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Infant Mortality Statistics from the 2003 Period Linked Birth/Infant Death Data Set

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Abstract

Objectives—This report presents 2003 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 6.84 infant deaths per 1,000 live births in 2003, a return to the rate in 2001, compared with 6.95 in 2002. Infant mortality rates ranged from 4.83 per 1,000 live births for Asian or Pacific Islander mothers to 13.60 for non-Hispanic black mothers. Among Hispanics, rates ranged from 4.57 for Cuban mothers to 8.18 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 smoked during pregnancy. Infant mortality was also higher for male infants, multiple births, and infants born preterm or at low birthweight. Infants born at the lowest birthweights and gestational ages have a large impact on overall U.S. infant mortality. Nearly one-half (49 percent) of all infant deaths in the U.S. in 2003 occurred to the 0.8 percent of infants whose birthweight was less than 1,000 grams. The three leading causes of infant death—Congenital malformations, low birthweight, and SIDS— taken

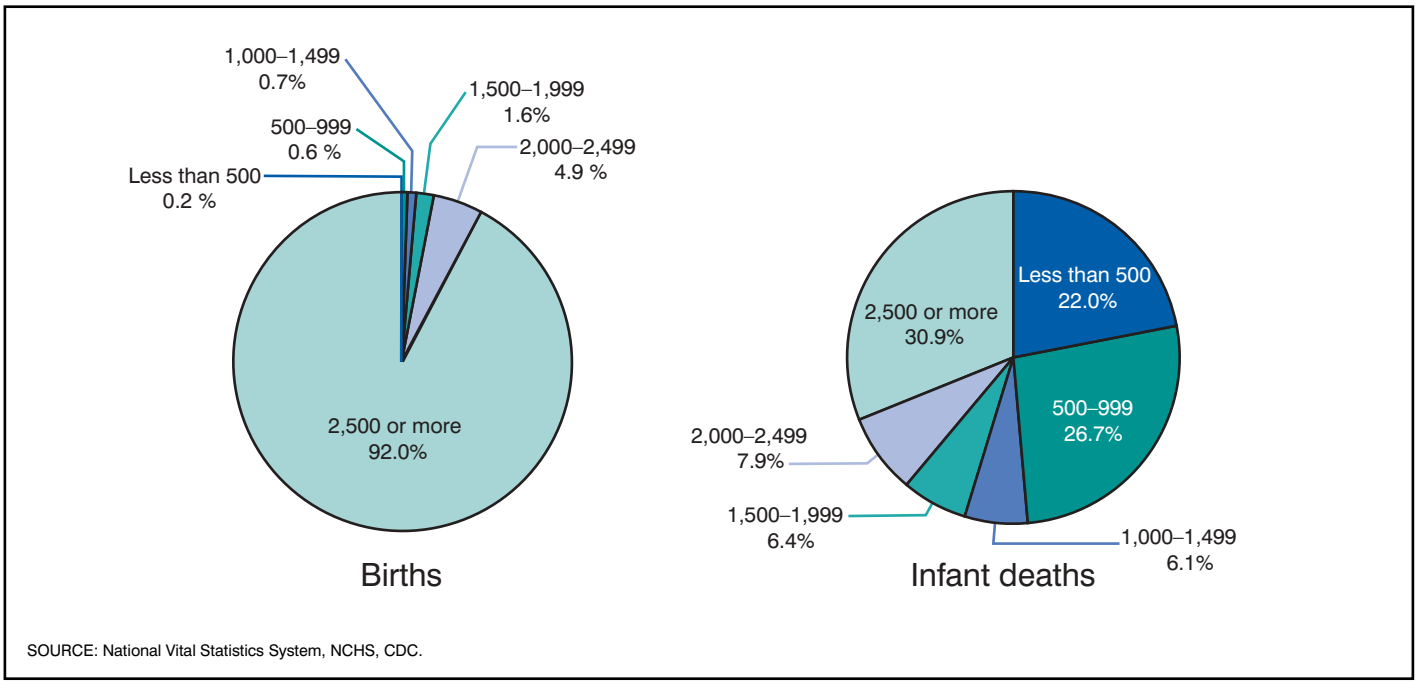


Figure 1. Percentage of live births and infant deaths by birthweight in grams, 2003

together accounted for 45 percent of all infant deaths. For infants of non-Hispanic black mothers, the cause-specific infant mortality rate for low birthweight was nearly four times that for infants of non-Hispanic white mothers. For infants of non-Hispanic black and American Indian mothers, the SIDS rates were more than double the rate for non-Hispanic white mothers.

Keywords: infant mortality • infant health • birthweight • maternal characteristics

Introduction

This report presents infant mortality data from the 2003 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 2003. 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, trimester of pregnancy prenatal care began, maternal age, maternal educational attainment, live-birth order, mother's marital status, mother's place of birth, maternal smoking during pregnancy, age at death, and underlying cause of death (Tables 1–7, A–C, and Figures 1–3). 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. 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 (2). 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 that 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."

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, each State provided to the Centers for Disease Control and Prevention's 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 2003. 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 2003, 99.0 percent of all infant death records were successfully

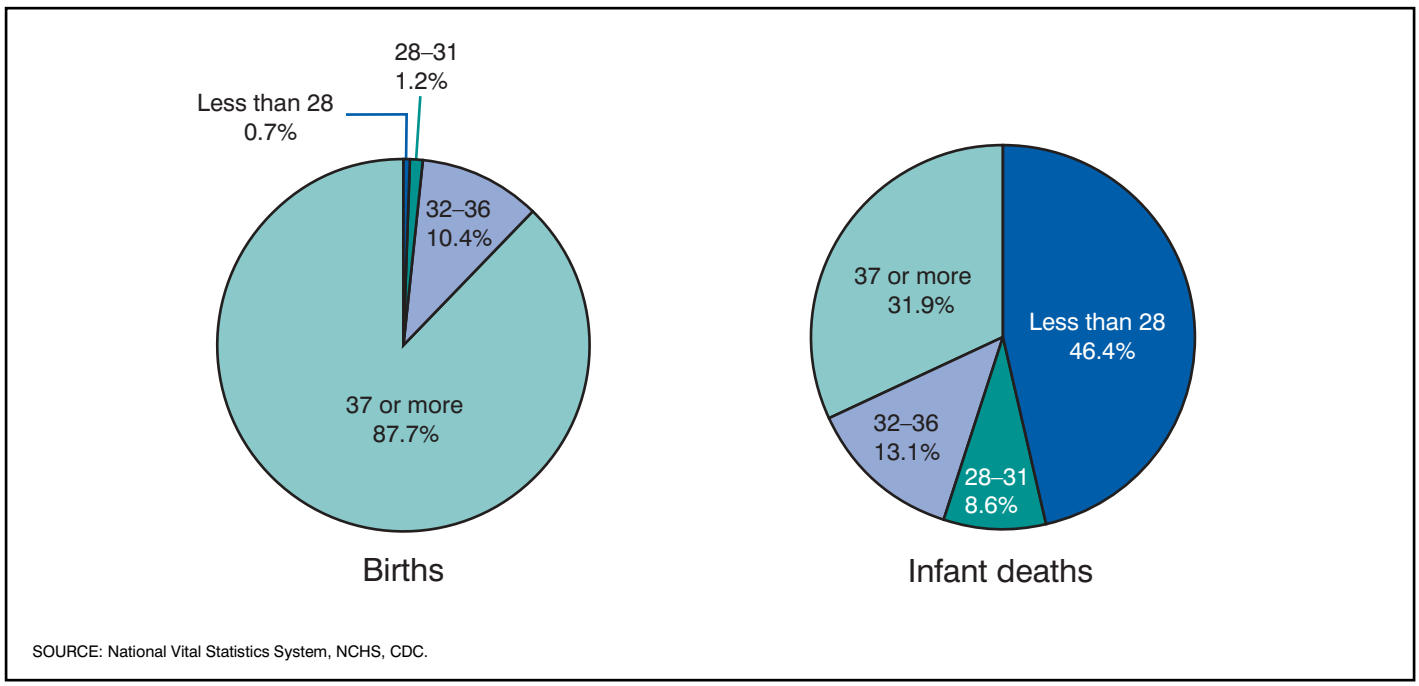
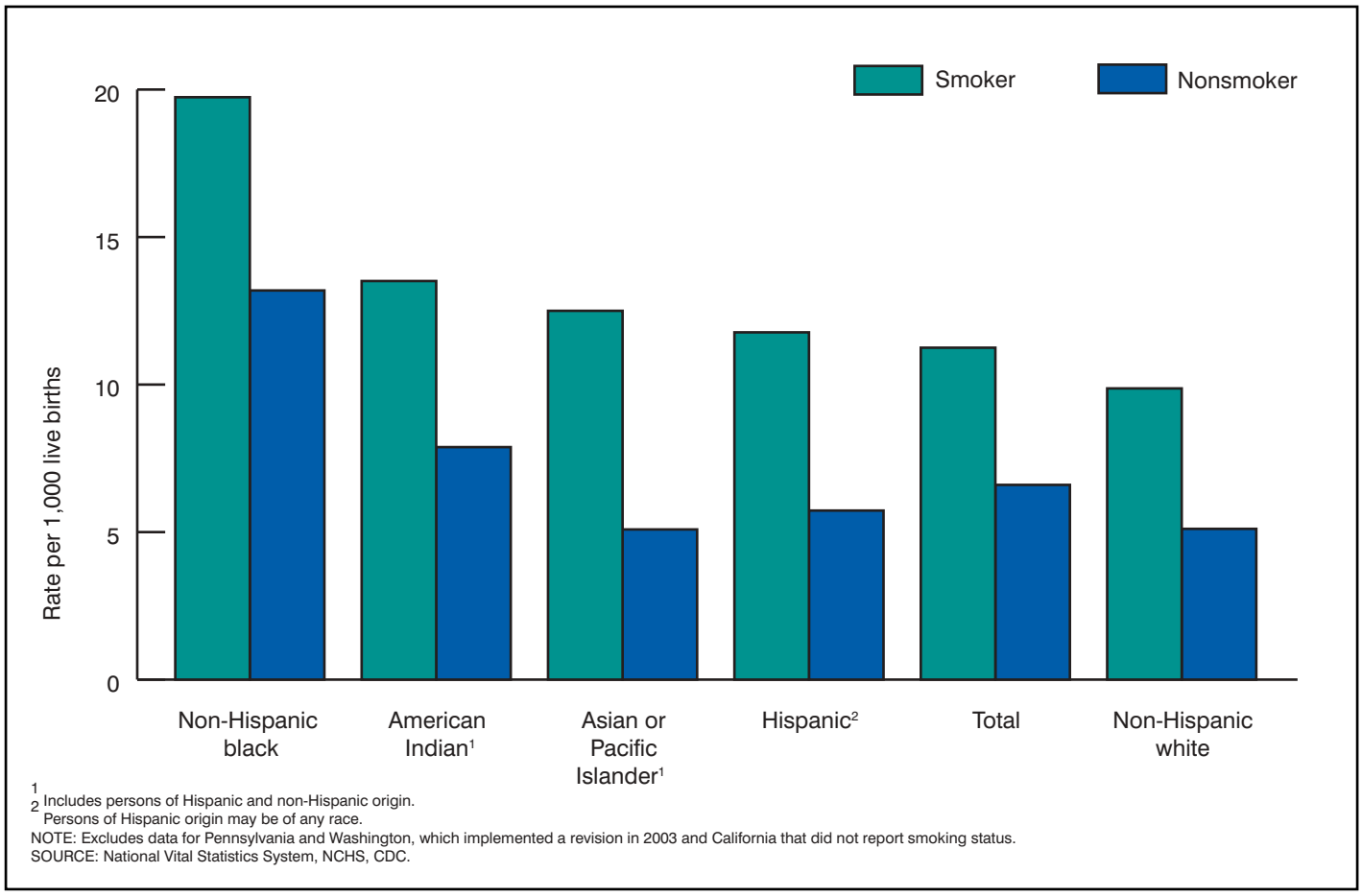


Figure 2. Percentage of live births and infant deaths by period of gestation in weeks, 2003



[1] [2] Includes persons of Hispanic and non-Hispanic origin.
Persons of Hispanic origin may be of any race.
NOTE: Excludes data for Pennsylvania and Washington, which implemented a revision in 2003 and California that did not report smoking status.
SOURCE: National Vital Statistics System, NCHS, CDC.

