74	204	2.51	0.67	1.85	-28.7**
4,000–4,499 grams . . . . .	22,991	70	21	49	3.04	0.91	2.13	-31.4
4,500–4,999 grams . . . . .	3,254	5	2	3	*	*	*	*
5,000 grams or more . . . . .	460	8	5	3	*	*	*	*
Not stated . . . . .	90	26	25	1	...	...	...	*

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

\*\* Significant at  $p < .05$ .

... Category not applicable.

- Quantity zero.

<sup>1</sup>Includes races other than white or black.<sup>2</sup>Includes Aleuts and Eskimos.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

**Table 7. Infant deaths and mortality rates for the five leading causes of infant death, by race and Hispanic origin of mother: United States, 2004 linked file**

[Rates per 100,000 live births in specified group]

Cause of death (Based on the Tenth Revision International Classification of Diseases, 1992)	All races			Non-Hispanic white			Non-Hispanic black <sup>1</sup>			American Indian <sup>2,3</sup>			Asian and Pacific Islander <sup>4</sup>		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes . . . . .	...	27,860	677.5	...	13,001	566.1	...	7,869	1,359.6	...	371	844.6	...	1,070	467.0
Congenital malformations, deformations, and chromosomal abnormalities. . . . . (Q00–Q99)	1	5,636	137.1	1	2,969	129.3	2	969	167.4	1	89	202.6	1	239	104.3
Disorders related to short gestation and low birth weight, not elsewhere classified. . . . . (P07)	2	4,610	112.1	2	1,770	77.1	1	1,720	297.2	3	29	66.0	2	174	75.9
Sudden infant death syndrome . . . . . (R95)	3	2,247	54.6	3	1,240	54.0	3	642	110.9	2	44	100.2	4	55	24.0
Newborn affected by maternal complications of pregnancy. . . . . (P01)	4	1,706	41.5	4	739	32.2	4	597	103.1	6	12	*	3	69	30.1
Accidents (unintentional injuries) . . . . . (V01–X59)	5	1,054	25.6	5	589	25.6	7	271	46.8	4	21	47.8	9	26	11.4

Cause of death (Based on the Tenth Revision International Classification of Diseases, 1992)	Total Hispanic <sup>5</sup>			Mexican <sup>6</sup>			Puerto Rican <sup>7</sup>			Central and South American <sup>8</sup>		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes . . . . .	...	5,248	554.6	...	3,705	546.8	...	479	782.4	...	667	464.7
Congenital malformations, deformations, and chromosomal abnormalities. . . . . (Q00–Q99)	1	1,308	138.2	1	976	144.0	2	78	127.4	1	157	109.4
Disorders related to short gestation and low birth weight, not elsewhere classified. . . . . (P07)	2	816	86.2	2	540	79.7	1	93	151.9	2	108	75.3
Sudden infant death syndrome . . . . . (R95)	3	261	27.6	3	181	26.7	3	36	58.8	7	23	16.0
Newborn affected by maternal complications of pregnancy. . . . . (P01)	4	256	27.1	4	168	24.8	4	31	50.6	3	37	25.8
Accidents (unintentional injuries) . . . . . (V01–X59)	8	150	15.9	8	112	16.5	13	8	*	8	15	*

... 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 Non-Hispanic black women, Newborn affected by complications of placenta, cord and membranes was the fifth leading cause of death with 288 deaths and a rate of 49.8.<sup>2</sup>Includes Aleuts and Eskimos.<sup>3</sup>For American Indians, Newborn affected by complications of placenta, cord and membranes was the fifth leading cause of death; however with only 14 deaths, a reliable infant mortality rate could not be computed.<sup>4</sup>For Asian or Pacific Islanders, Diseases of the circulatory system and Neonatal hemorrhage were tied for the fifth leading cause of death, with 37 deaths each and rates of 16.1.<sup>5</sup>For Total Hispanic, Newborn affected by complications of placenta, cord and membranes was the fifth leading cause of death with 184 deaths and a rate of 19.4.<sup>6</sup>For Mexicans, Newborn affected by complications of placenta, cord and membranes was the fifth leading cause of death with 130 deaths and a rate of 19.2.<sup>7</sup>For Puerto Ricans, Respiratory distress of newborn was the fifth leading cause of death; however, with only 16 deaths, a reliable infant mortality rate could not be computed.<sup>8</sup>For Central and South Americans Respiratory distress of newborn was the fourth leading cause of death with 28 deaths and a rate of 19.5. Bacterial sepsis of newborn was the fifth leading cause of death with 27 deaths and a rate of 18.8.

