

Infant Mortality Statistics from the 2005 Period Linked Birth/Infant Death Data Set

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

Abstract

Objectives—This report presents 2005 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 6.86 infant deaths per 1,000 live births in 2005, which is statistically unchanged from 6.78 in

2004. Infant mortality rates ranged from 4.89 deaths per 1,000 live births for Asian or Pacific Islander (API) mothers to 13.63 for non-Hispanic black mothers. Among Hispanics, rates ranged from 4.42 for Cuban mothers to 8.30 for Puerto Rican mothers. Infant mortality rates were higher for infants who were born in multiple deliveries or whose mothers were born in the 50 states and the District of Columbia or were unmarried. Infant mortality was also higher for male infants and infants born preterm or at low birthweight. The neonatal mortality rate was essentially unchanged from 2004 (4.52) to 2005 (4.54). The postneonatal mortality rate increased 3 percent from 2.25 in 2004 to 2.32 in 2005. Infants born at the lowest gestational ages and birthweights have

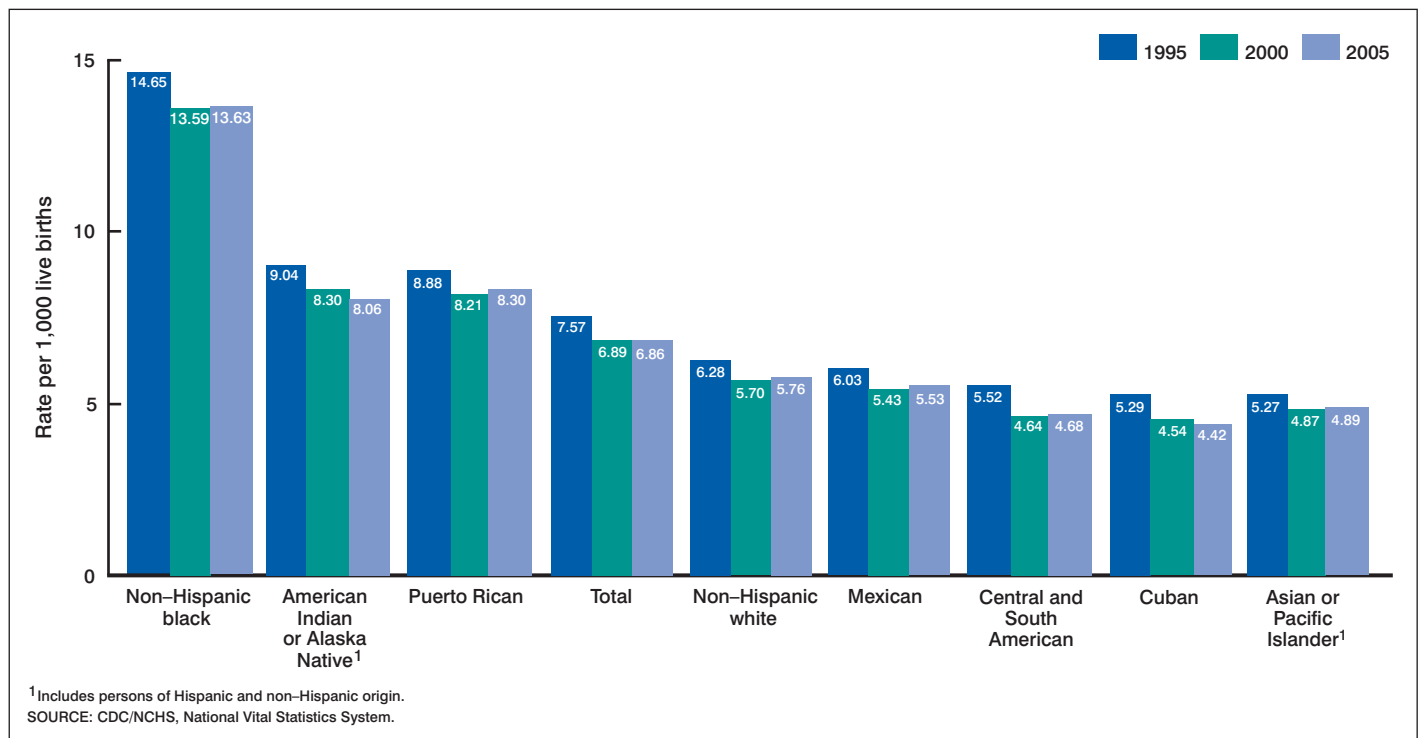


Figure 1. Infant mortality rates by race and ethnicity of mother: United States, 1995, 2000, and 2005

a large impact on overall U.S. infant mortality. For example, more than one-half (55 percent) of all infant deaths in the United States in 2005 occurred to the 2 percent of infants born very preterm (less than 32 weeks of gestation). Infant mortality rates for late preterm infants (34–36 weeks of gestation) were three times those for term infants (37–41 weeks). The three leading causes of infant death—congenital malformations, low birthweight, and sudden infant death syndrome (SIDS)—accounted for 44 percent all infant deaths. The percentage of infant deaths that were “preterm-related” increased from 34.6 percent in 2000 to 36.5 percent in 2005. The preterm-related infant mortality rate for non-Hispanic black mothers was 3.4 times higher and the rate for Puerto Rican mothers was 87 percent higher than the rate for non-Hispanic white mothers.

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

Introduction

This report presents infant mortality data from the 2005 period linked file. In the linked file, information from the death certificate is linked to information from the birth certificate for each infant under 1 year of age who died during 2005 in the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, or Guam. Linked birth/infant death data are not available for American Samoa and the Commonwealth of the Northern Marianas. The purpose of the linkage is to use the many additional variables available from the birth certificate to conduct more detailed analyses of infant mortality patterns. This report presents infant mortality data by race and Hispanic origin of the mother, birthweight, period of gestation, sex of infant, plurality, maternal age, live-birth order, mother’s marital status, mother’s place of birth, infant age at death, and underlying cause of death (Tables 1–8, A–E, and Figures 1–6).

Other variables that are available in the linked file data set (1) but are not discussed in this report include father’s age, race, and Hispanic origin; birth attendant; place of delivery; mother’s weight gain during pregnancy; and many medical and health measurements. Several states have implemented the 2003 revised birth certificate. Three key data items are considered noncomparable between the 1989 and 2003 revisions and are presented separately in this report: trimester of pregnancy prenatal care began, maternal educational attainment, and maternal smoking during pregnancy (2). Another report, based on data exclusively from the vital statistics mortality file, provides further information on trends in infant mortality and on causes of infant death (3). Some rates calculated from the mortality file differ from those published using the linked birth/infant death file (linked file). The linked file is used for analysis and for calculating infant mortality rates by race and ethnicity 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 (CDC) National Center for Health Statistics (NCHS) matching birth and death certificate numbers for each infant under 1 year of age who died in the state during 2005. 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 2005, 98.7 percent of all infant death records were successfully matched to their corresponding birth records. Records were weighted to adjust for the 1.3 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 2005 (2).

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

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 12 states, (Florida, Idaho, Kansas, Kentucky, Nebraska, New Hampshire, New York (but not New York City), Pennsylvania, South Carolina, Tennessee, Texas, and Washington) and Puerto Rico that implemented the 2003 Revision of the U.S. Standard Certificate of Live Birth on or before January 1, 2005 (revised). Vermont implemented the revision in 2005 but after January 1. The remaining reporting areas include data that are based on the 1989 Revision of the U.S. Standard Certificate of Live Birth (unrevised). Revised and unrevised data are combined when comparable. See *National Vital Statistics Reports*, Volume 56 Number 6, “Births: Final Data for 2005” for more information (2).

Data by maternal and infant characteristics

This report presents descriptive tabulations of infant mortality data by a variety of maternal and infant characteristics. These tabulations are useful for understanding the basic relationships between risk factors and infant mortality *unadjusted for the possible effects of other variables*. In reality, women with one risk factor often have other risk factors as well. For example, teenage mothers are

more likely to be unmarried and of a low-income status, and mothers who do not receive prenatal care are more likely to be of a low-income status and uninsured. The preferred method for disentangling the multiple interrelationships among risk factors is multivariate analysis; however, an understanding of the basic relationships between risk factors and infant mortality is a necessary precursor to more sophisticated types of analyses, and it is the aim of this publication.