Figure 3. Infant mortality rates by smoking status of the mother during pregnancy by race and ethnicity, 2003

matched to their corresponding birth records. Records were weighted to adjust for the 1.0 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 2003 (3).

Race and Hispanic origin are reported independently on the birth certificate. In tabulations of birth data by race and Hispanic origin, data for Hispanic persons are not further classified by race as the vast majority of women of Hispanic origin are reported as white. Data for American Indian 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."

This report includes data for two States, Pennsylvania and Washington, that implemented the 2003 revision of the U.S. Standard Certificate of Live Birth in 2003 (revised), as well as the 48 States and the District of Columbia for which data 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 *National Vital Statistics Report* "Births: Final Data for 2003" for more information (3).

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). Race information from the birth certificate 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 (2,6).

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 2003 infant mortality rate from the linked file was 6.84 infant deaths per 1,000 live births, not significantly lower than the rate in 2002 (6.95) and a return to the rate in 2001 (Table C) (the overall rate in 2003 from the mortality file was 6.85). Infant mortality rates for race and Hispanic origin groups were not significantly different in 2003 compared with 2002 (Table C).

The significant increase in the infant mortality rate from 2001 to 2002 generated considerable concern; it was the first such rise in more than 40 years. An intensive analysis of the 2001–02 increase in the infant mortality rate was published last year (7). This analysis discussed some of the potential explanatory factors that could account for the increase, concluding that the increase in the number of very small infants (less than 750 grams) was the principal factor. The increase did not continue in 2003.

The infant mortality rate was 10 percent lower in 2003 than in 1995 (7.57) (Table C). During this period, decreases have been observed for all race and ethnic groups, although only a few had significant declines. Significant declines were observed for infants of non-Hispanic white (9 percent), non-Hispanic black (7 percent), and Mexican mothers (9 percent).

Infant mortality by race and Hispanic origin of mother

There continues to be a wide variation in infant mortality rates by race and Hispanic origin of mother with the highest rate, 13.60 per 1,000 live births for infants of non-Hispanic black mothers, nearly three times greater than the lowest rate of 4.57 for infants of Cuban mothers. Rates were also high for infants of American Indian mothers (8.73) and Puerto Rican mothers (8.18) (Tables A and B). Rates were intermediate, but all below the U.S. rate, for infants of non-Hispanic white (5.70), Mexican (5.49), and Central and South American mothers (5.04) (Table B). The rate was low for Asian or Pacific Islander mothers (4.83) (Table A).

Infant mortality by State

Between 2002 and 2003, more States had decreases than increases in the infant mortality rate, but most changes were not significant. No State had a significant increase and two, Connecticut and Nebraska, had significant declines of 18 and 22 percent, respectively (detailed data not shown). Infant mortality rates varied considerably by State and within States by race and Hispanic origin of mother for 2001–03 (Table 3). To obtain statistically reliable rates by race and Hispanic origin, 3 years of data were combined. Infant mortality rates ranged from 10.53 for Mississippi to 4.33 for New Hampshire. The highest rate noted (10.94) 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 17.48 in Wisconsin to 8.39 in Minnesota. For infants of non-Hispanic white mothers, West Virginia had the highest infant mortality rate (7.65) and New Jersey had the lowest rate (3.92).

For infants of American Indian and Asian or Pacific Islander mothers, mortality rates could be reliably computed for only 15 and 27 States, respectively. For infants of American Indian mothers, mortality rates ranged from 12.66 in Wisconsin to 6.00 in New Mexico. Overall, infant mortality rates for infants of Asian or Pacific Islander mothers were the lowest, ranging from 3.38 in New York to 9.85 in Louisiana.

Sex of infant

In 2003, the overall infant mortality rate for female infants was 6.07 per 1,000, 20 percent lower than the rate for male infants (7.59). Infant mortality rates were higher for male than female infants in each race group except American Indian (Table 1). Among Hispanics, this difference was not significant for infants of Cuban mothers (Table 2).

Multiple births

For multiple births, the infant mortality rate was 30.99, more than five times the rate of 6.01 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 2003, the infant mortality rate for twins (28.66) was nearly five times the rate for single births (6.01). The rate for triplets (62.23) was 10 times, the rate for quadruplets (156.41) 26 times, and the rate for quintuplets and higher order births (242.86) was 40 times higher than the rate for single births (tabular data not shown).

For twins, the infant mortality rate declined significantly from 2002 (30.20) to 2003 (28.66). No other plurality group had a significant change in infant mortality from the year before.

Multiple pregnancy can lead to an accentuation of maternal risks and complications associated with pregnancy (3,8,9). For example, multiple births are much more likely to be born preterm and at low birthweight than single births (3,8,9). The higher risk profile of multiple

Table A. Infant, neonatal, and postneonatal deaths and mortality rates by race of mother: United States, 2003 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	4,090,007	27,995	18,935	9,060	6.84	4.63	2.22
White	3,225,890	18,458	12,457	6,000	5.72	3.86	1.86
Black	599,860	8,094	5,530	2,563	13.49	9.22	4.27
American Indian[1]	43,054	376	196	180	8.73	4.55	4.18
Asian or Pacific Islander	221,203	1,068	752	316	4.83	3.40	1.43

[1]Includes Aleuts and Eskimos.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. In this table all women (including Hispanic women) are classified only according to their race. See reference 3.

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, 2003 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[1]	4,090,007	27,995	18,935	9,060	6.84	4.63	2.22
Total Hispanic	912,331	5,151	3,573	1,579	5.65	3.92	1.73
Mexican	654,507	3,595	2,462	1,133	5.49	3.76	1.73
Puerto Rican	58,400	478	333	145	8.18	5.70	2.48
Cuban	14,867	68	50	18	4.57	3.36	*
Central and South American	135,585	684	494	189	5.04	3.64	1.39
Other and unknown Hispanic	48,972	326	232	94	6.66	4.74	1.92
Non-Hispanic total[2]	3,149,067	22,396	14,994	7,402	7.11	4.76	2.35
Non-Hispanic white	2,321,921	13,228	8,797	4,431	5.70	3.79	1.91
Non-Hispanic black	576,047	7,836	5,335	2,501	13.60	9.26	4.34
Not stated	28,609	448	368	80	. . .	. . .	. . .

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

. . . Category not applicable.

[1]Origin of mother not stated included in All origins but not distributed among origins.

[2]Includes races other than white or black.

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. See reference 3.

Table C. Infant mortality rates by race and Hispanic origin of mother: United States, 1995–2003 linked files

Race and Hispanic origin of mother	1995	1996	1997	1998	1999	2000	2001	2002	2003	Percent Change 1995 to 2003	Percent Change 2002 to 2003
All races	7.57	7.30	7.21	7.19	7.04	6.89	6.84	6.95	6.84	–9.6	–1.6**
White	6.30	6.07	6.05	5.96	5.79	5.71	5.69	5.79	5.72	–9.2	–1.2**
Black	14.58	14.13	13.69	13.80	13.99	13.48	13.34	13.81	13.50	–7.4	–2.2**
American Indian[1]	9.04	9.95	8.69	9.34	9.29	8.30	9.65	8.64	8.73	–3.4**	1.0**
Asian or Pacific Islander	5.27	5.20	4.98	5.54	4.85	4.87	4.73	4.77	4.83	–8.3**	1.3**
Hispanic	6.27	6.05	5.95	5.76	5.71	5.59	5.44	5.62	5.65	–9.9	0.5**
Mexican	6.03	5.84	5.83	5.60	5.51	5.43	5.22	5.42	5.49	–9.0	1.3**
Puerto Rican	8.88	8.60	7.86	7.78	8.35	8.21	8.53	8.20	8.18	–7.9**	–0.2**
Cuban	5.29	5.07	5.51	3.63	4.66	4.54	4.28	3.72	4.57	–13.6**	22.8**
Central and South American	5.52	5.02	5.45	5.28	4.68	4.64	4.98	5.06	5.04	–8.7**	–0.4**
Non-Hispanic white	6.28	6.04	6.02	5.98	5.76	5.70	5.72	5.80	5.70	–9.2	–1.7**
Non-Hispanic black	14.65	14.20	13.72	13.88	14.14	13.59	13.46	13.89	13.60	–7.2	–2.1**

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

[1]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. See reference 3.

births has a substantial impact on overall infant mortality (7,8,10). For example, in 2003 multiples accounted for 3 percent of all live births, but 15 percent of all infant deaths in the U.S. (Table 1).

Age at death

In 2003, more than two-thirds of all infant deaths (18,935 out of 27,995) occurred during the neonatal period (from birth through 27 days of age). The neonatal mortality rate, 4.63 deaths per 1,000 live births in 2003, was more than double the postneonatal (28 days to under 1 year) mortality rate of 2.22. Neonatal and postneonatal mortality rates for 2003 were essentially unchanged from the previous year.

The neonatal mortality rate for infants of non-Hispanic black mothers (9.26) was significantly higher than for all other race/ethnic groups and more than double those for non-Hispanic white, Asian or Pacific Islander, Mexican, Central and South American, and Cuban women. Neonatal mortality rates for Puerto Rican (5.70) and American Indian (4.55) 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 (4.34 and 4.18, 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 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 (11–15).

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. Figure 1 shows the percent distribution of live births and infant deaths by birthweight. Births at less than 500 grams accounted for only 0.2 percent of births, but 22.0 percent of all infant deaths in the U.S. in 2003. Births at 500–999 grams accounted for 0.6 percent of births, but 26.7 percent of infant deaths. Together, births to infants weighing less than 1,000 grams accounted for 0.8 percent of births, and nearly one-half (48.6 percent) of all infant deaths in the U.S. in 2003. Conversely, 92.0 percent of infants born in the U.S. in 2003 weighed 2,500 grams or more, but these infants accounted for only 31.0 percent of infant deaths.

A similar pattern is found when data by period of gestation are examined (Figure 2). Births at less than 28 weeks of gestation accounted for 0.7 percent of all live births, and 46.4 percent of all infant deaths in the U.S. in 2003.

The percentage of infants born at low birthweight (less than 2,500 grams) varied greatly by race and ethnicity, from a low of 6.3 percent for births to Mexican mothers to a high of 13.6 percent for births to non-Hispanic black mothers (Tables 4 and 5). The percentage 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 17.8 percent for births to non-Hispanic black mothers.

For all race and ethnic groups studied, infant mortality rates were much higher for low birthweight infants (59.04) than for infants with birthweights of 2,500 grams or more (2.29). Overall, the infant mortality rate for very low birthweight infants (those with birthweights of less than 1,500 grams) was 252.00, more than 110 times the rate for infants with birthweights of 2,500 grams or more (Table 6). Similarly, the infant mortality rate for very preterm infants (those born at less than 32 weeks of gestation) was 188.24, 78 times the rate for infants born at term (2.42) (37–41 weeks of gestation) (Tables 1 and 2).