NOTES: Reliable cause-specific infant mortality rates cannot be computed for Cubans because of the small number of infant deaths (68). 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. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

**Table 8. Number of and percent of preterm-related infant deaths and preterm-related infant mortality rates by race and Hispanic origin of mother: United States, 1999–2004 linked files**

Year	All races and origins	Non-Hispanic white	Non-Hispanic black	American Indian	Asian or Pacific Islander	Total Hispanic <sup>1</sup>	Mexican	Puerto Rican	Central and South American
Number of preterm-related infant deaths									
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
1999	9,865	4,285	3,669	100	260	1,408	879	216	153
Percent of total infant deaths that are preterm-related									
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
1999	35.4	31.7	44.1	26.8	29.7	32.3	29.5	45.3	31.7
Preterm-related infant mortality rate <sup>2</sup>									
2004	2.48	1.82	6.29	1.89	1.65	1.85	1.76	3.19	1.66
2003	2.53	1.88	6.28	2.11	1.65	1.93	1.78	3.42	1.89
2002	2.48	1.89	6.19	2.12	1.52	1.76	1.62	3.31	1.52
2001	2.43	1.84	6.04	1.89	1.40	1.69	1.56	3.40	1.56
2000	2.38	1.75	5.93	2.30	1.49	1.73	1.60	3.25	1.50
1999	2.49	1.83	6.23	2.49	1.44	1.84	1.63	3.78	1.48

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

<sup>2</sup>Rate per 1,000 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-P369, P520-P523, P77; see Technical Notes. Fifteen states reported multiple-race data on the birth certificate for 2004. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

## Technical Notes

### Differences between period and cohort data

From 1983 to 1991, NCHS produced linked files in a birth cohort format (44). Beginning with 1995 data, linked files are produced first using a period format and then subsequently using a birth cohort format. The 2004 period linked file contains a numerator file that consists of all infant deaths occurring in 2004 that have been linked to their corresponding birth certificates, whether the birth occurred in 2003 or in 2004. In contrast, the 2004 birth cohort linked file will contain a numerator file that consists of all infant deaths to babies born in 2004 whether the death occurred in 2004 or 2005.

While the birth cohort format has methodological advantages, it creates delays in data availability, since it is necessary to wait until the close of the following data year to include all infant deaths in the birth cohort. Beginning with 1995 data, the period linked file is the basis for all official NCHS linked file statistics.

For the 2004 file, NCHS accepted birth records that could be linked to infant deaths even if registered after the closure of the 2004 birth file (less than 100 cases). This improved the infant birth/death linkage and made the denominator file distinctly different from the official 2004 birth file.

### Weighting

A record weight is added to the linked file to compensate for the 1.1 percent (in 2004) 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 are not weighted. The percent of records linked varied by registration area (from 96.7–100.0 percent with all but four areas—California, Massachusetts, New Jersey, and Texas at 97.5 percent or higher) (Table I). The number of infant deaths in the linked file for the 50 states and the District of Columbia was weighted to equal the sum of the linked plus unlinked infant deaths by state of occurrence at birth and age at death (less than 7 days, 7–27 days, and 28 days to under 1 year). The addition of the weight greatly reduced the potential for bias in comparing infant mortality rates by characteristics.

The 2004 linked file started with 27,920 infant death records. Of these 27,920 records, 27,612 were linked; 308 were unlinked because corresponding birth certificates could not be identified. The 27,920 linked and unlinked records contained 60 records of infants whose mother's usual place of residence was outside of United States. These 60 records were excluded to derive a weighted total of 27,860 infant deaths. Thus, all total calculations for 2004 in this report used a weighted total of 27,860 infant deaths (Tables A–C, 1, 2, and 6–8).