Race and Hispanic origin data—Infant mortality rates are presented here by race and detailed Hispanic origin of mother. The linked file is particularly useful for computing accurate infant mortality rates for this purpose because the race and Hispanic origin of the mother from the birth certificate is used in both the numerator and denominator of the infant mortality rate. In contrast, for the vital statistics mortality file, race information for the denominator is the race of the mother as reported on the birth certificate, whereas the race information for the numerator is the race of the decedent as reported on the death certificate (1,6). Thus, standard infant mortality rates can be based on inconsistent race information. In addition, race information from the birth certificate reported by the mother is considered to be more reliable than that from the death certificate in which 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 ethnicity-specific infant mortality rates between the two data files (3,6).

The 2003 revision of the U.S. Standard Certificate of Live Birth allows the reporting of more than one race (multiple races) for each parent (7,8). Information on this change is presented in a recent report (2). Nineteen states reported multiple race on their birth certificate for either part or all of 2005. To provide uniformity and comparability of the data, multiple race is imputed to a single race (see “[Technical Notes](#)”).

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

Results and Discussion

Trends in infant mortality

The overall 2005 infant mortality rate from the linked file was 6.86 infant deaths per 1,000 live births, higher (but not significantly) than the rate in 2004 (6.78) and similar to the rate reported in 2001 and 2003 ([Table C](#)) (the overall rate in 2005 was 6.87 from the mortality file). Infant mortality rates for race and Hispanic origin groups were not significantly different in 2005 compared with 2004 ([Figure 1](#) and [Table C](#)). The neonatal mortality rate for 2005 (4.54) was not significantly different from 2004 (4.52). The postneonatal mortality rate increased from 2.25 in 2004 to 2.32 in 2005 ([Tables A](#) and [B](#)).

Although the infant mortality rate was 9 percent lower in 2005 than in 1995 (7.57), the rate has not changed significantly since 2000 (6.89) ([Figure 1](#) and [Table C](#)). Between 1995 and 2005, decreases have been observed for all race and ethnic groups, although not all had significant declines. Significant declines were observed for infants of Central and South American (15 percent), non-Hispanic white and Mexican (8 percent), and non-Hispanic black mothers (7 percent).

Infant mortality by race and Hispanic origin of mother

As in past years, there continues to be a wide variation in infant mortality rates by race and Hispanic origin of mother (9,10). The highest rate, 13.63 deaths per 1,000 live births, was for infants of non-Hispanic black mothers, which is more than three times the lowest rate of 4.42 for infants of Cuban mothers. Rates were also fairly high for infants of Puerto Rican (8.30) and AIAN (8.06) mothers ([Tables A, B, and C](#)). Rates were intermediate, but all below the U.S. rate, for infants of non-Hispanic white (5.76) and Mexican mothers (5.53). Central and South American (4.68) and API mothers (4.89) had the lowest rates ([Tables A, B, and C](#)).

Infant mortality by state

Between 2004 and 2005, 32 states and the District of Columbia had increases and 18 states had decreases in the infant mortality rate, although almost all of these changes were not statistically significant. One state, Mississippi, had a significant increase of 16 percent, and one, Maryland, had a significant decline of

Table A. Infant, neonatal, and postneonatal deaths and mortality rates, by race of mother: United States, 2005 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	4,138,573	28,384	18,782	9,602	6.86	4.54	2.32
White	3,229,494	18,500	12,173	6,328	5.73	3.77	1.96
Black	633,152	8,393	5,649	2,743	13.26	8.92	4.33
American Indian or Alaska Native	44,815	361	181	180	8.06	4.04	4.02
Asian or Pacific Islander	231,112	1,129	779	350	4.89	3.37	1.51

NOTES: Infant deaths are weighted so numbers may not exactly add to totals because of rounding. Neonatal is less than 28 days, and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table B. Infant, neonatal, and postneonatal deaths and mortality rates, by Hispanic origin of mother and by race of mother for mothers of non-Hispanic origin: United States, 2005 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	4,138,573	28,384	18,782	9,602	6.86	4.54	2.32
Total Hispanic	985,513	5,537	3,803	1,734	5.62	3.86	1.76
Mexican	693,202	3,833	2,623	1,210	5.53	3.78	1.75
Puerto Rican	63,341	526	377	150	8.30	5.95	2.37
Cuban	16,064	71	49	22	4.42	3.05	1.37
Central and South American	151,202	708	488	220	4.68	3.23	1.46
Other and unknown Hispanic	61,704	397	266	132	6.43	4.31	2.14
Non-Hispanic total ²	3,123,206	22,472	14,679	7,792	7.20	4.70	2.49
Non-Hispanic white	2,279,959	13,134	8,452	4,682	5.76	3.71	2.05
Non-Hispanic black	583,764	7,958	5,332	2,626	13.63	9.13	4.50
Not stated	29,854	375	300	76	...	...	...

... Category not applicable.

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

²Includes races other than white or black.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals because of rounding. Neonatal is less than 28 days, and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

14 percent (Table D). To obtain statistically reliable rates by race and Hispanic origin, 3 years of data were combined (Table 3). For 2003–2005, infant mortality rates ranged from 10.74 for Mississippi to 4.78 for Minnesota. The highest rate noted (12.22) was for the District of Columbia; 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 16.80 in Delaware to 8.58 in Oregon. For infants of non-Hispanic white mothers, Oklahoma had the highest infant mortality rate (7.54), and New Jersey had the lowest rate (3.70).

Mortality rates could be reliably computed for only 13 states for AIAN infants and 26 states for API infants. For infants of AIAN mothers, mortality rates ranged from 12.73 in South Dakota to 6.24 in California. Infant mortality rates for API mothers ranged from 8.06 in Tennessee to 3.79 in Massachusetts.

Sex of infant

In 2005, the overall infant mortality rate for female infants was 6.12 per 1,000 live births, 19 percent lower than the rate for male infants (7.56). Infant mortality rates were higher for male infants than those for female infants in each racial group except for AIAN, in which the difference was not significant (Table 1). Among Hispanics, this difference was not significant for infants of Puerto Rican and Cuban mothers (Table 2).

Multiple births

For multiple births, the infant mortality rate was 31.50, more than five times the rate of 6.00 for single births (Tables 1 and 2). Infant mortality rates for multiple births were higher than rates for single

Table C. Infant mortality rates by race and Hispanic origin of mother: United States, 1995–2005 linked files

Race and Hispanic origin of mother	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Percent change	Percent change
												1995 to 2005	2004 to 2005
All races	7.57	7.30	7.21	7.19	7.04	6.89	6.84	6.95	6.84	6.78	6.86	** -9.4	1.2
White	6.30	6.07	6.05	5.96	5.79	5.71	5.69	5.79	5.72	5.66	5.73	** -9.0	1.2
Black	14.58	14.13	13.69	13.80	13.99	13.48	13.34	13.81	13.50	13.25	13.26	** -9.1	0.1
American Indian or Alaska Native	9.04	9.95	8.69	9.34	9.29	8.30	9.65	8.64	8.73	8.45	8.06	-10.8	-4.6
Asian or Pacific Islander	5.27	5.20	4.98	5.54	4.85	4.87	4.73	4.77	4.83	4.67	4.89	-7.2	4.7
Hispanic	6.27	6.05	5.95	5.76	5.71	5.59	5.44	5.62	5.65	5.55	5.62	** -10.4	1.3
Mexican	6.03	5.84	5.83	5.60	5.51	5.43	5.22	5.42	5.49	5.47	5.53	** -8.3	1.1
Puerto Rican	8.88	8.60	7.86	7.78	8.35	8.21	8.53	8.20	8.18	7.82	8.30	-6.5	6.1
Cuban	5.29	5.07	5.51	3.63	4.66	4.54	4.28	3.72	4.57	4.55	4.42	-16.4	-2.9
Central and South American	5.52	5.02	5.45	5.28	4.68	4.64	4.98	5.06	5.04	4.65	4.68	** -15.2	0.6
Non-Hispanic white	6.28	6.04	6.02	5.98	5.76	5.70	5.72	5.80	5.70	5.66	5.76	** -8.3	1.8
Non-Hispanic black	14.65	14.20	13.72	13.88	14.14	13.59	13.46	13.89	13.60	13.60	13.63	** -7.0	0.2