At least 86 percent of infants with birthweights of less than 500 grams died within the first year of life (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 3,000–4,499 grams.

Trends in birthweight-specific infant mortality rates for the period 1995 to 2003 are shown in Table 6. For the total population, non-Hispanic white, non-Hispanic black, and Hispanic mothers, declines were largest for infants weighing 2,500–4,499 grams (Table 6).

From 2002 to 2003, changes in birthweight-specific infant mortality rates were not statistically significant. Previously, the infant mortality rate for very low birthweight infants had increased significantly from 2001–02, as had rates for preterm and very preterm infants. Also, the number of live born infants and fetal deaths of very low birthweights (i.e., less than 500 grams) had increased (7).

Prenatal care

Pennsylvania and Washington implemented the 2003 revision of the U.S. Standard Certificate of Live Birth in 2003. The question on the timing of prenatal care on the 2003 revision differs substantively from the question on the 1989 revision that is in use in the other States (3); thus, prenatal care data are not comparable between the two revisions. As a result, data for Pennsylvania and Washington were not included in the prenatal care tabulations in this report.

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 (16–19). Early comprehensive prenatal care can promote healthier pregnancies by providing health behavior advice, early detection and treatment of risk factors and symptoms, and monitoring (16,17). The initiation and subsequent utilization of prenatal care is also viewed as an indicator for access to care (19,20).

In 2003, the mortality rate for infants of mothers who began prenatal care after the first trimester of pregnancy or not at all was 8.96 per 1,000. This rate was 45 percent higher than the rate for infants of mothers who began care in the first trimester (6.20).

Overall, the infant mortality rate for women who began care in the third trimester (6.64) was lower than for women who began care in the second trimester (7.32). This is because women who began prenatal care in the third trimester had to have a period of gestation of at least 7 months, thus reducing the probability that the infant would be born preterm or of low birthweight. Therefore, to be able to compare women who receive the timeliest care with all other women, the category "after first trimester or no care" is used (Tables 1 and 2).

For each race and Hispanic origin group, infant mortality rates were higher for mothers who began prenatal care after the first trimester or no care, than for mothers who initiated prenatal care during the first trimester (Tables 1 and 2). These differences were significant for all but infants of American Indian, Puerto Rican, and Central or South

American mothers. Because of the small number of infant deaths for Cuban mothers with late or no care, a reliable rate could not be calculated.

Maternal age

Infant mortality rates vary with maternal age; infants of teenage mothers and mothers aged 40 and over have the highest rates (10.22 and 8.60 respectively). The lowest rates are for infants of mothers in their late twenties and early thirties (Tables 1 and 2).

In 2003, among births to teenagers, infants of the youngest mothers (under age 15 years) had the highest rate (16.06). The rate for infants of mothers aged 15–17 years was 11.45; the rate for infants of mothers aged 18–19 years was 9.49 (tabular data not shown).

Within race and ethnic subgroups, among groups for which rates could be reliably computed, infant mortality rates for births to non-Hispanic white mothers less than 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 (21); young maternal age might be a marker for poverty (22). Among older mothers, especially those of low socioeconomic status, infant mortality rates may be affected by pregnancy complications related to higher maternal age, (e.g., gestational diabetes mellitus and hypertensive disorders) (23).

Maternal education

Pennsylvania and Washington implemented the 2003 revision of the U.S. Standard Certificate of Live Birth in 2003. The question on education on the 2003 revision differs substantively from the question on the 1989 revision that is in use in the other States (3); thus, education data are not comparable between the two revisions. As a result, data for Pennsylvania and Washington were not included in the education tabulations in this report.

Infant mortality rates generally decreased with increasing educational level (Tables 1 and 2). This pattern may reflect the effects of more education as well as socioeconomic differences; women with more education tend to have higher income levels (24). However, infants of mothers with 0–8 years of education had a lower infant mortality rate compared to those with 9–11 years of education. This may be because most mothers with 0–8 years of education were born outside of the 50 States and the District of Columbia (25), and their infant mortality rates tend to be lower than for native-born mothers (see "Nativity").

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 (6.83) was 14 percent higher than for second births (5.98). The rate for fifth and higher order births (10.28) was 72 percent higher than the rate for second births. The higher parities and, therefore, the highest order births (fifth child and above) are more likely to be associated with older maternal age, multiple births, and lower socioeconomic status (3,26).

Marital status

Marital status may be a marker for the presence or absence of social, emotional, and financial resources (27, 28). Infants of mothers who are not married have been shown to be at higher risk for poor outcomes (29,30). In 2003, infants of married mothers had an infant mortality rate of 5.33 per 1,000, 45 percent lower than the rate for infants of unmarried mothers (9.71) (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 Puerto Rican, Cuban, and Central and South American infants, these differences were significant.

Nativity

In 2003, the infant mortality rate for mothers born in the 50 States and the District of Columbia (7.15) was 37 percent higher than the rate for mothers born elsewhere (5.21). 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) (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 and the social support for new mothers (31). 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 (32).

Maternal smoking

Pennsylvania and Washington implemented the 2003 revision of the U.S. Standard Certificate of Live Birth in 2003. The question on smoking during pregnancy on the 2003 revision differs substantively from the question on the 1989 revision that is in use in the other States (3); thus, smoking during pregnancy data are not comparable between the two revisions. As a result, data for Pennsylvania and Washington were not included in the smoking during pregnancy tabulations in this report. Additionally, California does not report maternal smoking on the birth certificate.

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 (33,34).

The infant mortality rate for infants of smokers was 11.25 in 2003, 71 percent higher than the rate of 6.59 for nonsmokers. For each race and Hispanic-origin group for which these rates could be computed, the infant mortality rate for smokers was higher than for nonsmokers (Tables 1 and 2 and Figure 3). Infant mortality rates for API mothers

who smoked during pregnancy were nearly two and one-half times the rates for nonsmokers.

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 2003 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 Newborn affected by complications of placenta, cord, and membranes (cord complications), accounted for 6 and 4 percent, respectively, of all infant deaths in 2003. Together, the five leading causes accounted for 55 percent of all infant deaths in the U.S. in 2003. The order of the five leading causes of death was the same in 2003 as in the previous year.

The rank order of the 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 mothers, for whom low birthweight was the leading cause.

Infant mortality rates for the five leading causes of death were basically unchanged from 2002–03, except for SIDS, which decreased by 8 percent. Recent declines in SIDS may also reflect a change in the way SIDS is diagnosed by the medical community (35). When examined by race and ethnicity, none of the race/ethnic groups shown in Table 7 had significant changes in cause-specific infant mortality rates from 2002–03.

When differences among cause-specific infant mortality rates were examined by race and ethnicity, infant mortality rates from Congenital malformations were 31 percent higher for non-Hispanic black, 47 percent higher for American Indian, and 19 percent higher for Mexican than for non-Hispanic white mothers.

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

SIDS rates were highest for American Indian and non-Hispanic black mothers—2.4 and 2.2 times those for non-Hispanic white mothers, respectively. As most SIDS deaths occur during the postneonatal 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 45 percent lower for Asian or Pacific Islander mothers, 51 percent lower for Mexican mothers, and 61 percent lower for Central and South American mothers.

For maternal complications and cord complications, infants of non-Hispanic black mothers had the highest mortality rates—2.8 and 2.2 times, respectively, than 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. Compared with non-Hispanic white women, Mexican women had lower infant mortality rates from maternal complications (15 percent lower) and cord complications (23 percent lower).

An examination of cause-specific differences in infant mortality rates between race and Hispanic origin groups can help the researcher to understand overall differences in infant mortality rates among these groups. For example, 30 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, 8 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 45 percent.

For American Indian mothers, 24 percent of their elevated infant mortality rate, when compared with non-Hispanic white mothers, can be accounted for by their higher SIDS rates, 20 percent by differences in Congenital malformations, and 11 percent by differences in low birthweight. 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 55 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, 6 percent by differences in Congenital malformations, and 5 percent by differences in cord complications. If Puerto Rican infant mortality for these three causes 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 46 percent. In addition to helping to explain differences in infant mortality rates among various groups, comparisons such as these can be helpful in targeting prevention efforts.

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List of Detailed Tables

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and specified race of mother: United States, 2003 linked file

Characteristics	All races	Race of mother			
		White	Black	American Indian[1]	Asian or Pacific Islander
	Infant mortality rates per 1,000 live births in specified group				
Total	6.84	5.72	13.49	8.73	4.83
Age at death:					
Total neonatal	4.63	3.86	9.22	4.55	3.40
Early neonatal (less than 7 days)	3.70	3.09	7.37	3.41	2.74
Late neonatal (7–27 days)	0.92	0.77	1.85	1.14	0.66
Postneonatal	2.22	1.86	4.27	4.18	1.43
Sex:					
Male	7.59	6.37	14.93	9.58	5.15
Female	6.07	5.04	12.00	7.84	4.48
Plurality:					
Single births	6.01	4.99	12.01	8.39	4.30
Plural births	30.99	26.96	53.89	21.30	23.93
Birthweight:					
Less than 2,500 grams	59.04	53.87	76.81	60.80	42.94
Less than 1,500 grams	252.00	240.00	278.56	253.94	236.21
1,500–2,499 grams	15.00	15.19	15.19	18.70	11.01
2,500 grams or more	2.29	2.08	3.56	4.52	1.58
Period of gestation:					
Less than 32 weeks	188.24	174.84	220.67	161.08	176.03
32–36 weeks	8.53	8.15	9.90	11.59	8.17
37–41 weeks	2.42	2.19	3.89	4.47	1.67
42 weeks or more	2.88	2.60	4.69	*	1.78
Trimester of pregnancy prenatal care began:[2]					
First trimester	6.20	5.24	12.56	7.99	4.43
After first trimester or no care	8.96	7.39	14.41	10.15	6.25
Second trimester	7.32	6.25	11.18	9.67	4.98
Third trimester	6.64	6.12	8.92	*	4.41
No prenatal care	34.06	25.22	53.66	32.00	41.10
Age of mother:					
Under 20 years	10.22	8.67	14.75	9.43	10.78
20–24 years	7.70	6.44	12.95	8.26	6.56
25–29 years	5.97	4.98	12.85	8.93	3.88
30–34 years	5.62	4.77	13.54	7.47	4.14
35–39 years	6.10	5.17	13.89	9.64	4.82
40–54 years	8.60	7.56	16.67	*	6.74
Educational attainment of mother:[2]					
0–8 years	6.99	6.45	14.34	12.36	6.41
9–11 years	9.35	7.80	15.19	9.01	8.12
12 years	7.66	6.28	13.37	8.98	6.05
13–15 years	6.21	5.12	11.93	6.42	4.46
16 years and over	4.24	3.76	10.21	7.96	3.61
Live-birth order:					
1	6.83	5.82	13.39	8.20	4.87
2	5.98	5.07	12.15	8.14	4.21
3	6.82	5.64	13.24	8.53	4.90
4	8.22	6.60	14.84	10.36	7.37
5 or more	10.28	8.04	17.18	11.56	7.58
Marital status:					
Married	5.33	4.89	11.51	7.27	4.20
Unmarried	9.71	7.73	14.41	9.66	8.36
Mother's place of birth:					
Born in the 50 States and DC	7.15	5.79	13.76	8.96	6.31
Born elsewhere	5.21	4.92	9.27	*	4.45
Maternal smoking during pregnancy:[2,3]					
Smoker	11.25	9.96	19.71	13.36	12.50
Nonsmoker	6.59	5.27	13.05	7.85	5.09