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

The overall infant mortality rate from the 2004 period linked file of 6.78 is nearly the same as the 2004 vital statistics mortality file (6.79)(3). The number of infant deaths differs slightly; the number in the mortality file was 27,936 (3). Differences in numbers of infant deaths between the two data sources are primarily due to geographic coverage differences, as for the vital statistics mortality file, all deaths occurring in the 50 states and the District of Columbia are included

**Table I. Percentage of infant death records which were linked to their corresponding birth records: United States and each state, Puerto Rico, Virgin Islands, and Guam, 2004 linked file**

State	Percent linked by state of occurrence of death
United States <sup>1</sup> . . . . .	98.9
Alabama . . . . .	100.0
Alaska . . . . .	100.0
Arizona . . . . .	98.7
Arkansas . . . . .	99.7
California . . . . .	96.9
Colorado . . . . .	100.0
Connecticut . . . . .	100.0
Delaware . . . . .	100.0
District of Columbia . . . . .	100.0
Florida . . . . .	99.8
Georgia . . . . .	100.0
Hawaii . . . . .	100.0
Idaho . . . . .	99.2
Illinois . . . . .	97.6
Indiana . . . . .	99.4
Iowa . . . . .	100.0
Kansas . . . . .	100.0
Kentucky . . . . .	99.4
Louisiana . . . . .	98.6
Maine . . . . .	100.0
Maryland . . . . .	100.0
Massachusetts . . . . .	97.0
Michigan . . . . .	100.0
Minnesota . . . . .	100.0
Mississippi . . . . .	99.2
Missouri . . . . .	99.9
Montana . . . . .	100.0
Nebraska . . . . .	99.5
Nevada . . . . .	99.5
New Hampshire . . . . .	100.0
New Jersey . . . . .	97.3
New Mexico . . . . .	100.0
New York . . . . .	98.7
North Carolina . . . . .	100.0
North Dakota . . . . .	100.0
Ohio . . . . .	98.5
Oklahoma . . . . .	99.0
Oregon . . . . .	99.6
Pennsylvania . . . . .	99.6
Rhode Island . . . . .	100.0
South Carolina . . . . .	100.0
South Dakota . . . . .	100.0
Tennessee . . . . .	99.9
Texas . . . . .	96.7
Utah . . . . .	100.0
Vermont . . . . .	100.0
Virginia . . . . .	100.0
Washington . . . . .	99.8
West Virginia . . . . .	100.0
Wisconsin . . . . .	100.0
Wyoming . . . . .	100.0
Puerto Rico . . . . .	99.5
Virgin Islands . . . . .	100.0
Guam . . . . .	100.0

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

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 the District of Columbia (the territory linked file is a

separate file). Also, although every effort has been made to design weights that will accurately reflect the distribution of deaths by characteristics, weighting may contribute to small differences in numbers and rates by specific variables between these two data sets.

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

This report includes 2004 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) (2). The 2003 revision is described in detail elsewhere (45–47). Seven states, Idaho, Kentucky, New York (excluding New York City), Pennsylvania, South Carolina, Tennessee, and Washington implemented the revised birth certificate as of January 1, 2004, or in 2003. Two additional states, Florida and New Hampshire, implemented the revised birth certificate in 2004, but after January 1. The nine revised states represent 20 percent of all 2004 births; the seven revised states that implemented as of January 1, 2004, represent 14 percent of all births.

Data for educational attainment, prenatal care, and tobacco use, although collected on both the revised and unrevised certificates, are not considered comparable between revisions. As discussed above, the 2004 period linked file contains all infant deaths in 2004 linked to their corresponding birth certificates, whether the birth occurred in 2003 or 2004. Therefore, complete revised data for these variables were only available from the two states (Pennsylvania and Washington) that revised as of January 1, 2003. Revised data for educational attainment, prenatal care, and tobacco use are not shown in this report as data from two states was deemed insufficient for national-level analysis. Future reports will include revised data for these items. Data items exclusive to either the 1989 or the 2003 birth certificate revision are not shown in this report.