** Significant at $p < 0.05$.

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table D. Infant mortality rates by state: United States, 2004 and 2005 linked files

[By place of residence]

State	Infant mortality rate per 1,000 live births		Percent change 2004–2005
	2004	2005	
Total	6.78	6.86	1.2
Alabama	8.69	9.53	9.7
Alaska	6.58	5.93	-9.8
Arizona	6.73	6.85	1.8
Arkansas	8.37	7.84	-6.3
California	5.16	5.32	3.0
Colorado	6.23	6.44	3.3
Connecticut	5.44	5.85	7.5
Delaware	8.62	9.02	4.7
District of Columbia	12.23	13.67	11.8
Florida	7.02	7.24	3.3
Georgia	8.53	8.07	-5.3
Hawaii	5.80	6.58	13.5
Idaho	6.08	5.99	-1.5
Illinois	7.51	7.38	-1.6
Indiana	7.88	8.04	1.9
Iowa	5.07	5.45	7.4
Kansas	7.34	7.37	0.5
Kentucky	6.82	6.72	-1.4
Louisiana	10.31	9.84	-4.6
Maine	5.67	6.88	21.4
Maryland	8.46	7.30	** -13.7
Massachusetts	4.80	5.13	6.7
Michigan	7.57	7.89	4.1
Minnesota	4.62	5.09	10.3
Mississippi	9.90	11.47	** 15.8
Missouri	7.48	7.51	0.4
Montana	4.60	7.25	57.7
Nebraska	6.53	5.66	-13.3
Nevada	6.22	5.66	-9.0
New Hampshire	5.63	5.27	-6.4
New Jersey	5.55	5.17	-6.9
New Mexico	6.48	6.18	-4.6
New York	6.15	5.82	-5.4
North Carolina	8.73	8.81	1.0
North Dakota	5.86	5.96	1.7
Ohio	7.52	8.18	8.7
Oklahoma	7.93	7.96	0.3
Oregon	5.47	6.00	9.6
Pennsylvania	7.25	7.29	0.5
Rhode Island	5.40	6.46	19.6
South Carolina	9.28	9.46	2.0
South Dakota	7.94	6.97	-12.2
Tennessee	8.61	8.77	1.8
Texas	6.28	6.55	4.3
Utah	5.23	4.52	-13.6
Vermont	4.39	6.49	47.7
Virginia	7.35	7.47	1.6
Washington	5.50	5.07	-7.9
West Virginia	7.57	8.17	8.0
Wisconsin	5.94	6.54	10.0
Wyoming	8.81	6.64	-24.7

** Significant at $p < 0.05$.

births for all race and Hispanic-origin groups, except for AIAN, for whom rates could not be reliably computed because of small numbers of events.

The risk of infant death increases with the increasing number of infants in the pregnancy. In 2005, the infant mortality rate for twins (29.84) was nearly five times the rate for single births (6.00). The rate for triplets (59.60) was 10 times higher and the rate for quadruplets (105.26) was nearly 18 times higher than the rate for single births

(tabular data not shown). A reliable infant mortality rate for quintuplet and higher-order births could not be computed because of small numbers of infant deaths for that category. Changes in infant mortality rates from 2004–2005 for specific plurality categories were not statistically significant.

Multiple pregnancy can lead to an accentuation of maternal risks and complications associated with pregnancy (2,11–13). For example, multiple births are much more likely to be born preterm and at low birthweight than single births (2,11–13). The higher risk profile of multiple births has a substantial impact on overall infant mortality (10,14–16). For example, in 2005, multiples accounted for 3 percent of all live births but 15 percent of all infant deaths in the United States (Table 1).

Age at death

In 2005, about two-thirds of all infant deaths (18,782 out of 28,384) occurred during the neonatal period (from birth through 27 days of age) (Tables A and B). In 2005, the neonatal mortality rate was 4.54 deaths per 1,000 live births, essentially unchanged from the previous year (4.52). The 2005 postneonatal (28 days to under 1 year) mortality rate of 2.32 was 3 percent higher than the 2004 rate (2.25).

The neonatal mortality rate for infants of non-Hispanic black mothers (9.13) was more than twice those for AIAN (4.04), non-Hispanic white (3.71), API (3.37), Mexican (3.78), Central and South American (3.23), and Cuban mothers (3.05) (Tables A and B). Neonatal mortality rates for Puerto Rican (5.95) mothers were intermediate between these two groups.

The highest postneonatal mortality rates were for infants of non-Hispanic black (4.50) and AIAN (4.02) mothers, about twice the rate for non-Hispanic white mothers (2.05). Postneonatal mortality rates for Mexican (1.75), API (1.51), and Central and South American mothers (1.46) were lower than for non-Hispanic white mothers. The postneonatal mortality rate was higher for Puerto Rican mothers (2.37) than for API, Mexican, and Central and South American mothers, but it was not significantly different from the rate for non-Hispanic white mothers (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 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 (17–21).

Because of their much greater risk of death, infants born at the lowest birthweights and gestational ages have a large impact on overall U.S. infant mortality. For example, infants born weighing less than 1,000 grams accounted for only 0.8 percent of births but nearly one-half (48.2 percent) of all infant deaths in the United States in 2005 (Figure 2). Conversely, 91.8 percent of infants born in the United States in 2005 weighed 2,500 grams or more, but these infants accounted for less than one-third (30.9 percent) of infant deaths. A similar pattern is found when data by period of gestation were examined. Only 0.8 percent