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and specified race of mother: United States, 2003 linked file—Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian[1]	Asian or Pacific Islander
	Live births				
Total	4,090,007	3,225,890	599,860	43,054	221,203
Sex:					
Male	2,093,564	1,652,166	305,215	22,019	114,164
Female	1,996,443	1,573,724	294,645	21,035	107,039
Plurality:					
Single births	3,953,667	3,117,848	578,577	41,974	215,268
Plural births	136,340	108,042	21,283	1,080	5,935
Birthweight:					
Less than 2,500 grams	325,619	224,570	80,603	3,191	17,255
Less than 1,500 grams	60,505	38,629	18,858	571	2,447
1,500–2,499 grams	265,114	185,941	61,745	2,620	14,808
2,500 grams or more	3,763,758	3,000,852	519,127	39,856	203,923
Not stated	630	468	130	7	25
Period of gestation:					
Less than 32 weeks	79,633	52,138	23,474	925	3,096
32–36 weeks	419,402	313,237	81,636	4,831	19,698
37–41 weeks	3,288,550	2,618,962	454,209	33,529	181,850
42 weeks or more	258,553	206,544	36,235	3,390	12,384
Not stated	43,869	35,009	4,306	379	4,175
Trimester of pregnancy prenatal care began:[2]					
First trimester	3,189,811	2,562,471	425,307	28,145	173,888
After first trimester or no care	603,714	427,592	134,879	11,627	29,616
Second trimester	469,651	336,408	101,347	8,585	23,311
Third trimester	94,603	65,011	22,090	2,292	5,210
No prenatal care	39,460	26,173	11,442	750	1,095
Not stated	70,033	50,852	13,602	898	4,681
Age of mother:					
Under 20 years	421,254	302,031	103,683	7,844	7,696
20–24 years	1,032,325	790,927	196,270	14,646	30,482
25–29 years	1,086,375	871,501	139,950	10,525	64,399
30–34 years	975,555	795,910	97,530	6,423	75,692
35–39 years	467,646	379,777	49,889	2,906	35,074
40–54 years	106,852	85,744	12,538	710	7,860
Educational attainment of mother:[2]					
0–8 years	233,843	210,713	14,570	1,699	6,861
9–11 years	588,289	443,340	121,101	10,547	13,301
12 years	1,162,705	879,196	221,000	15,925	46,584
13–15 years	811,986	629,733	132,461	8,563	41,229
16 years and over	1,012,739	837,728	75,614	3,393	96,004
Not stated	53,996	40,205	9,042	543	4,206
Live-birth order:					
1	1,634,003	1,288,693	226,482	15,238	103,590
2	1,320,479	1,057,831	174,614	11,788	76,246
3	684,299	544,266	105,790	7,738	26,505
4	267,686	205,042	49,948	4,152	8,544
5 or more	171,560	121,347	40,693	3,978	5,542
Not stated	11,980	8,711	2,333	160	776
Marital status:					
Married	2,673,979	2,278,856	190,518	16,651	187,954
Unmarried	1,416,028	947,034	409,342	26,403	33,249
Mother's place of birth:					
Born in the 50 States and DC	3,109,555	2,519,779	511,863	40,529	37,384
Born elsewhere	965,213	696,325	83,600	2,426	182,862
Not stated	15,239	9,786	4,397	99	957
Maternal smoking during pregnancy:[2,3]					
Smoker	354,591	301,072	43,740	6,738	3,041
Nonsmoker	2,948,501	2,285,705	495,373	30,448	136,975
Not stated	19,469	15,764	2,326	568	811

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and specified race of mother: United States, 2003 linked file—Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian[1]	Asian or Pacific Islander
	Infant deaths				
Total	27,995	18,458	8,094	376	1,068
Age at death:					
Total neonatal	18,935	12,457	5,530	196	752
Early neonatal (less than 7 days)	15,152	9,975	4,423	147	607
Late neonatal (7–27 days)	3,783	2,482	1,107	49	145
Postneonatal	9,060	6,000	2,563	180	316
Sex:					
Male	15,882	10,526	4,558	211	588
Female	12,113	7,931	3,536	165	480
Plurality:					
Single births	23,770	15,544	6,947	352	926
Plural births	4,225	2,913	1,147	23	142
Birthweight:					
Less than 2,500 grams	19,223	12,097	6,191	194	741
Less than 1,500 grams	15,247	9,271	5,253	145	578
1,500–2,499 grams	3,976	2,825	938	49	163
2,500 grams or more	8,603	6,251	1,848	180	323
Not stated	169	110	54	1	4
Period of gestation:					
Less than 32 weeks	14,990	9,116	5,180	149	545
32–36 weeks	3,579	2,554	808	56	161
37–41 weeks	7,961	5,743	1,765	150	304
42 weeks or more	744	536	170	15	22
Not stated	721	509	171	5	36
Trimester of pregnancy prenatal care began:[2]					
First trimester	19,772	13,434	5,342	225	771
After first trimester or no care	5,408	3,161	1,944	118	185
Second trimester	3,436	2,103	1,133	83	116
Third trimester	628	398	197	10	23
No prenatal care	1,344	660	614	24	45
Not stated	1,445	889	480	12	64
Age of mother:					
Under 20 years	4,304	2,618	1,529	74	83
20–24 years	7,954	5,091	2,542	121	200
25–29 years	6,484	4,341	1,799	94	250
30–34 years	5,481	3,799	1,321	48	313
35–39 years	2,853	1,962	693	28	169
40–54 years	919	648	209	10	53
Educational attainment of mother:[2]					
0–8 years	1,634	1,360	209	21	44
9–11 years	5,503	3,459	1,840	95	108
12 years	8,903	5,524	2,954	143	282
13–15 years	5,045	3,225	1,580	55	184
16 years and over	4,296	3,150	772	27	347
Not stated	1,244	765	411	13	55
Live-birth order:					
1	11,163	7,502	3,033	125	504
2	7,900	5,361	2,122	96	321
3	4,665	3,069	1,401	66	130
4	2,201	1,354	741	43	63
5 or more	1,763	976	699	46	42
Not stated	302	196	97	–	8
Marital status:					
Married	14,243	11,139	2,193	121	790
Unmarried	13,752	7,319	5,900	255	278

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and specified race of mother: United States, 2003 linked file—Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian[1]	Asian or Pacific Islander
		Infant deaths			
Mother's place of birth:					
Born in the 50 States and DC	22,241	14,597	7,044	363	236
Born elsewhere	5,027	3,428	775	11	813
Not stated	727	433	275	1	18
Maternal smoking during pregnancy:[2,3]					
Smoker	3,990	3,000	862	90	38
Nonsmoker	19,444	12,045	6,463	239	697
Not stated	384	278	93	7	6

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

[1]Includes Aleuts and Eskimos.

[2]Excludes data for Pennsylvania and Washington, which implemented the 2003 Revision to the U.S. Standard Certificate of Live Birth for data year 2003. This change has resulted in a lack of comparability between data based on the 2003 Revision and data based on the 1989 Revision to the U.S. Certificate of Live Birth; see "Technical Notes."

[3]Excludes data for California, which does not report tobacco use on the birth certificate.

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. See reference 3.

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, 2003 linked file

Characteristics	All origins[1]	Hispanic						Non-Hispanic		
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total[2]	White	Black
	Infant mortality rates per 1,000 live births in specified group									
Total	6.84	5.65	5.49	8.18	4.57	5.04	6.66	7.11	5.70	13.60
Age at death:										
Total neonatal	4.63	3.92	3.76	5.70	3.36	3.64	4.74	4.76	3.79	9.26
Early neonatal (less than 7 days)	3.70	3.14	3.00	4.64	2.56	2.96	3.94	3.80	3.02	7.39
Late neonatal (7–27 days)	0.92	0.77	0.77	1.06	*	0.69	0.80	0.96	0.77	1.88
Postneonatal	2.22	1.73	1.73	2.48	*	1.39	1.92	2.35	1.91	4.34
Sex:										
Male	7.59	6.21	6.03	9.22	4.89	5.60	7.10	7.90	6.37	15.05
Female	6.07	5.06	4.94	7.10	4.24	4.45	6.19	6.29	4.99	12.10
Plurality:										
Single births	6.01	5.11	5.02	7.11	3.62	4.47	6.12	6.21	4.89	12.10
Plural births	30.99	29.28	28.06	42.76	*	27.74	26.28	31.01	26.21	54.12
Birthweight:										
Less than 2,500 grams	59.04	57.47	58.28	59.04	52.53	53.23	57.79	58.73	52.02	76.46
Less than 1,500 grams	252.00	255.82	259.14	247.26	210.78	243.72	279.07	248.67	231.69	276.92
1,500–2,499 grams	15.00	15.28	16.45	11.34	*	12.80	14.55	14.85	15.10	15.16
2,500 grams or more	2.29	1.89	1.91	2.46	*	1.57	2.13	2.40	2.15	3.60
Period of gestation:										
Less than 32 weeks	188.24	169.04	165.06	190.19	167.91	170.48	176.85	190.82	175.45	219.63
32–36 weeks	8.53	7.58	7.74	9.31	*	6.37	6.60	8.78	8.35	9.96
37–41 weeks	2.42	2.01	2.03	2.46	*	1.71	2.32	2.53	2.26	3.92
42 weeks or more	2.88	2.48	2.59	*	*	2.27	*	3.00	2.64	4.82
Trimester of pregnancy prenatal care began:[3]										
First trimester	6.20	5.30	5.23	7.56	4.18	4.77	5.66	6.42	5.22	12.68
After first trimester or no care	8.96	6.17	6.01	9.78	*	5.37	7.12	10.22	8.35	14.51
Second trimester	7.32	5.36	5.25	7.41	*	4.81	6.05	8.20	6.98	11.21
Third trimester	6.64	4.41	4.43	*	*	4.09	*	7.77	7.62	9.13
No prenatal care	34.06	19.25	17.11	54.87	*	19.84	*	41.65	31.32	53.72
Age of mother:										
Under 20 years	10.22	6.77	6.42	10.93	*	6.12	6.70	11.67	10.02	14.72
20–24 years	7.70	5.46	5.26	6.95	*	5.24	6.83	8.44	6.87	13.08
25–29 years	5.97	4.97	4.83	7.98	*	4.42	5.73	6.19	4.93	13.06
30–34 years	5.62	5.42	5.37	7.42	*	4.83	7.02	5.59	4.56	13.64
35–39 years	6.10	6.28	6.32	8.42	*	5.65	6.82	5.98	4.82	14.10
40–54 years	8.60	9.10	10.00	*	*	5.55	*	8.34	7.12	16.45
Educational attainment of mother:[3]										
0–8 years	6.99	5.61	5.44	11.92	*	5.83	7.34	11.29	10.61	15.51
9–11 years	9.35	5.92	5.71	9.74	*	5.45	5.80	11.62	9.85	15.38
12 years	7.66	5.52	5.39	7.78	4.62	5.30	5.31	8.28	6.62	13.50
13–15 years	6.21	5.11	5.21	6.97	*	3.78	5.66	6.40	5.16	12.04
16 years and over	4.24	4.40	4.17	5.67	5.04	4.06	4.90	4.22	3.71	10.20
Live-birth order:										
1	6.83	5.88	5.65	8.34	4.16	5.51	7.40	7.00	5.76	13.49
2	5.98	4.98	4.93	6.60	4.35	4.47	5.32	6.21	5.07	12.33
3	6.82	5.24	5.18	8.51	*	4.23	5.02	7.32	5.81	13.36
4	8.22	6.12	5.78	9.15	*	5.48	10.21	9.00	6.84	14.96
5 or more	10.28	7.97	7.65	13.86	*	7.00	*	11.15	8.08	17.31
Marital status:										
Married	5.33	5.13	5.07	7.46	3.92	4.73	5.51	5.31	4.78	11.61
Unmarried	9.71	6.28	6.04	8.64	6.00	5.42	7.96	11.00	8.66	14.52
Mother's place of birth:										
Born in the 50 States and DC	7.15	6.41	6.20	8.20	5.28	5.84	6.37	7.21	5.69	13.81
Born elsewhere	5.21	5.08	5.03	7.94	3.96	4.92	4.51	5.33	4.36	9.59
Maternal smoking during pregnancy:[3,4]										
Smoker	11.25	11.77	11.18	13.29	*	*	13.76	11.21	9.87	19.74
Nonsmoker	6.59	5.73	5.58	7.77	4.79	5.26	6.40	6.79	5.11	13.19

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, 2003 linked file—Con.