## Marital status

National estimates of births to unmarried women are based on two methods of determining marital status. In 2004, marital status was based on a direct question in 48 states and the District of Columbia. In the two States (Michigan and New York), which used inferential procedures to compile birth statistics by marital status, a birth is inferred as nonmarital if either of these factors, listed in priority-of-use order, is present: a paternity acknowledgment was received or the father's name is missing. For more information on the inferential procedures and on the changes in reporting, see "Technical Notes" in *Births: Final Data for 2004* (2).

## Multiple race

For the birth certificates in the 2004 data year, multiple race was reported by California, Florida (for births occurring from March 1, 2004, only), Hawaii, Idaho, Kentucky, Michigan (for births at selected facilities only), Minnesota, New Hampshire (for births occurring from July 19, 2004, only), New York State (excluding New York City), Ohio, Pennsylvania, South Carolina, Tennessee, Utah, and Washington (2). Data from the vital records of the remaining states, the District of

Columbia, and New York City followed the 1977 OMB standards in which a single race is reported (48,49). In addition, these areas also report the minimum set of four races as stipulated in the 1977 standards, compared with the minimum of five races for the 1997 standards (2).

To provide uniformity and comparability of the data during the transition period, before multiple-race data are available for all reporting areas, it is necessary to bridge the responses of those who reported more than one race to a single race. Multiple race is imputed to a single race (one of the following: AIAN, API, black, or white) according to the combination of races, Hispanic origin, sex, and age indicated on the birth certificate (2).

## Period of gestation and birthweight

The primary measure used to determine the gestational age of the newborn is the interval between the first day of the mother's last normal menstrual period (LMP) and the date of birth. It is subject to error for several reasons, including imperfect maternal recall or misidentification of the LMP because of postconception bleeding, delayed ovulation, or intervening early miscarriage. These data are edited for LMP-based gestational ages that are clearly inconsistent with the infant's plurality and birthweight (see below), but reporting problems for this item persist and many occur more frequently among some subpopulations and among births with shorter gestations (50,51).

The U.S. Standard Certificate of Live Birth contains an item, "clinical estimate of gestation," which is compared with length of gestation computed from the date the LMP began when the latter appears to be inconsistent with birthweight. This is done for normal weight births of apparently short gestations and very low birthweight births reported to be full term. The clinical estimate was also used if the LMP date was not reported. The period of gestation for 5.9 percent of the births in 2004 was based on the clinical estimate of gestation. For 97 percent of these records, the clinical estimate was used because the LMP date was not reported. For the remaining 3 percent, the clinical estimate was used because it was consistent with the reported birthweight, whereas the LMP-based gestation was not. In cases where the reported birthweight was inconsistent with both the LMP-computed gestation and the clinical estimate of gestation, the LMP-computed gestation was used and birthweight was reclassified as "not stated." This was necessary for about 0.04 percent of all birth records in 2004 (2).

For the linked file, not stated birthweight was imputed for 3,244 records or 0.08 percent of the birth records in 2004 when birthweight was not stated but the period of gestation was known. In this case, birthweight was assigned the value from the previous record with the same period of gestation, maternal race, sex, and plurality. If birthweight and period of gestation were both unknown the not stated value for birthweight was retained. This imputation was done to improve the accuracy of birthweight-specific infant mortality rates, since the percent of records with not stated birthweight was higher for infant deaths (4.10 percent before imputation) than for live births (0.09 percent before imputation). The imputation reduced the percent of not stated records to 0.44 percent for infant deaths, and 0.01 percent for births. The not



stated birthweight cases in the natality/birth file, as distinct from the linked file, are not imputed (2).

## Cause-of-death classification

The mortality statistics presented in this report were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify and code causes of death in accordance with the current revision of the *International Statistical Classification of Diseases and Related Health Problems*. The ICD provides the basic guidance used in virtually all countries to code and classify causes of death. The ICD not only details disease classification but also provides definitions, tabulation lists, the format of the death certificate, and the rules for coding cause of death. Cause-of-death data presented in this report were coded by procedures outlined in annual issues of the *NCHS Instruction Manual* (52,53).