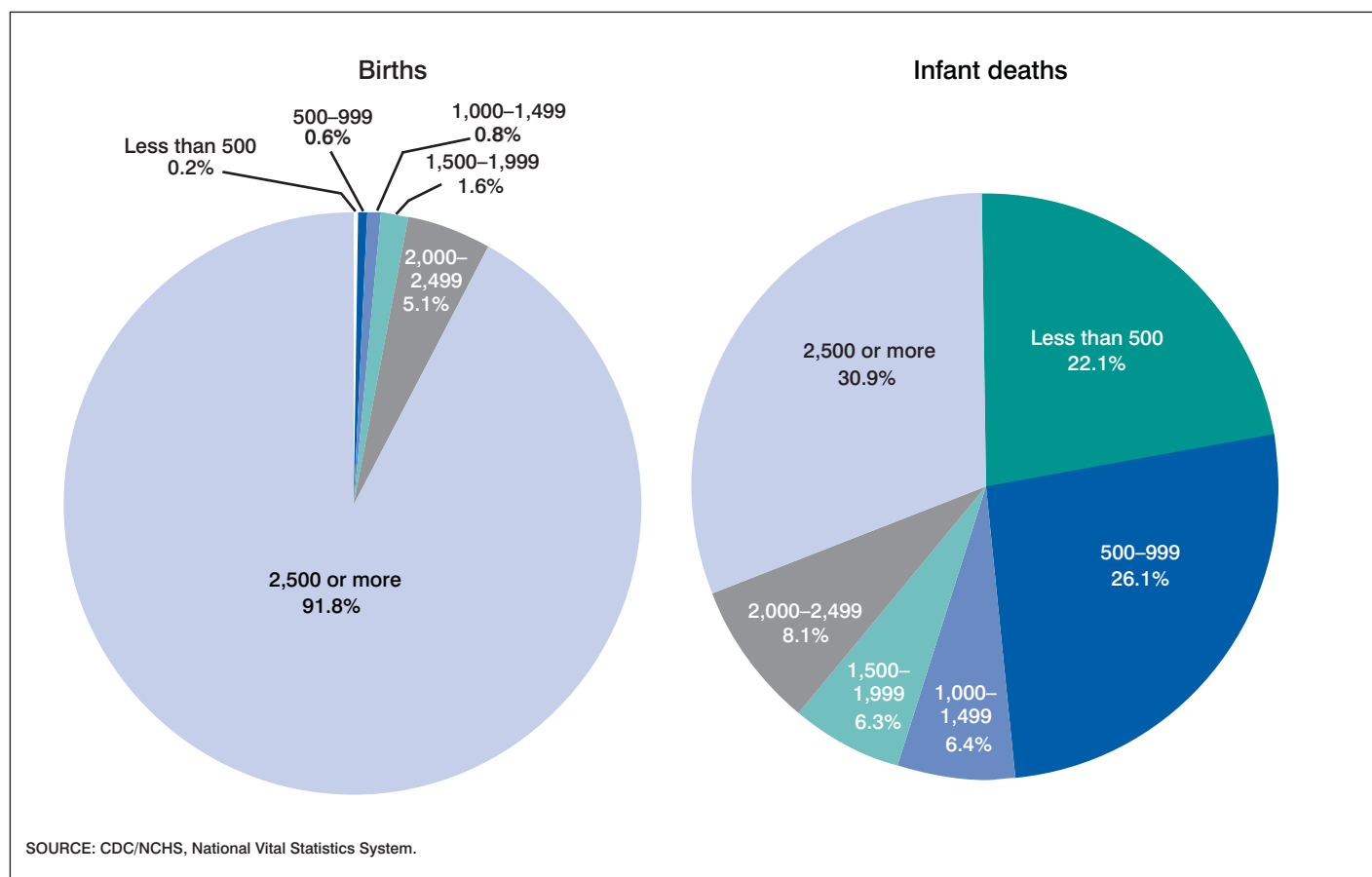


Figure 2. Percentage of live births and infant deaths by birthweight in grams: United States, 2005

of births occurred at less than 28 weeks of gestation, but they accounted for nearly one-half (46.4 percent) of all infant deaths in the United States in 2005 (Figure 3).

The percentage of preterm and low birthweight births has been increasing steadily since the mid-1980s (2). A portion of the increase is related to an increase in multiple births (in part because of increases in the use of assisted reproductive technologies) and to changes in the medical management of pregnancy (i.e., increases in cesarean section and induction of labor for preterm infants) (2,13,22–24).

The percentage of infants born at low birthweight (less than 2,500 grams) varies greatly by race and ethnicity, from a low in 2005 of 6.5 percent for births to Mexican mothers to a high of 14.1 percent for births to non-Hispanic black mothers (Tables 4 and 5). The percentage of preterm births (infants born before 37 completed weeks of gestation) ranged from 10.7 percent of births to API mothers to 18.4 percent of births to non-Hispanic black mothers. These differences in low birthweight and preterm births are major factors in the differences in infant mortality rates by race and ethnicity (16,25).

For all race and ethnic groups studied, infant mortality rates were much higher for low birthweight infants (57.39 per 1,000 live births) than for infants with birthweights of 2,500 grams or more (2.30). Overall, the infant mortality rate for very low birthweight infants (those with birthweights of less than 1,500 grams) was 244.95, more than 100 times the rate for infants with birthweights of 2,500 grams or more (Table 6). About 86 percent of infants with birthweights of less than 500 grams (1 lb 1 oz or less) died within the first year of life (Table 6). Reporting of deaths among these very small infants may be incomplete (26). An

infant's chances of survival increase rapidly with increasing birthweight. Infant mortality rates were lowest at birthweights of 3,000–4,999 grams (Table 6).

From 2000–2005, infant mortality rates declined by 7 to 8 percent for infants weighing 2,000–2,999 grams, and by 10 to 12 percent for infants weighing 3,000–3,999 grams at birth (Table 6). Changes for other detailed birthweight categories were not statistically significant. Although the rate declined by 3 percent for the overall birthweight category of less than 2,500 grams, this was primarily driven by a decline for infants weighing 2,000–2,499 grams, and no significant declines were observed for infants with birthweights less than 2,000 grams.

Of particular note is the lack of decline in infant mortality rates for very low birthweight infants (less than 1,500 grams) from 2000–2005. After rapid declines from 1983–2000, the infant mortality rate for very low birthweight infants was 244.95 in 2005, essentially unchanged from the rate of 244.26 in 2000 (Table 6). This is of particular concern because of the high proportion of infant deaths that occur to very low birthweight infants and also because the proportion of both infant deaths and live births that are very low birthweight has been increasing. The percentage of infant deaths to very low birthweight infants has been increasing (from 52.1 percent in 2000 to 54.6 percent in 2005), as has the percentage of very low birthweight live births (from 1.45 percent in 2000 to 1.52 percent in 2005) (Figure 2 and Table 4).

For non-Hispanic white, AIAN, and API mothers, no statistically significant changes were observed for any detailed birthweight category from 2000–2005, although, for non-Hispanic white mothers, infant mortality declined for the overall category less than 2,500 grams. For

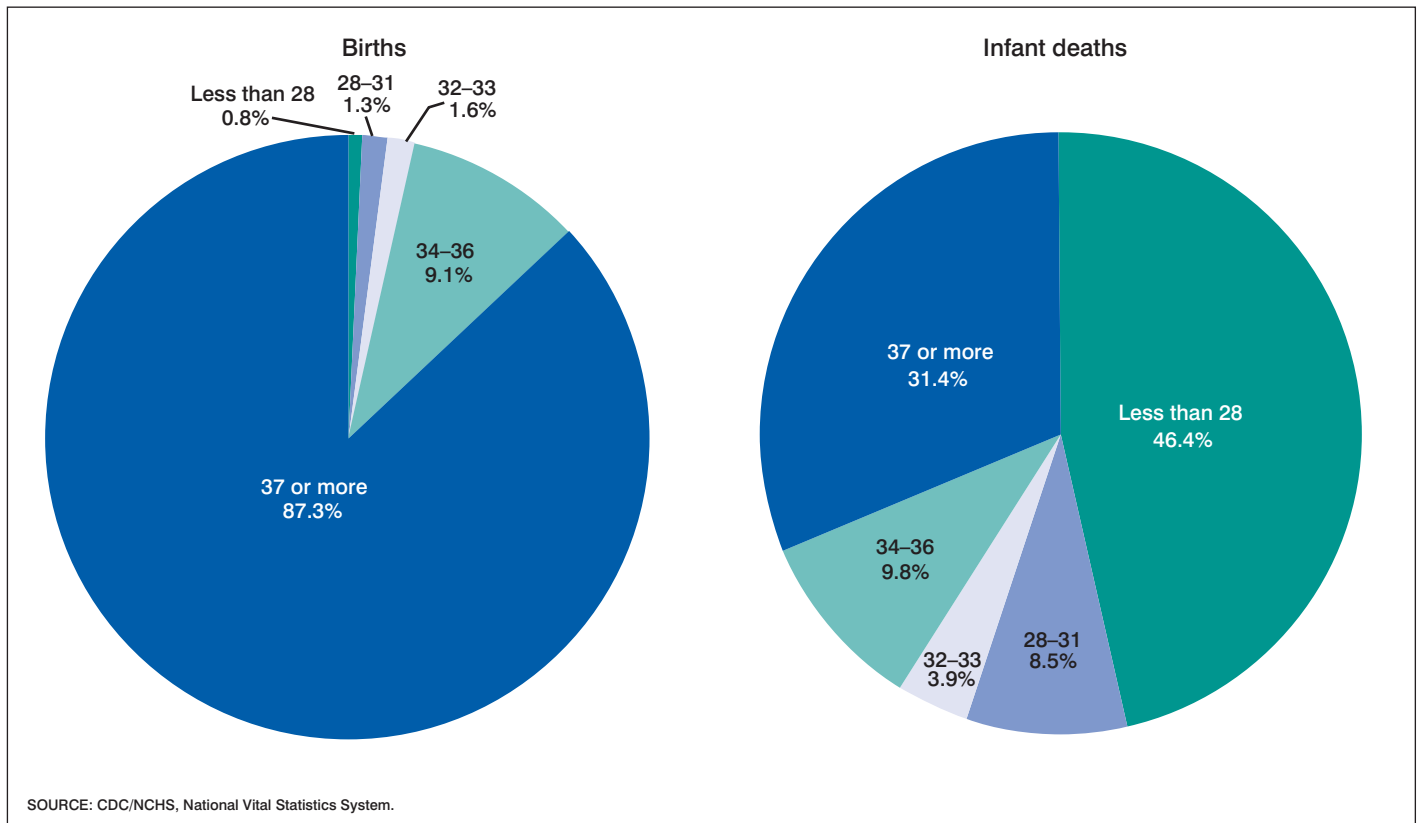


Figure 3. Percentage of live births and infant deaths by period of gestation in weeks: United States, 2005

non-Hispanic black mothers, declines were significant for infants with birthweights of 2,500–3,999 grams. For Hispanic women, declines were significant for infants with birthweights of 3,000–3,999 grams.