Characteristics	All origins[1]	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total[2]	White	Black	
	Live births										
Total	4,090,007	912,331	654,507	58,400	14,867	135,585	48,972	3,149,067	2,321,921	576,047	28,609
Sex:											
Male	2,093,564	465,230	333,692	29,817	7,560	69,246	24,915	1,613,723	1,191,196	293,061	14,611
Female	1,996,443	447,101	320,815	28,583	7,307	66,339	24,057	1,535,344	1,130,725	282,986	13,998
Plurality:											
Single births	3,953,667	892,075	641,073	56,646	14,374	132,304	47,678	3,034,153	2,234,299	555,406	27,439
Plural births	136,340	20,256	13,434	1,754	493	3,281	1,294	114,914	87,622	20,641	1,170
Birthweight:											
Less than 2,500 grams	325,619	61,212	41,268	5,860	1,047	9,092	3,945	261,875	164,033	78,445	2,532
Less than 1,500 grams	60,505	10,738	7,112	1,185	204	1,592	645	49,146	27,964	18,370	621
1,500–2,499 grams	265,114	50,474	34,156	4,675	843	7,500	3,300	212,729	136,069	60,075	1,911
2,500 grams or more	3,763,758	851,069	613,206	52,534	13,820	126,489	45,020	2,886,805	2,157,621	497,506	25,884
Not stated	630	50	33	6	*	4	7	387	267	96	193
Period of gestation:											
Less than 32 weeks	79,633	15,405	10,487	1,488	268	2,229	933	63,501	36,905	22,848	727
32–36 weeks	419,402	90,283	64,066	6,551	1,483	13,029	5,154	326,344	224,058	79,146	2,775
37–41 weeks	3,288,550	721,266	515,224	46,009	12,172	109,061	38,800	2,545,085	1,904,576	435,340	22,199
42 weeks or more	258,553	63,292	45,575	4,109	897	9,256	3,455	193,615	144,119	34,670	1,646
Not stated	43,869	22,085	19,155	243	47	2,010	630	20,522	12,263	4,043	1,262
Trimester of pregnancy prenatal care began:[3]											
First trimester	3,189,811	673,272	479,633	41,517	13,388	103,926	34,808	2,498,043	1,892,780	411,017	18,496
After first trimester or no care	603,714	195,976	147,450	9,607	1,156	27,370	10,393	403,946	235,029	130,237	3,792
Second trimester	469,651	150,082	112,275	7,690	970	21,217	7,930	317,105	189,307	97,827	2,464
Third trimester	94,603	32,179	24,127	1,352	120	4,893	1,687	61,655	33,333	21,259	769
No prenatal care	39,460	13,715	11,048	565	66	1,260	776	25,186	12,389	11,151	559
Not stated	70,033	18,931	14,026	1,291	112	2,106	1,396	48,851	31,005	12,746	2,251
Age of mother:											
Under 20 years	421,254	130,880	100,238	10,430	1,177	11,271	7,764	287,870	174,023	100,157	2,504
20–24 years	1,032,325	273,311	203,315	19,004	2,608	33,587	14,797	752,619	522,283	189,023	6,395
25–29 years	1,086,375	246,362	177,500	14,169	3,966	38,505	12,222	832,788	627,438	133,824	7,225
30–34 years	975,555	169,055	115,034	9,301	4,298	31,448	8,974	799,183	626,318	93,347	7,317
35–39 years	467,646	75,801	48,120	4,515	2,283	16,629	4,254	387,808	303,355	47,661	4,037
40–54 years	106,852	16,922	10,300	981	535	4,145	961	88,799	68,504	12,035	1,131
Educational attainment of mother:[3]											
0–8 years	233,843	179,656	149,187	1,929	179	24,683	3,678	53,298	33,456	12,377	889
9–11 years	588,289	234,794	188,165	13,651	1,505	21,466	10,007	351,378	212,023	117,282	2,117
12 years	1,162,705	263,657	183,953	17,730	5,194	40,777	16,003	893,848	620,665	214,314	5,200
13–15 years	811,986	118,462	71,044	12,058	3,153	23,021	9,186	689,988	513,666	128,458	3,536
16 years and over	1,012,739	75,687	36,969	6,700	4,562	20,932	6,524	932,036	760,504	73,397	5,016
Not stated	53,996	15,923	11,791	347	63	2,523	1,199	30,292	18,500	8,172	7,781
Live-birth order:											
1	1,634,003	330,033	227,448	22,913	6,969	53,522	19,181	1,292,851	961,903	217,196	11,119
2	1,320,479	280,461	198,082	18,020	5,283	43,848	15,228	1,031,631	780,028	167,442	8,387
3	684,299	175,225	130,702	10,222	1,885	23,856	8,560	504,735	370,972	101,659	4,339
4	267,686	76,317	58,997	4,262	493	8,940	3,625	189,498	129,617	48,204	1,871
5 or more	171,560	47,922	37,638	2,814	219	5,140	2,111	122,125	73,900	39,526	1,513
Not stated	11,980	2,373	1,640	169	18	279	267	8,227	5,501	2,020	1,380
Marital status:											
Married	2,673,979	501,709	368,763	23,461	10,200	73,168	26,117	2,153,458	1,774,925	181,206	18,812
Unmarried	1,416,028	410,622	285,744	34,939	4,667	62,417	22,855	995,609	546,996	394,841	9,797
Mother's place of birth:											
Born in the 50 States and DC	3,109,555	334,095	236,685	38,639	7,013	16,430	35,328	2,753,747	2,181,598	501,663	21,713
Born elsewhere	965,213	576,245	416,948	19,399	7,838	118,976	13,084	383,605	133,209	70,707	5,363
Not stated	15,239	1,991	874	362	16	179	560	11,715	7,114	3,677	1,533
Maternal smoking during pregnancy:[3,4]											
Smoker	354,591	16,401	8,231	3,989	334	1,158	2,689	335,799	283,666	43,069	2,391
Nonsmoker	2,948,501	599,699	395,288	46,318	13,574	106,398	38,121	2,333,599	1,695,785	477,863	15,203
Not stated	19,469	2,374	1,615	133	19	269	338	15,975	12,599	2,143	1,120

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, 2003 linked file—Con.

Characteristics	All origins[1]	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total[2]	White	Black	
	Infant deaths										
Total	27,995	5,151	3,595	478	68	684	326	22,396	13,228	7,836	448
Age at death:											
Total neonatal	18,935	3,572	2,463	333	50	494	232	14,994	8,798	5,336	368
Early neonatal (less than 7 days)	15,152	2,865	1,962	271	38	401	193	11,956	7,021	4,255	331
Late neonatal (7–27 days)	3,783	707	501	62	12	93	39	3,038	1,777	1,081	37
Postneonatal	9,060	1,579	1,133	145	18	189	94	7,402	4,431	2,501	80
Sex:											
Male	15,882	2,889	2,012	275	37	388	177	12,746	7,589	4,412	247
Female	12,113	2,262	1,584	203	31	295	149	9,650	5,639	3,424	201
Plurality:											
Single births	23,770	4,558	3,219	403	52	592	292	18,832	10,932	6,719	380
Plural births	4,225	593	377	75	16	91	34	3,564	2,297	1,117	68
Birthweight:											
Less than 2,500 grams	19,223	3,518	2,405	346	55	484	228	15,381	8,533	5,998	323
Less than 1,500 grams	15,247	2,747	1,843	293	43	388	180	12,221	6,479	5,087	279
1,500–2,499 grams	3,976	771	562	53	12	96	48	3,160	2,054	911	44
2,500 grams or more	8,603	1,606	1,171	129	13	198	96	6,916	4,643	1,793	81
Not stated	169	26	19	3	*	2	2	100	52	45	43
Period of gestation:											
Less than 32 weeks	14,990	2,604	1,731	283	45	380	165	12,117	6,475	5,018	269
32–36 weeks	3,579	684	496	61	9	83	34	2,864	1,870	788	30
37–41 weeks	7,961	1,447	1,046	113	13	186	90	6,441	4,302	1,708	74
42 weeks or more	744	157	118	13	1	21	4	580	380	167	7
Not stated	721	259	204	8	*	14	32	394	202	156	68
Trimester of pregnancy prenatal care began:[3]											
First trimester	19,772	3,570	2,507	314	56	496	197	16,037	9,881	5,213	165
After first trimester or no care	5,408	1,210	886	94	10	147	74	4,128	1,963	1,890	69
Second trimester	3,436	804	590	57	8	102	48	2,600	1,321	1,097	31
Third trimester	628	142	107	6	*	20	9	479	254	194	7
No prenatal care	1,344	264	189	31	2	25	17	1,049	388	599	31
Not stated	1,445	235	139	20	2	27	46	1,108	573	465	103
Age of mother:											
Under 20 years	4,304	886	644	114	8	69	52	3,360	1,744	1,474	58
20–24 years	7,954	1,493	1,069	132	15	176	101	6,352	3,589	2,473	108
25–29 years	6,484	1,225	858	113	15	170	70	5,159	3,091	1,748	100
30–34 years	5,481	917	618	69	16	152	63	4,464	2,854	1,273	99
35–39 years	2,853	476	304	38	10	94	29	2,319	1,462	672	58
40–54 years	919	154	103	12	4	23	11	741	488	198	24
Educational attainment of mother:[3]											
0–8 years	1,634	1,007	812	23	*	144	27	602	355	192	26
9–11 years	5,503	1,391	1,074	133	9	117	58	4,083	2,088	1,804	29
12 years	8,903	1,456	992	138	24	216	85	7,402	4,109	2,894	45
13–15 years	5,045	605	370	84	12	87	52	4,419	2,649	1,547	21
16 years and over	4,296	333	154	38	23	85	32	3,936	2,820	749	27
Not stated	1,244	224	128	12	*	22	62	831	395	382	190
Live-birth order:											
1	11,163	1,941	1,284	191	29	295	142	9,053	5,545	2,929	170
2	7,900	1,396	977	119	23	196	81	6,406	3,956	2,064	98
3	4,665	919	677	87	12	101	43	3,696	2,157	1,358	50
4	2,201	467	341	39	2	49	37	1,706	886	721	27
5 or more	1,763	382	288	39	2	36	16	1,362	597	684	20
Not stated	302	46	29	2	*	7	8	173	88	81	82
Marital status:											
Married	14,243	2,574	1,868	175	40	346	144	11,445	8,489	2,103	224
Unmarried	13,752	2,577	1,727	302	28	338	182	10,951	4,739	5,733	223

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, 2003 linked file—Con.