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” (4). It is selected from the conditions entered by the physician in the cause-of-death section of the death certificate. When more than one cause or condition is entered by the physician, the underlying cause is determined by the sequence of conditions on the certificate, provisions of the ICD, and associated selection rules and modifications. 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 (54,55).

About every 10–20 years, the International Classification of Diseases is revised to take into account advances in medical knowledge. Effective with deaths occurring in 1999, the United States began using the Tenth Revision of the *International Statistical Classification of Diseases and Related Health Problems* (ICD-10) (4); during the period 1979–98, causes were coded and classified according to the Ninth Revision (ICD-9) (5).

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 (3, 56,57).

## 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 (58). Briefly, category titles that begin with the words “Other” and “All other” are not ranked to determine the leading causes of death. When one of the titles that represents a subtotal is ranked (for example, Influenza and pneumonia (J10–J18)), its component parts are not ranked (in this case, Influenza (J10–J11) and Pneumonia (J12–18)).

## Preterm-related causes of death

This year, a new grouping of preterm-related causes of death was added to the report. This grouping attempts to identify causes of

death that have a direct etiological connection to preterm birth, and does not include causes that are incidental to preterm birth (for example, a Motor vehicle accident to a preterm infant). For an underlying cause of death to be considered preterm-related, 75 percent or more of infants whose deaths were attributed to that cause had to be born preterm, and the cause of death had to be a direct consequence of preterm birth based on a clinical evaluation and review of the literature. Further detail on the development of this cause-of-death grouping is available in a related publication (59).

## 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 they are calculated by dividing the number of infant deaths in a calendar year by the number of live births registered for the same period and are presented as rates per 1,000 or per 100,000 live births. Both the mortality file and the linked birth/infant death file use this computation method but due to unique numbers of infant deaths, as explained in the section above on the comparison of these two files, the rates will often differ for specific variables (particularly for race and ethnicity). Infant mortality rates use the number of live births in the denominator to approximate the population at risk of dying before the first birthday. In contrast to the infant mortality rates based on live births, infant death rates, used only in age-specific death rates with the mortality file, use the estimated population of persons under 1 year of age as the denominator. For all variables, not stated responses were shown in tables of frequencies, but were dropped before rates were computed. Rates per 1,000 live births display two digits after the decimal place to provide a more precise and sensitive measurement. For rates per 100,000 live births (by cause of death) the infant mortality rate is shown for one decimal place. Adding an additional decimal for rates per 100,000 does not increase precision as it does for rates per 1,000.

As stated previously, infant death records for the 50 states and the District of Columbia in the 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 (60). 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 binomial distribution. When the number of events is large, the relative standard error is usually small. When the number of events is small (perhaps less than 100) and the probability of such an event is



small, considerable caution must be observed in interpreting the data. Such infrequent events may be assumed to follow a Poisson probability distribution (3). Estimates of relative standard errors (RSE's) and 95-percent confidence intervals are shown below.

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

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

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

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

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

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

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

*Binomial distribution*—When the number of events is greater than 100, the binomial distribution is used to estimate the 95 percent 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:

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

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

Thus the chances are 95 out of 100 that the true IMR for Group A lies somewhere in the 5.55–6.63 interval.

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

$$\text{Lower: } \text{IMR} \cdot L(.95, D_{\text{adj}})$$

$$\text{Upper: } \text{IMR} \cdot U(.95, D_{\text{adj}})$$

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:

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

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

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

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

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

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

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

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

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

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

## Availability of linked file data

Linked file data are available on CD-ROM from the National Center for Health Statistics (NCHS) at 1–866–441–6247. Data are also available in selected issues of the Vital and Health Statistics, Series 20 reports, the *National Vital Statistics Reports* (formerly the *Monthly Vital Statistics Report*) through NCHS. Additional unpublished tabulations are available from NCHS or through our Internet site at <http://www.cdc.gov/nchs>.

**Table II. 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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