After rapid declines from 1983–2000, the infant mortality rate for very preterm infants (less than 32 weeks of gestation) did not decline from 2000–2005. In 2005, the infant mortality rate for very preterm infants was 183.24, compared with a rate of 182.45 in 2004 and 180.95 in 2000. In 2005, the infant mortality rate for very preterm infants was 75 times the rate of 2.43 for term infants (Tables 1 and 2).

The risk of infant death generally decreases as the length of gestation increases (17–21). Still, infants born only a few weeks early have a substantially increased risk of death when compared with term infants (22,27–28). For example, the infant mortality rate for late preterm infants (34–36 weeks of gestation) is 7.30, three times the rate of 2.43 for term infants (37–41 weeks). Even within the term period, infants born at 37–39 weeks of gestation have mortality rates 30 percent higher than those born at 40–41 weeks of gestation (Tables 1 and 2).

Prenatal care

This report includes data on the timing of prenatal care based on the 1989 (unrevised) and the 2003 (revised) revisions to the U.S. Standard Certificate of Live Birth (2). The 2003 revision of the birth certificate introduced substantive changes to item wording and also to the sources of prenatal information (see “Technical Notes”). Accordingly, prenatal care data for the two revisions are not directly comparable and are shown separately. For 2005, unrevised data are

available for 37 states, New York City, and the District of Columbia. Revised data are available for 7 states (Table E).

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 (29–32). Early comprehensive prenatal care can promote healthier pregnancies by providing health behavior advice, monitoring, and early detection and treatment of risk factors and symptoms (29,30). The initiation and subsequent utilization of prenatal care is also viewed as an indicator for access to care (32).

In 2005, for the 37-state reporting area for which comparable data are available, the mortality rate for infants of mothers who began prenatal care after the first trimester of pregnancy or had no care at all was 8.69 deaths per 1,000 live births (Table E). This rate was 40 percent higher than the rate for infants of mothers whose care began in the first trimester (6.20).

For the 7 revised states for which data are available for all of 2004 and 2005 data years, the infant mortality rate for mothers who began prenatal care after the first trimester or not at all was 8.42. This rate was 57 percent higher than the rate for infants of mothers whose care began in the first trimester (5.35).

Maternal age

Infant mortality rates vary with maternal age; the highest death rates are for infants of teenage mothers (10.28) and mothers aged 40 years and over (7.85). The lowest rates are for infants of mothers in their late twenties and early thirties (Tables 1 and 2).

In 2005, among births to teenagers, infants of the youngest mothers (under 15 years of age) had the highest rate (16.36). The rate

Table E. Infant mortality rates by trimester of pregnancy prenatal care began, smoking status during pregnancy, and education of mother: 37 states, the District of Columbia, and New York City (unrevised), 2004 and 2005, and 7 states (revised), 2005

Characteristic	Unrevised ¹		Revised ²
	2005 ³	2004 ³	2005 ⁴
Prenatal care			
Prenatal care beginning in the first trimester	6.20	6.13	5.35
Prenatal care beginning after the first trimester or no care	8.69	8.63	8.42
Prenatal care beginning in the second or third trimester	6.88	6.79	7.14
No prenatal care	37.39	37.71	34.78
Smoking status			
Smoker	11.44	11.00	10.69
Nonsmoker	6.58	6.57	5.96
Education (revised)			
Less than high school diploma . . . . .	...	...	9.84
High school diploma . . . . .	...	...	8.22
Some college or technical school . . . . .	...	...	5.31
Bachelor's degree or higher . . . . .	...	...	3.60
Education (unrevised)			
0–11 years	8.50	8.51	...
12 years	8.09	7.61	...
13–15 years	6.10	6.27	...
16 or more years	4.15	4.13	...

... Category not applicable.
¹Data are based on the 1989 Revision of the U.S. Standard Certificate of Live Birth; these data are not comparable with those based on the 2003 revision.
²Data are based on the 2003 Revision of the U.S. Standard Certificate of Live Birth; these data are not comparable with those based on the 1989 revision.
³Excludes data from Florida, Idaho, Kansas, Kentucky, Nebraska, New Hampshire, New York (excluding New York City), Pennsylvania, South Carolina, Tennessee, Texas, Vermont, and Washington. Information on smoking status excludes data for California.
⁴Includes data from Idaho, Kentucky, New York (excluding New York City), Pennsylvania, South Carolina, Tennessee, and Washington.

for infants of mothers aged 15–17 years was 11.40, a 10 percent increase from 2004 (10.37); the rate for infants of mothers aged 18–19 years was 9.60 in 2005, compared with 9.28 in 2004 (tabular data not shown). The rate for infants of mothers aged 40–54 decreased 11 percent from 8.82 in 2004 to 7.85 in 2005.

Within racial and ethnic subgroups (among groups for which rates could be reliably computed), infant mortality rates for births to non-Hispanic white mothers under 20 years of age were higher than rates for mothers aged 40 years 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 (33); young maternal age might be a marker for poverty (34). Among older mothers, especially for those having a first-time birth, infants are at an increased risk of prematurity and low birthweight and thus tend to have higher infant mortality rates (35).

Large differences exist in infant mortality by age when looking at plurality. Infant mortality rates for singleton births are highest for the youngest and oldest mothers, similar to the patterns for all births. In contrast, the rates for multiple births are highest for young mothers and

sharply lower for older mothers, which may be due to socioeconomic differences as well as differences in biological maturity (36) (Figures 4 and 5).

Maternal education

Information on educational attainment is reported on the 2003 Standard Certificate of Live Birth (revised) and 1989 Standard Certificate of Live Birth (unrevised) (2). However, the format of the education item on the revised standard certificate substantively differs from that of the unrevised standard certificate (see “Technical Notes”). The 1989 certificate item asks for the highest grade completed at the time of the birth; the 2003 certificate item asks for the highest degree or level of school completed at the time of the birth (high school diploma, bachelor degree, etc.). Accordingly,

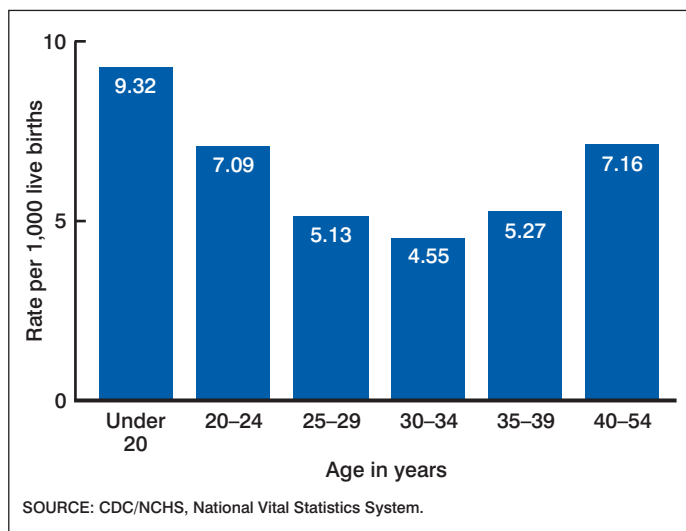


Figure 4. Infant mortality rates by age of mother for singleton births: United States, 2005

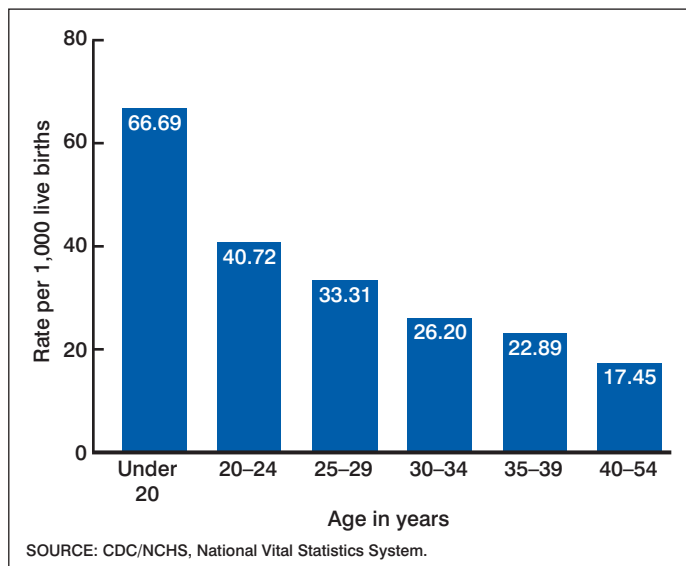


Figure 5. Infant mortality rates by age of mother for multiple births: United States, 2005

education data for the states that have implemented the revised certificates are not directly comparable with the data for the states that are not yet using the revised certificate. For 2005, unrevised data are available for 37 states, New York City, and the District of Columbia. Revised data are available for all of 2005 for 7 states.