Characteristics	All origins[1]	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total[2]	White	Black	
	Infant deaths										
Mother's place of birth:											
Born in the 50 States and DC	22,241	2,143	1,468	317	37	96	225	19,868	12,406	6,928	230
Born elsewhere	5,027	2,928	2,099	154	31	585	59	2,044	581	678	55
Not stated	727	80	28	7	*	3	42	485	241	230	162
Maternal smoking during pregnancy:[3,4]											
Smoker	3,990	193	92	53	3	8	37	3,764	2,800	850	32
Nonsmoker	19,444	3,434	2,206	360	65	560	244	15,853	8,671	6,302	158
Not stated	384	31	17	5	*	4	5	277	183	83	75

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

– Quantity zero.

[1]Includes origin not stated.

[2]Includes races other than black or white.

[3]Excludes data for Pennsylvania and Washington, which implemented the 2003 Revision to the U.S. Standard Certificate of Live Birth for data year 2003. This change has resulted in a lack of comparability between data based on the 2003 Revision and data based on the 1989 Revision to the U.S. Certificate of Live Birth; see "Technical Notes."

[4]Excludes data for California, which does not report tobacco use on the birth certificate.

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 3.

Table 3. Infant mortality rates by race and Hispanic origin of mother: United States and each State, Puerto Rico, Virgin Islands, and Guam, 2001–2003 linked files

[By place of residence]

State	Total	Race and Hispanic origin of mother						
		Race				Hispanic origin		
		White	Black	American Indian[1]	Asian or Pacific Islander	Hispanic	Non-Hispanic white	Non-Hispanic black
	Infant mortality rates per 1,000 live births in specified group							
United States[2]	6.88	5.74	13.55	9.00	4.78	5.57	5.74	13.65
Alabama	9.04	6.74	14.09	*	*	7.00	6.71	14.09
Alaska	6.80	5.40	*	10.58	*	*	5.06	*
Arizona	6.62	6.13	13.74	9.68	6.21	6.17	6.10	13.81
Arkansas	8.46	7.35	13.08	*	*	5.27	7.63	13.08
California	5.32	5.00	11.15	7.34	4.34	5.08	4.67	11.13
Colorado	5.98	5.50	14.55	*	6.68	6.31	5.16	14.24
Connecticut	5.95	5.04	13.23	*	*	6.34	4.63	13.58
Delaware	9.53	7.48	16.34	*	*	6.88	7.57	16.43
District of Columbia	10.94	4.79	14.42	*	*	7.18	3.82	14.81
Florida	7.42	5.72	13.27	7.38	5.14	5.29	5.85	13.31
Georgia	8.66	6.36	13.50	*	6.54	6.41	6.34	13.46
Hawaii	7.05	5.71	*	*	7.34	6.77	5.32	*
Idaho	6.21	6.19	*	*	*	6.98	5.99	*
Illinois	7.58	5.90	15.50	*	5.42	5.86	5.93	15.52
Indiana	7.66	6.94	13.83	*	*	6.44	6.99	13.84
Iowa	5.56	5.35	12.08	*	*	6.45	5.25	12.31
Kansas	7.07	6.44	15.71	*	*	7.31	6.32	15.81
Kentucky	6.62	6.29	10.01	*	*	4.92	6.34	10.07
Louisiana	9.83	6.87	13.94	*	9.85	4.48	6.97	13.92
Maine	5.17	5.11	*	*	*	*	5.12	*
Maryland	7.96	5.48	13.09	*	4.33	6.04	5.40	13.21
Massachusetts	4.86	4.40	9.49	*	3.40	6.27	4.01	10.18
Michigan	8.23	6.49	16.77	*	5.19	7.29	6.35	16.71
Minnesota	5.12	4.67	8.82	9.82	5.48	5.67	4.55	8.39
Mississippi	10.53	7.13	14.77	*	*	*	7.14	14.72
Missouri	7.91	6.56	15.69	*	6.22	7.01	6.52	15.75
Montana	7.33	7.00	*	9.42	*	*	6.86	*
Nebraska	6.41	5.78	14.94	*	*	6.18	5.59	15.18
Nevada	5.80	5.14	12.78	*	4.26	4.44	5.40	12.81
New Hampshire	4.33	4.32	*	*	*	*	4.20	*
New Jersey	5.91	4.61	12.45	*	3.73	6.06	3.92	13.08
New Mexico	6.07	5.98	*	6.00	*	5.89	6.09	*
New York	5.98	4.91	10.85	11.91	3.38	5.55	4.63	11.22
North Carolina	8.30	6.15	15.13	11.05	4.78	6.07	6.15	15.12
North Dakota	7.48	6.93	*	11.40	*	*	6.84	*
Ohio	7.78	6.43	15.48	*	5.11	8.22	6.33	15.41
Oklahoma	7.76	7.11	14.41	7.37	*	5.62	7.19	14.25
Oregon	5.56	5.45	9.30	8.93	4.72	4.72	5.61	9.35
Pennsylvania	7.39	6.30	14.25	*	4.02	7.97	5.97	14.11
Rhode Island	6.88	6.31	11.14	*	*	8.75	5.30	11.84
South Carolina	8.88	6.01	14.49	*	7.85	5.30	6.09	14.52
South Dakota	6.86	5.76	*	12.65	*	*	5.75	*
Tennessee	9.08	7.02	16.90	*	6.41	6.61	7.06	16.87
Texas	6.24	5.57	11.98	*	4.38	5.38	5.70	11.94
Utah	5.16	5.01	*	*	7.95	6.40	4.76	*
Vermont	5.07	5.14	*	*	*	*	5.03	*
Virginia	7.51	5.67	14.04	*	5.03	4.89	5.74	14.15
Washington	5.68	5.42	9.72	10.62	4.72	5.15	5.33	9.45
West Virginia	7.91	7.73	12.85	*	*	*	7.65	12.47
Wisconsin	6.83	5.57	17.46	12.66	6.64	6.90	5.47	17.48
Wyoming	6.05	5.79	*	*	*	*	5.64	*
Puerto Rico	9.43	9.28	10.86	- - -	- - -	- - -	- - -	- - -
Virgin Islands	5.80	*	*	*	*	*	*	*
Guam	9.12	*	*	*	9.39	*	*	*

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

[1]Includes Aleuts and Eskimos. [2]Excludes data for Puerto Rico, Virgin Islands, and Guam.

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management 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 3.

Table 4. Percent of live births with selected maternal and infant characteristics by race of mother: United States, 2003 linked file

Characteristic	All races	White	Black	American Indian[1]	Asian or Pacific Islander
Birthweight:					
Less than 1,500 grams	1.5	1.2	3.2	1.3	1.1
Less than 2,500 grams	8.0	7.0	13.5	7.4	7.8
Preterm births[2]	12.3	11.4	17.7	13.5	10.5
Prenatal care beginning in the first trimester[3]	84.0	85.6	75.9	70.7	85.4
Births to mothers under 20 years	10.3	9.3	17.3	18.3	3.4
Fourth and higher order births	10.8	10.1	15.2	19.0	6.3
Births to unmarried mothers	34.6	29.2	68.4	61.5	14.7
Mothers completing 12 or more years of school[3]	78.3	78.2	76.1	69.5	90.2
Mothers born in the 50 States and DC	76.3	78.8	86.7	95.1	16.6
Mothers who smoked during pregnancy[3,4]	10.7	11.7	8.2	18.2	2.2

[1]Includes births to Aleuts and Eskimos.

[2]Born prior to 37 completed weeks of gestation.

[3]Excludes data for Pennsylvania and Washington, which implemented the 2003 Revision to the U.S. Standard Certificate of Live Birth for data year 2003. This change has resulted in a lack of comparability between data based on the 2003 Revision and data based on the 1989 Revision to the U.S. Certificate of Live Birth: see "Technical Notes."

[4]Excludes data for California, which does not report tobacco use on the birth certificate.

NOTES: 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. See reference 3.

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, 2003 linked file

Characteristic	All origins[1]	Hispanic						Non-Hispanic		
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total[2]	White	Black
Birthweight:										
Less than 1,500 grams	1.5	1.2	1.1	2.0	1.4	1.2	1.3	1.6	1.2	3.2
Less than 2,500 grams	8.0	6.7	6.3	10.0	7.0	6.7	8.1	8.3	7.1	13.6
Preterm births[3]	12.3	11.9	11.7	13.8	11.8	11.4	12.6	12.5	11.3	17.8
Prenatal care beginning in the first trimester[4]	84.0	77.4	76.5	81.1	92.0	79.1	77.0	85.9	88.8	75.9
Births to mothers under 20 years	10.3	14.3	15.3	17.9	7.9	8.3	15.9	9.1	7.5	17.4
Fourth and higher order births	10.8	13.7	14.8	12.2	4.8	10.4	11.8	9.9	8.8	15.3
Births to unmarried mothers	34.6	45.0	43.7	59.8	31.4	46.0	46.7	31.6	23.6	68.5
Mothers completing 12 or more years of school[4]	78.3	52.5	46.4	70.0	88.4	64.7	69.8	86.0	88.3	76.2
Mothers born in the 50 States and DC	76.3	36.7	36.2	66.6	47.2	12.1	73.0	87.7	94.2	87.6
Mothers who smoked during pregnancy[4,5]	10.7	2.7	2.0	7.9	2.4	1.1	6.6	12.6	14.3	8.3

[1]Includes origin not stated.

[2]Includes races other than black or white.

[3]Born prior to 37 completed weeks of gestation.

[4]Excludes data for Pennsylvania and Washington, which implemented the 2003 Revision to the U.S. Standard Certificate of Live Birth for data year 2003. This change has resulted in a lack of comparability between data based on the 2003 Revision and data based on the 1989 Revision to the U.S. Certificate of Live Birth; see "Technical Notes."

[5]Excludes data for California, which does not report tobacco use on the birth certificate.

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. See reference 3.