For the 37-state reporting area described above, the infant mortality rate for mothers who completed 16 or more years of school was 4.15 in 2005. This rate was 51 percent lower than the rate for mothers who completed less than 12 years of education (8.50) (Table E).

In 2005, for both revised and unrevised states, infant mortality rates generally decreased with increasing educational level. This pattern may reflect the effects of more education as well as socioeconomic differences; women with more education tend to have higher income levels (10,37).

For the 7-state area collecting revised data in all of 2004 and 2005 data years, the infant mortality rate for mothers with a college degree was 3.60, 63 percent lower than the rate for mothers with less than a high school diploma (9.84) (Table E).

Live birth order

Infant mortality rates were generally higher for first births than for second births, and then they generally increased as birth order increased (Tables 1 and 2). Overall, the infant mortality rate for first births (6.88) was 14 percent higher than for second births (6.02). The rate for fifth and higher order births (10.36) 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 (2,38).

Marital status

Marital status may be a marker for the presence or absence of social, emotional, and financial resources (39,40). Infants of mothers who are not married have been shown to be at higher risk for poor outcomes (41,42). In 2005, infants of married mothers had an infant mortality rate of 5.25 per 1,000 live births, 45 percent lower than the rate for infants of unmarried mothers (9.61) (Tables 1 and 2). Within each race and Hispanic origin group, infants of unmarried mothers had higher rates of mortality, and (with the exception of Cuban infants) these differences were significant.

Nativity

In 2005, the infant mortality rate for mothers born in the 50 states and the District of Columbia (7.26) was 43 percent higher than the rate for mothers born elsewhere (5.08). 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; however, the differences were 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, social support, and risk behaviors (43,44). 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 (45).

Maternal smoking

Information on smoking during pregnancy was reported according to two distinct questions in 2005 (2). For 36 states, New York City, and the District of Columbia, smoking status was based on the 1989 U.S. Standard Certificate of Live Birth (unrevised), whereas data for 7 states are drawn from the 2003 revision of the birth certificate (revised). No smoking data are available for California. The questions on the two versions of the birth certificate are not comparable. Briefly stated, the 1989 revision asks a simple “yes/no” question on tobacco use during pregnancy. In contrast, the 2003 revision asks for tobacco use during each trimester of pregnancy (as well as the 3-month period prior to pregnancy). For the purposes of this report, data are shown separately for the areas using the unrevised certificate and for the areas using the revised certificate. For the 7 revised states with data on smoking for all of 2004 and 2005 data years, if the mother reported smoking in any of the 3 trimesters of pregnancy, she was recorded as a smoker.

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 (46,47). Maternal smoking has also been shown to increase the risk of respiratory infections and inhibit allergic immune responses in infants (48,49).

The infant mortality rate for the unrevised states for infants of mothers who smoked was 11.44 in 2005, 74 percent higher than the rate of 6.58 for nonsmokers (Table E). Rates were similar for the revised states. The difference in the infant mortality rate for the revised states was 79 percent (with rates of 10.69 for smokers and 5.96 for nonsmokers) (Table E).

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 2005 was Congenital malformations, deformations and chromosomal abnormalities (congenital malformations), which accounted for 20 percent of all infant deaths. Disorders relating to short gestation and low birthweight, not elsewhere classified (low birthweight) was second, which accounted for 17 percent of all infant deaths, followed by SIDS, which accounted 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 percent and 4 percent of all infant deaths in 2005. Together, the five leading causes accounted for 54 percent of all infant deaths in the United States in 2005. The order of the top four leading causes was the same as in 2004. The fifth leading cause of death in 2005 was cord complications, which was ranked sixth in 2004. Accidents (unintentional injuries) was the fifth leading cause in 2004, but dropped to sixth in 2005.

The rank order of leading causes of infant death varied substantially by race and Hispanic origin of the mother. Congenital malformations was the leading cause of infant death for all groups except for non-Hispanic black and Puerto Rican mothers, for whom low birthweight was the leading cause.

Infant mortality rates for the five leading causes did not change significantly from 2004 to 2005 for the total population or for specific race and ethnic groups.

When differences between cause-specific infant mortality rates were examined by race and ethnicity, infant mortality rates from Congenital malformations were 34 percent higher for non-Hispanic black and 18 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 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 AIAN and non-Hispanic black mothers—2.0 times and 1.8 times higher than those for non-Hispanic white mothers. As most SIDS deaths occur during the postneonatal period, the high SIDS rates for infants of non-Hispanic black and AIAN mothers accounted for much of their elevated risk of postneonatal mortality. Compared with non-Hispanic white mothers, SIDS rates were 48 percent lower for Mexican mothers, 57 percent lower for API mothers, and 68 percent lower for Central and South American mothers.

For maternal complications (which include incompetent cervix, premature rupture of membranes, and multiple pregnancy), infants of non-Hispanic black mothers had the highest mortality rates—3.3 times those for non-Hispanic white mothers. Rates for Puerto Rican mothers were twice those for non-Hispanic white mothers. The higher percentage of non-Hispanic black and Puerto Rican infants born at low birthweight may help explain their higher infant mortality rates from maternal complications as this cause occurs predominantly among low birthweight infants. Infant mortality rates from maternal complications were 55 percent lower for Central and South American mothers than for non-Hispanic white mothers.

Infant mortality rates from cord complications were twice as high for non-Hispanic black mothers and 38 percent higher for Puerto Rican mothers than for non-Hispanic white mothers. Infant mortality rates from cord complications were 39 percent lower for API mothers and 16 percent lower for Mexican mothers than for non-Hispanic white mothers.

An examination of cause-specific differences in infant mortality rates among race and Hispanic origin groups can help the researcher to understand overall differences in infant mortality rates among these groups. For example, 29 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, and 9 percent can be accounted for by differences in maternal complications. In other words, if non-Hispanic black infant mortality rates for these two 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 38 percent.

For AIAN mothers compared with non-Hispanic white mothers, 24 percent of their elevated infant mortality rate can be accounted for

by their higher SIDS rate, 17 percent by differences in congenital malformations, and 10 percent by differences in low birthweight. Thus, if AIAN infant mortality rates for these three causes could be reduced to non-Hispanic white levels, the difference in the infant mortality rate between AIAN and non-Hispanic white mothers would be reduced by 51 percent.

Similarly, 35 percent of the difference between Puerto Rican and non-Hispanic white infant mortality rates can be accounted for by differences in low birthweight, and 13 percent can be accounted for by differences in maternal complications. Thus, if Puerto Rican infant mortality from these two 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 48 percent. In addition to helping explain differences in infant mortality rates between various groups, comparisons such as these can be helpful in targeting prevention efforts.

Preterm-related causes of death

In order to more fully assess the impact of preterm birth on infant mortality, CDC researchers have developed a grouping of preterm-related causes of death (50). A cause of death was considered preterm-related if 75 percent or more of infants whose deaths were attributed to that cause were born at less than 37 weeks of gestation and if the cause of death was a direct consequence of preterm birth based on a clinical evaluation and review of the literature (50,51).