Table 6. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race and Hispanic origin of mother and birthweight: United States, 2003 linked file, and percentage change in birthweight-specific infant mortality, 1995–2003 linked file

Race and birthweight	Number in 2003				Mortality rate per 1,000 live births in 2003			Percent change in infant mortality rate 1995–2003
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races[1]	4,090,007	27,995	18,935	9,060	6.84	4.63	2.22	–9.5
Less than 2,500 grams	325,619	19,223	15,762	3,461	59.04	48.41	10.63	–8.6
Less than 1,500 grams	60,505	15,247	13,435	1,812	252.00	222.05	29.95	–6.1
Less than 500 grams	7,060	6,110	5,975	136	865.44	846.32	19.26	–4.3**
500–749 grams	11,515	5,489	4,747	742	476.68	412.24	64.44	–9.7
750–999 grams	11,892	1,947	1,447	500	163.72	121.68	42.05	–10.1
1,000–1,249 grams	13,635	945	717	227	69.31	52.59	16.65	–19.0
1,250–1,499 grams	16,403	755	549	206	46.03	33.47	12.56	–15.7
1,500–1,999 grams	63,891	1,781	1,182	600	27.88	18.50	9.39	–15.9
2,000–2,499 grams	201,223	2,194	1,145	1,049	10.90	5.69	5.21	–19.6
2,500 grams or more	3,763,758	8,603	3,017	5,585	2.29	0.80	1.48	–22.7
2,500–2,999 grams	711,351	2,927	1,140	1,787	4.11	1.60	2.51	–24.3
3,000–3,499 grams	1,558,404	3,371	1,141	2,230	2.16	0.73	1.43	–24.7
3,500–3,999 grams	1,132,005	1,747	523	1,224	1.54	0.46	1.08	–23.3
4,000–4,499 grams	309,849	413	145	268	1.33	0.47	0.86	–26.7
4,500–4,999 grams	46,715	111	49	62	2.38	1.05	1.33	9.7**
5,000 grams or more	5,434	34	20	14	6.26	3.68	*	–25.1**
Not stated	630	169	155	14	. . .	. . .	. . .	*
White	3,225,890	18,458	12,457	6,000	5.72	3.86	1.86	–9.2
Less than 2,500 grams	224,570	12,097	10,037	2,060	53.87	44.69	9.17	–9.8
Less than 1,500 grams	38,629	9,271	8,303	968	240.00	214.94	25.06	–7.9
Less than 500 grams	4,035	3,510	3,450	60	869.89	855.02	14.87	–4.5**
500–749 grams	6,840	3,328	2,954	373	486.55	431.87	54.53	–10.9
750–999 grams	7,515	1,275	995	280	169.66	132.40	37.26	–12.0
1,000–1,249 grams	8,952	630	507	124	70.38	56.64	13.85	–22.6
1,250–1,499 grams	11,287	528	397	131	46.78	35.17	11.61	–15.7
1,500–1,999 grams	44,495	1,248	860	389	28.05	19.33	8.74	–15.5
2,000–2,499 grams	141,446	1,577	874	703	11.15	6.18	4.97	–18.6
2,500 grams or more	3,000,852	6,251	2,322	3,929	2.08	0.77	1.31	–22.4
2,500–2,999 grams	511,562	2,050	854	1,196	4.01	1.67	2.34	–24.0
3,000–3,499 grams	1,221,031	2,397	866	1,531	1.96	0.71	1.25	–26.1
3,500–3,999 grams	952,131	1,354	419	935	1.42	0.44	0.98	–22.0
4,000–4,499 grams	270,283	333	123	209	1.23	0.46	0.77	–22.6
4,500–4,999 grams	41,179	92	44	48	2.23	1.07	1.17	10.2**
5,000 grams or more	4,666	25	16	9	5.36	*	*	–30.2**
Not stated	468	110	99	11	. . .	. . .	. . .	*
Black	599,860	8,094	5,530	2,563	13.49	9.22	4.27	–7.4
Less than 2,500 grams	80,603	6,191	4,943	1,248	76.81	61.33	15.48	–3.0**
Less than 1,500 grams	18,858	5,253	4,480	772	278.56	237.56	40.94	–2.5**
Less than 500 grams	2,705	2,334	2,265	68	862.85	837.34	25.14	–3.6**
500–749 grams	4,159	1,909	1,560	349	459.00	375.09	83.91	–8.1
750–999 grams	3,753	556	362	194	148.15	96.46	51.69	–9.1**
1,000–1,249 grams	3,970	271	175	96	68.26	44.08	24.18	–8.3**
1,250–1,499 grams	4,271	182	117	65	42.61	27.39	15.22	–12.3**
1,500–1,999 grams	15,673	426	247	179	27.18	15.76	11.42	–16.0
2,000–2,499 grams	46,072	513	216	297	11.13	4.69	6.45	–17.2
2,500 grams or more	519,127	1,848	536	1,313	3.56	1.03	2.53	–21.5
2,500–2,999 grams	143,252	717	221	496	5.01	1.54	3.46	–19.6
3,000–3,499 grams	228,445	764	211	552	3.34	0.92	2.42	–18.3
3,500–3,999 grams	117,937	296	80	216	2.51	0.68	1.83	–27.9
4,000–4,499 grams	25,443	51	17	34	2.00	*	1.34	–53.9
4,500–4,999 grams	3,546	14	4	10	*	*	*	*
5,000 grams or more	504	7	3	4	*	*	*	*
Not stated	130	54	51	3	. . .	. . .	. . .	*

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, 2003 linked file, and percentage change in birthweight-specific infant mortality, 1995–2003 linked file—Con.

Race and birthweight	Number in 2003				Mortality rate per 1,000 live births in 2003			Percent change in infant mortality rate 1995–2003
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
American Indian[2]	43,054	376	196	180	8.73	4.55	4.18	–3.4**
Less than 2,500 grams	3,191	194	148	46	60.80	46.38	14.42	5.6**
Less than 1,500 grams	571	145	124	21	253.94	217.16	36.78	7.3**
Less than 500 grams	54	38	37	1	703.70	685.19	*	–20.8**
500–749 grams	108	55	47	8	509.26	435.19	*	–16.4**
750–999 grams	117	30	23	7	256.41	196.58	*	*
1,000–1,249 grams	139	9	6	3	*	*	*	*
1,250–1,499 grams	153	12	10	2	*	*	*	*
1,500–1,999 grams	637	20	14	6	31.40	*	*	*
2,000–2,499 grams	1,983	29	10	19	14.62	*	*	–24.0**
2,500 grams or more	39,856	180	47	133	4.52	1.18	3.34	–15.1**
2,500–2,999 grams	7,010	47	18	29	6.70	*	4.14	–36.5**
3,000–3,499 grams	15,841	72	16	56	4.55	*	3.54	–6.2**
3,500–3,999 grams	12,314	42	10	32	3.41	*	2.60	–16.6**
4,000–4,499 grams	3,883	16	2	14	*	*	*	*
4,500–4,999 grams	701	1	–	1	*	*	*	*
5,000 grams or more	107	1	–	1	*	*	*	*
Not stated	7	1	1	–	. . .	. . .	. . .	. . .
Asian or Pacific Islander	221,203	1,068	752	316	4.83	3.40	1.43	–8.5**
Less than 2,500 grams	17,255	741	634	107	42.94	36.74	6.20	–7.3**
Less than 1,500 grams	2,447	578	528	50	236.21	215.77	20.43	–1.5**
Less than 500 grams	266	228	222	6	857.14	834.59	*	–5.2**
500–749 grams	408	197	185	12	482.84	453.43	*	–6.5**
750–999 grams	507	85	66	19	167.65	130.18	*	–12.3**
1,000–1,249 grams	574	34	29	5	59.23	50.52	*	–34.8**
1,250–1,499 grams	692	33	25	8	47.69	36.13	*	–35.6**
1,500–1,999 grams	3,086	87	61	26	28.19	19.77	8.43	–31.6**
2,000–2,499 grams	11,722	76	46	30	6.48	3.92	2.56	–37.8
2,500 grams or more	203,923	323	113	210	1.58	0.55	1.03	–26.7
2,500–2,999 grams	49,527	112	47	66	2.26	0.95	1.33	–35.4
3,000–3,499 grams	93,087	138	47	91	1.48	0.50	0.98	–23.2
3,500–3,999 grams	49,623	55	14	40	1.11	*	0.81	–20.5**
4,000–4,499 grams	10,240	13	3	10	*	*	*	*
4,500–4,999 grams	1,289	4	1	3	*	*	*	*
5,000 grams or more	157	1	1	–	*	*	*	*
Not stated	25	4	4	–	. . .	. . .	. . .	*
Hispanic	912,331	5,151	3,573	1,579	5.65	3.92	1.73	–9.9
Less than 2,500 grams	61,212	3,518	2,944	575	57.47	48.10	9.39	–6.3
Less than 1,500 grams	10,738	2,747	2,441	306	255.82	227.32	28.50	–2.8**
Less than 500 grams	1,146	991	966	24	864.75	842.93	20.94	–1.0**
500–749 grams	2,090	1,057	926	131	505.74	443.06	62.68	–6.5**
750–999 grams	2,123	374	302	72	176.17	142.25	33.91	–7.0**
1,000–1,249 grams	2,450	175	138	36	71.43	56.33	14.69	–16.3**
1,250–1,499 grams	2,929	150	108	42	51.21	36.87	14.34	–5.9**
1,500–1,999 grams	11,675	354	250	104	30.32	21.41	8.91	–10.2**
2,000–2,499 grams	38,799	417	252	165	10.75	6.50	4.25	–17.2
2,500 grams or more	851,069	1,606	605	1,001	1.89	0.71	1.18	–24.6
2,500–2,999 grams	157,630	561	251	309	3.56	1.59	1.96	–20.6
3,000–3,499 grams	366,590	620	223	397	1.69	0.61	1.08	–25.9
3,500–3,999 grams	252,283	319	88	231	1.26	0.35	0.92	–31.3
4,000–4,499 grams	63,699	72	27	44	1.13	0.42	0.69	–25.3**
4,500–4,999 grams	9,620	27	11	16	2.81	*	*	–7.0**
5,000 grams or more	1,247	8	5	3	*	*	*	*
Not stated	50	26	23	3	. . .	. . .	. . .	*

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, 2003 linked file, and percentage change in birthweight-specific infant mortality, 1995–2003 linked file—Con.

Race and birthweight	Number in 2003				Mortality rate per 1,000 live births in 2003			Percent change in infant mortality rate 1995–2003
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
Non-Hispanic white	2,321,921	13,228	8,797	4,431	5.70	3.79	1.91	–9.2
Less than 2,500 grams	164,033	8,533	7,038	1,495	52.02	42.91	9.11	–11.6
Less than 1,500 grams	27,964	6,479	5,812	667	231.69	207.84	23.85	–10.2
Less than 500 grams	2,856	2,483	2,446	36	869.40	856.44	12.61	–5.7**
500–749 grams	4,752	2,260	2,016	244	475.59	424.24	51.35	–13.2
750–999 grams	5,421	898	690	208	165.65	127.28	38.37	–13.4
1,000–1,249 grams	6,549	458	369	88	69.93	56.34	13.44	–24.0
1,250–1,499 grams	8,386	381	291	91	45.43	34.70	10.85	–18.2
1,500–1,999 grams	32,970	888	604	284	26.93	18.32	8.61	–18.3
2,000–2,499 grams	103,099	1,166	622	544	11.31	6.03	5.28	–18.5
2,500 grams or more	2,157,621	4,643	1,708	2,935	2.15	0.79	1.36	–21.4
2,500–2,999 grams	356,426	1,487	598	889	4.17	1.68	2.49	–24.8
3,000–3,499 grams	858,603	1,781	645	1,136	2.07	0.75	1.32	–25.3
3,500–3,999 grams	701,090	1,033	327	705	1.47	0.47	1.01	–19.3
4,000–4,499 grams	206,495	261	96	165	1.26	0.46	0.80	–20.6
4,500–4,999 grams	31,591	63	31	32	1.99	0.98	1.01	7.1**
5,000 grams or more	3,416	18	11	7	*	*	*	*
Not stated	267	52	51	1	. . .	. . .	. . .	*
Non-Hispanic black	576,047	7,836	5,335	2,501	13.60	9.26	4.34	–7.2
Less than 2,500 grams	78,445	5,998	4,778	1,220	76.46	60.91	15.55	–3.3**
Less than 1,500 grams	18,370	5,087	4,330	757	276.92	235.71	41.21	–2.9**
Less than 500 grams	2,617	2,254	2,188	66	861.29	836.07	25.22	–3.8**
500–749 grams	4,060	1,851	1,509	342	455.91	371.67	84.24	–8.3
750–999 grams	3,659	544	352	192	148.67	96.20	52.47	–9.1**
1,000–1,249 grams	3,858	263	169	94	68.17	43.81	24.36	–8.3**
1,250–1,499 grams	4,176	175	112	63	41.91	26.82	15.09	–13.2**
1,500–1,999 grams	15,229	416	242	174	27.32	15.89	11.43	–15.4
2,000–2,499 grams	44,846	495	207	289	11.04	4.62	6.44	–17.7
2,500 grams or more	497,506	1,793	515	1,278	3.60	1.04	2.57	–21.2
2,500–2,999 grams	138,511	700	214	486	5.05	1.55	3.51	–18.9
3,000–3,499 grams	218,983	737	201	536	3.37	0.92	2.45	–18.2
3,500–3,999 grams	112,182	288	77	211	2.57	0.69	1.88	–27.1
4,000–4,499 grams	24,006	50	17	33	2.08	*	1.37	–53.0
4,500–4,999 grams	3,340	13	4	9	*	*	*	*
5,000 grams or more	484	5	2	3	*	*	*	*
Not stated	96	45	42	3	. . .	. . .	. . .	*

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

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

. . . Category not applicable.

– Quantity zero.

[1]Includes races other than white or black.

[2]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. See reference 3.

Table 7. Infant deaths and mortality rates for the five leading causes of infant death, by race and Hispanic origin of mother: United States, 2003 linked file

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

Cause of death (Based on the *International Classification of Diseases, Tenth Revision*, 1992)	All races			Non-Hispanic white			Non-Hispanic black[1]			American Indian[2,3]			Asian and Pacific Islander[4]		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes	. . .	27,995	684.5	. . .	13,227	569.7	. . .	7,838	1,360.7	. . .	376	872.9	. . .	1,068	482.9
Congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99)	1	5,640	137.9	1	2,973	128.0	2	965	167.5	1	81	187.6	1	259	117.2
Disorders related to short gestation and low birth weight, not elsewhere classified (P07)	2	4,849	118.6	2	1,847	79.5	1	1,807	313.7	3	48	112.6	2	192	86.9
Sudden infant death syndrome (R95)	3	2,162	52.9	3	1,173	50.5	3	627	108.8	2	53	124.0	3	61	27.7
Newborn affected by maternal complications of pregnancy (P01)	4	1,708	41.8	4	780	33.6	4	542	94.1	9	7	*	4	59	26.7
Newborn affected by complications of placenta, cord and membranes (P02)	5	1,092	26.7	5	543	23.4	6	297	51.6	6	13	*	5	32	14.3

Cause of death (Based on the *International Classification of Diseases, Tenth Revision*, 1992)	Total Hispanic			Mexican			Puerto Rican			Central and South American[5]		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes	. . .	5,150	564.5	. . .	3,594	549.1	. . .	478	818.5	. . .	684	504.5
Congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99)	1	1,316	144.2	1	994	151.9	2	83	142.1	1	160	118.0
Disorders related to short gestation and low birth weight, not elsewhere classified (P07)	2	864	94.7	2	565	86.3	1	98	167.8	2	124	91.5
Sudden infant death syndrome (R95)	4	234	25.6	4	162	24.8	3	31	53.1	6	27	19.9
Newborn affected by maternal complications of pregnancy (P01)	3	277	30.4	3	187	28.6	4	24	41.1	3	42	31.0
Newborn affected by complications of placenta, cord and membranes (P02)	5	192	21.0	5	118	18.0	5	21	36.0	4	29	21.4

. . . Category not applicable.

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

[1]For non-Hispanic blacks, infections specific to the perinatal period was the fifth leading cause of death, with 314 deaths and a rate of 54.5.

[2]Includes Aleuts and Eskimos.

[3]For American Indians, Accidents (unintentional injuries) was the fourth leading cause of death with 20 deaths and a rate of 46.7. Influenza and Pneumonia was the fifth leading cause of death; however, with only 14 deaths, a reliable infant mortality rate could not be computed. Maternal complications was tied for the ninth leading cause with Diseases of the circulatory system, Respiratory distress of newborn, and Necrotizing enterocolitis of newborn.

[4]For Asian or Pacific Islanders, Diseases of the circulatory system was tied for the fifth leading cause of death.

[5]For Central and South Americans, Infections specific to the perinatal period was the fifth leading cause of death, with 28 deaths and a rate of 20.7.

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. See reference 3.

Technical Notes

Differences between period and cohort data

From 1983 to 1991, NCHS produced linked files in a birth cohort format (36). Beginning with 1995 data, linked files are produced first using a period format and then subsequently using a birth cohort format. The 2003 period linked file contains a numerator file that consists of all infant deaths occurring in 2003 that have been linked to their corresponding birth certificates, whether the birth occurred in 2002 or in 2003. In contrast, the 2003 birth cohort linked file will contain a numerator file that consists of all infant deaths to babies born in 2003 whether the death occurred in 2003 or 2004.

Although the birth cohort format has methodological advantages, it creates delays in data availability, because 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 2003 file, NCHS accepted birth records that could be linked to infant deaths even if registered after the closure of the 2003 birth file (less than 100 cases). This improved the infant birth/death linkage and made the denominator file distinctly different from the official 2003 birth file.

Weighting

A record weight is added to the linked file to compensate for the 1.0 percent (in 2003) 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 95.6–100.0 percent with all but four areas—California, Louisiana, 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 2003 linked file started with 28,012 infant death records. Of these 28,012 records, 27,727 were linked; 285 were unlinked because corresponding birth certificates could not be identified. The 28,012 linked and unlinked records contained 17 records of infants whose mother's usual place of residence was outside the United States. These 17 records were excluded to derive a weighted total of 27,995 infant deaths. Thus, all total calculations for 2003 in this report used a weighted total of 27,995 infant deaths (Tables A, B, C, 1, 2, 6, and 7).

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

The overall infant mortality rate from the 2003 period linked file of 6.84 is nearly the same as the 2003 vital statistics mortality file (6.85) (2). The number of infant deaths differs slightly; the number in the mortality file was 28,025 (2). 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 regardless of the place of birth of the infant. In contrast, to be included in the linked file, both the birth and death must occur in the 50 States and the District of Columbia. Also, although every effort has

Table I. Percent of infant death records which were linked to their corresponding birth records: United States and each State, Puerto Rico, Virgin Islands, and Guam, 2003 linked file

State	Percent linked by State of occurrence of death
United States[1]	99.0
Alabama	100.0
Alaska	100.0
Arizona	99.3
Arkansas	100.0
California	97.4
Colorado	100.0
Connecticut	100.0
Delaware	100.0
District of Columbia	99.0
Florida	99.9
Georgia	100.0
Hawaii	100.0
Idaho	100.0
Illinois	98.2
Indiana	99.2
Iowa	100.0
Kansas	98.6
Kentucky	99.7
Louisiana	95.6
Maine	100.0
Maryland	100.0
Massachusetts	98.2
Michigan	100.0
Minnesota	100.0
Mississippi	100.0
Missouri	100.0
Montana	98.6
Nebraska	100.0
Nevada	100.0
New Hampshire	100.0
New Jersey	96.6
New Mexico	98.6
New York	99.1
North Carolina	99.8
North Dakota	100.0
Ohio	99.6
Oklahoma	97.6
Oregon	99.7
Pennsylvania	99.5
Rhode Island	100.0
South Carolina	100.0
South Dakota	100.0
Tennessee	100.0
Texas	97.0
Utah	100.0
Vermont	100.0
Virginia	100.0
Washington	98.8
West Virginia	100.0
Wisconsin	100.0
Wyoming	100.0
Puerto Rico	99.6
Virgin Islands	100.0
Guam	100.0

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

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.

Marital status

National estimates of births to unmarried women are based on two methods of determining marital status. In 2003, marital status was based on a direct question in 48 States and the District of Columbia. In the two States (Michigan and New York) that 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 2003" (3).

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 (37,38).

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 4.6 percent of the births in 2003 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 0.006 percent of all birth records in 2003 (3).

For the linked file, not stated birthweight was imputed for 3,007 records or 0.07 percent of the birth records in 2003 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, because the percent of records with not stated birthweight was higher for infant deaths (3.85 percent before imputation) than for live births (0.09 percent before imputation). The imputation reduced the percent of not stated records to 0.61 percent for infant deaths, and 0.02 percent for births. The not stated birthweight cases in the natality/birth file, as distinct from the linked file, are not imputed (3).

Cause-of-death classification

The mortality statistics presented in this report were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify and code causes of death in accordance with the current revision of the International Statistical Classification of Diseases and Related Health Problems (ICD). The ICD provides the basic guidance used in virtually all countries to code and classify causes of death. The ICD not only details disease classification but also provides definitions, tabulation lists, the format of the death certificate, and the rules for coding cause of death. Cause-of-death data presented in this report were coded by procedures outlined in annual issues of the NCHS Instruction Manual (39,40).

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 (41,42).

About every 10 to 20 years, the ICD is revised to take into account advances in medical knowledge. Effective with deaths occurring in 1999, the United States began using the Tenth Revision 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 (2,43,44).

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

Computation of rates

Infant mortality rates (IMR) 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.

For the first time the National Center for Health Statistics (NCHS) is publishing the infant mortality rate with two digits after the decimal place per 1,000 live births. Displaying two digits after the decimal place for rates such as the IMR provides a more sensitive and precise measurement. This is particularly noticeable when examining differences in rates among groups or over time. For example, the published total IMR for 2002 was 7.0; this rate with two decimal places is 6.95. The rate for 2003 is 6.84 and would be 6.8 if calculated to one decimal place. The difference between years by one decimal place is 0.2, but when using two decimal places the difference is 0.11—nearly half the difference shown by one decimal. For rates per 100,000 live births (by cause of death) the IMR continues to be 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 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 (46). 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 (2). Estimates of relative standard errors (RSEs) and 95 percent confidence intervals are shown below.

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

$$\mathrm{RSE}(D) = 100 \bullet \sqrt{\frac{1}{D}}$$

where D is the number of deaths and

$$\mathrm{RSE}\ (B) = 100 \bullet \sqrt{\frac{1}{B}}$$

where B is the number of births.

For example, let us say that for group A the number of infant deaths was 238 while the number of live births was 32,650 yielding an infant mortality rate of 7.29 infant deaths per 1,000 live births.

$$\text{The RSE of the deaths} = 100 \bullet \sqrt{\frac{1}{238}} = 6.48,$$

$$\text{while the RSE of the births} = 100 \bullet \sqrt{\frac{1}{32{,}650}} = 0.55.$$

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

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

The RSE of the IMR for the example above

$$= 100 \bullet \sqrt{\frac{1}{238} + \frac{1}{32{,}650}} = 6.51.$$

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:

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

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

Thus, for group A:

$$\text{Lower: } 7.29 - \left(1.96 \bullet 7.29 \bullet \frac{6.51}{100}\right) = 6.36$$

$$\text{Upper: } 7.29 + \left(1.96 \bullet 7.29 \bullet \frac{6.51}{100}\right) = 8.22$$

Thus the chances are 95 out of 100 that the true IMR for Group A lies somewhere in the 6.36–8.22 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.

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

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			

Upper: IMR • U (.95, D_{adj})

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

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

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

For example, let us say that for group B the number of infant deaths was 73, the number of live births was 11,422, and the infant mortality rate was 6.39.

$$D_{adj} = \frac{(73 \bullet 11{,}422)}{(73 + 11{,}422)} = 73$$

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

Lower: 6.39 • 0.78384 = 5.01

Upper: 6.39 • 1.25735 = 8.03

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:

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

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: http://www.cdc.gov/nchs.

Contents

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