This grouping was developed because it is difficult using traditional analyses of the leading causes of infant death to assess the overall impact of preterm-related infant deaths on infant mortality. In particular, the category “Disorders related to short gestation and low birthweight, not elsewhere classified” includes the phrase “not elsewhere classified,” thereby indicating that many other preterm-related infant deaths are classified to other ICD categories.

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

[Table 8](#) shows trends in preterm-related infant mortality by race and Hispanic origin of mother from 2000 through 2005. In 2005, 10,364 out of a total of 28,384 infant deaths in the United States were preterm-related. The percentage of infant deaths that were preterm-related increased from 34.6 percent in 2000 to 36.5 percent in 2005.

The impact of preterm-related infant deaths varied considerably by maternal race and ethnicity. In 2005, nearly one-half (46 percent) of infant deaths to non-Hispanic black women and 41 percent of infant deaths to Puerto Rican women were due to preterm-related causes, whereas the percentage was somewhat lower for other race and ethnic groups ([Table 8](#)).

Preterm-related infant mortality rates varied considerably by race and ethnicity of the mother ([Figure 6](#) and [Table 8](#)). Preterm-related infant mortality rates were 3.4 times higher for non-Hispanic black mothers (6.26) than those for non-Hispanic white mothers (1.84). In fact, in 2005, the preterm-related infant mortality rate for non-Hispanic

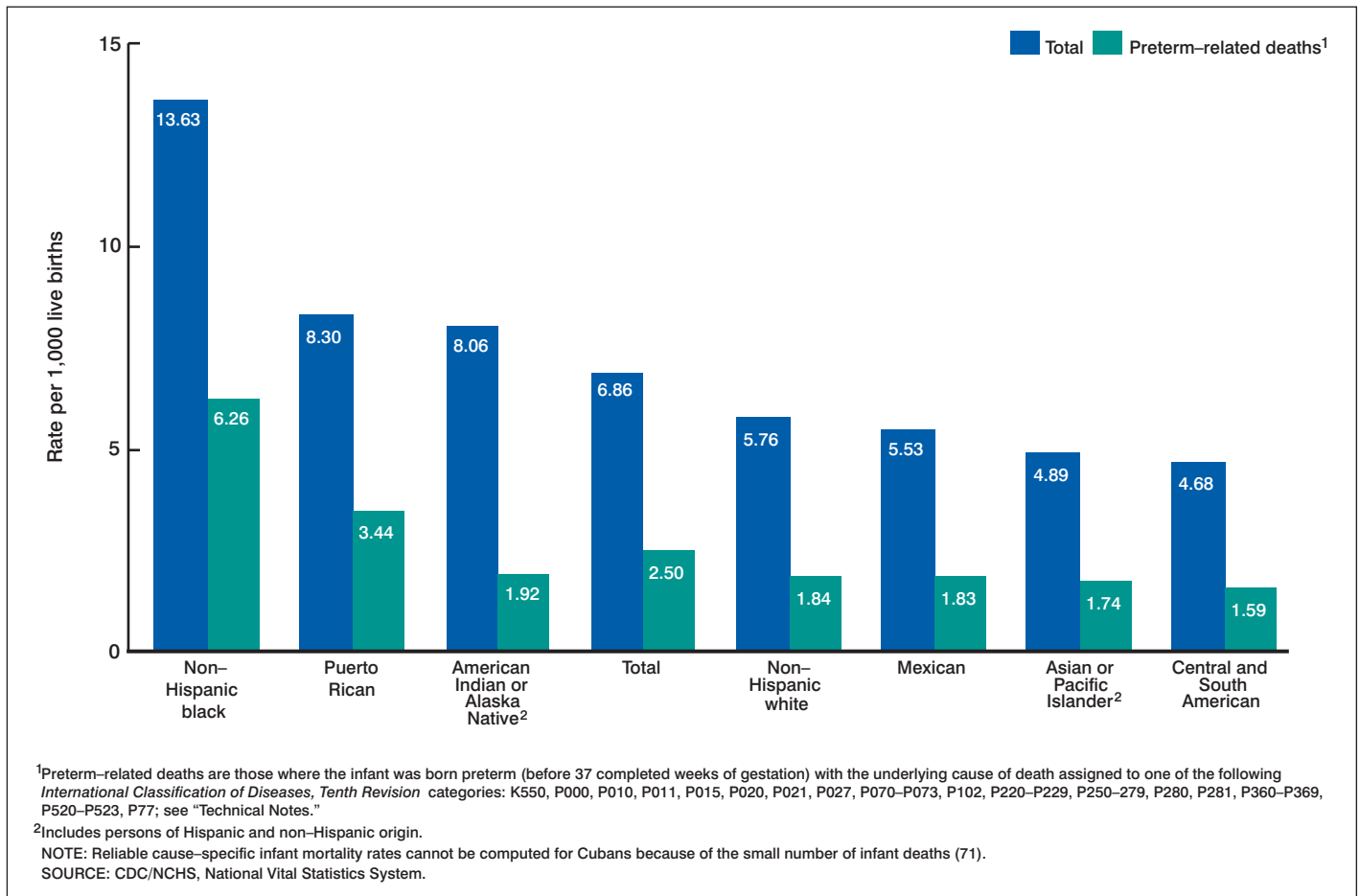


Figure 6. Total and preterm-related infant mortality rates by race and ethnicity of mother: United States, 2005

black mothers was higher than the **total** infant mortality rate for non-Hispanic white, Mexican, Central and South American, and API mothers. The preterm-related infant mortality rate for Puerto Rican (3.44) mothers was 87 percent higher than the rate for non-Hispanic white mothers. Preterm-related infant mortality rates for AIAN (1.92), Mexican (1.83), API (1.74), and Central and South American mothers were not significantly different from the rate for non-Hispanic white mothers. Preterm-related infant mortality rates increased significantly from 2000–2005 for non-Hispanic white, non-Hispanic black, API, and Mexican mothers. Changes from 2000–2005 were not significant for AIAN, Puerto Rican, and Central and South American mothers.

References

- National Center for Health Statistics. Public-use data file documentation: 2005 period linked birth/infant death data set [online]. Hyattsville, MD. Forthcoming.
- Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S, et al. Births: Final data for 2005. National vital statistics reports; vol 56 no 6. Hyattsville, MD: National Center for Health Statistics. 2007.
- Kung HC, Hoyert DL, Xu JQ, Murphy SL. Deaths: Final data for 2005. National vital statistics reports; vol 56 no 10. Hyattsville, MD: National Center for Health Statistics. 2008.
- World Health Organization. International Statistical Classification of Diseases and Related Health Problems, Tenth Revision. Geneva: World Health Organization. 1992.
- World Health Organization. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Ninth Revision. Geneva: World Health Organization. 1977.
- Rosenberg HM, Maurer JD, Sorlie PD, Johnson NJ, et al. Quality of death rates by race and Hispanic origin: A summary of current research, 1999. National Center for Health Statistics. Vital Health Stat 2(128). 1999.
- National Center for Health Statistics. U.S. Certificate of Live Birth. Available from: www.cdc.gov/nchs/data/dvs/birth11-03final-ACC.pdf. 2003.
- Hamilton BE, Ventura SJ. Characteristics of births to single- and multiple-race women: California, Hawaii, Pennsylvania, Utah, and Washington, 2003. National vital statistics reports; vol 55 no 15. Hyattsville, MD: National Center for Health Statistics. 2007.
- Tomashek KM, Qin C, Hsia J, Iyasu S, Barfield WD, Flowers LM. Infant mortality trends and differences between American Indian/Alaska Native infants and white infants in the United States, 1989–1991 and 1998–2000. *AJPH* 96:2222–7. 2006.
- Singh SK, Kogan MD. Persistent socioeconomic disparities in infant, neonatal, and postneonatal mortality rates in the United States, 1969–2001. *Pediatrics* 119:e928–39. 2007.
- American College of Obstetricians and Gynecologists. Multiple gestation: Complicated twin, triplet, and high-order multifetal pregnancy. *ACOG Practice Bulletin*; no 56. Washington, DC: American College of Obstetricians and Gynecologists. October 2004.
- Ayres A, Johnson TRB. Management of multiple pregnancy: Prenatal care—Part 1. *Obstet Gynecol* 60:527–37. 2005.

13. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes of preterm birth. *Lancet* 371:75–84. 2008.
14. Blondel B, Kogan MD, Alexander GR, et al. The impact of the increasing number of multiple births on the rates of preterm birth and low birthweight: An international study. *Am J Public Health* 92:1323–30. 2002.
15. MacDorman MF, Martin JA, Hoyert DL, Mathews TJ, Ventura SJ. Explaining the 2001–02 infant mortality increase: Data from the linked birth/infant death data set. *National vital statistics reports; vol 53 no 12*. Hyattsville, MD: National Center for Health Statistics. 2005.
16. Luke B, Brown MB. The changing risk of infant mortality by gestation, plurality, and race: 1989–91 versus 1999–2001. *Pediatrics* 118:2488–97. 2006.
17. Marlow N, Wolke D, Bracewell MA, Samara M. Neurologic and developmental disability at six years of age after extremely preterm birth. *N Engl J Med* 352:9–19. 2005.
18. Fanaroff AA, Stoll BJ, Wright LL, et al. Trends in neonatal morbidity and mortality for very low birthweight infants. *Am J Obstet Gynecol* 196:147.e1–8. 2007.
19. Costello DW, Friedman H, Minich N, et al. Improved neurodevelopmental outcomes for extremely low birth weight infants in 2000–2002. *Pediatrics* 119:37–45. 2008.
20. Tyson JE, Parikh NA, Langer J. Intensive care for extreme prematurity—Moving beyond gestational age. *New Engl J Med* 358:1672–81. 2008.
21. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Lancet* 371:261–9. 2008.
22. Davidoff MJ, Dias T, Damus K, et al. Changes in the gestational age distribution among U.S. singleton births: Impact on rates of late preterm birth, 1992 to 2002. *Semin Perinatol* 30:8–15. 2006.
23. MacDorman MF, Mathews TJ, Martin JA, Malloy MH. Trends and characteristics of induced labour in the United States, 1989–98. *Paediatr Perinat Epidemiol* 16:263–73. 2002.
24. Wright VC, Chang J, Jeng G, et al. Assisted reproductive technology surveillance—United States, 2004. *MMWR* 6(SS06):1–22. 2007.
25. Schempf AH, Branum AM, Lukacs SL, Schoendorf KC. The contribution of preterm birth to the black-white infant mortality gap, 1990 and 2000. *Am J Public Health* 97(7):1255–60. 2007.
26. Paulson J, Ramsini W, Conrey E, et al. Unregistered deaths among extremely low birthweight infants—Ohio, 2006. *MMWR* 56(42):1101–3. 2007.
27. McIntire DD, Leveno KJ. Neonatal mortality and morbidity rates in late preterm births compared with births at term. *Obstet Gynecol* 111:35–41. 2008.
28. Tomashek KM, Shapiro-Mendoza CK, Davidoff MJ, Petrini JR. Differences in mortality between late-preterm and term singleton infants in the United States, 1995–2002. *J Pediatrics* 151:450–6. 2007.
29. Kirkham C, Harris S, Grzybowski S. Evidence-based prenatal care: Part 1. General prenatal care and counseling issues. *Am Fam Physician* 71:1307–16. 2005.
30. Cramer ME, Chen LW, Roberts S, Clute D. Evaluating the social and economic impact of community-based prenatal care. *Public Health Nurs* 24(4):329–36. 2007.
31. Conway KS, Deb P. Is prenatal care really ineffective? Or, is the 'devil' in the distribution? *J Health Econ* 24:489–513. 2005.
32. Vintzileos AM, Ananth CV, Smulian JC, Scorza WE, Knuppel RA. The impact of prenatal care on neonatal deaths in the presence and absence of antenatal high-risk conditions. *Am J Obstet Gynecol* 186(5):1011–6. 2002.
33. Kirchengast S, Hartmann B. Impact of maternal age and maternal somatic characteristics on newborn size. *Am J Hum Biol* 15:220–8. 2003.
34. Phipps MG, Blume JD, DeMonner SM. Young maternal age associated with increased risk of postneonatal death. *Obstet Gynecol* 100:481–6. 2002.
35. Nabukera S, Wingate MS, Alexander GR, Salihu HM. First-time births among women 30 years and older in the United States: Patterns and risk of adverse outcomes. *J Reprod Med* 51(9):676–82. 2006.
36. Misra DP, Ananth CV. Infant mortality among singleton and twins in the United States during 2 decades: Effect of maternal age. *Pediatrics* 110(6):1163–8. 2002.
37. U.S. Census Bureau. Table 8. Income in 2004 by educational attainment of the population 18 years and over, by age, sex, race only, and Hispanic origin: 2005. In: *Current Population Survey, 2005 Annual Social and Economic Supplement*. Available from: www.census.gov/population/socdemo/education/cps2005/tab08-1.xls. 2006.
38. Bai J, Wong FWS, Bauman A, Mohsin M. Parity and pregnancy outcomes. *Am J Obstet Gynecol* 186(2):274–8. 2002.
39. McNamara TK, Orav EJ, Wilkins-Haug L, Chang G. Social support and prenatal alcohol use. *J Womens Health* 15(1):70–6. 2006.
40. Feldman PJ, Dunkel-Schetter C, Sandman CA, Wadhwa P. Maternal social support predicts birth weight and fetal growth in human pregnancy. *Psychosom Med* 67:715–25. 2000.
41. Jooma N, Borstell J, Shenkang Y, Tahner A, Vu H. Infant mortality in Louisiana—Identifying the risks. *J La State Med Soc* 153 (2):85–91. 2001.
42. Raatikainen K, Heiskanen N, Heinonen S. Marriage still protects pregnancy. *Br J Obstet Gynaecol* 112(10):1411–6. 2005.
43. Singh GK, Miller BA. Health, life expectancy, and mortality patterns among immigrant populations in the United States. *Can J Public Health* 95(3):114–21. 2004.
44. Liu KL, Laraque F. Higher mortality rate among infants of US-born mothers compared to foreign-born mothers in New York City. *J Immigr Minor Health* 8(3):281–9. 2006.
45. Acevedo-Garcia D, Soobader M, Berkman LF. The differential effect of foreign-born status on low birth weight by race/ethnicity and education. *Pediatrics* 115:20–30. 2005.
46. U.S. Department of Health and Human Services. *The health consequences of smoking: A report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention, Office on Smoking and Health. 2004.
47. Delpisheh A, Attia E, Drammond S, Brabin BJ. Adolescent smoking in pregnancy and birth outcomes. *Eur J Public Health*. Advance access published on November 22, 2005. Available from: <http://eurpub.oxfordjournals.org>.
48. Noakes PS, Hale J, Thomas R, Lane C, Devadason SG, Prescott SL. Maternal smoking is associated with impaired neonatal toll-like-receptor-mediated immune responses. *Eur Respir J* 28:721–9. 2006.
49. Le Souëf PN. Adverse effects of maternal smoking during pregnancy on innate immunity in infants. *Eur Respir J* 28:675–7. 2006.
50. Callaghan WD, MacDorman MF, Rasmussen SA, et al. The contribution of preterm birth to infant mortality rates in the United States. *Pediatrics* 118:1566–73. 2006.
51. MacDorman MF, Callaghan WM, Mathews TJ, Hoyert DL, Kochanek KD. Trends in preterm-related infant mortality by race and ethnicity, United States, 1999–2004. *Int J Health Serv* 37:635–41. 2007.
52. Buehler JW, Prager K, Hogue CJR. The role of linked birth and infant death certificates in maternal and child health epidemiology in the United States. *Am J Prev Med* 19(1S):3–11. 2000.
53. National Center for Health Statistics. 2003 revision of the U.S. Standard Certificate of Live Birth. 2003. Available from: www.cdc.gov/nchs/vital_certs_rev.htm. 2003.

54. National Center for Health Statistics. Report of the Panel to Evaluate the U.S. Standard Certificates and Reports. Available from: www.cdc.gov/nchs/data/dvs/panelreport_acc.pdf. 2000.

55. National Center for Health Statistics. Technical appendix. Vital statistics of the United States, 2003, vol I natality. Hyattsville, MD: National Center for Health Statistics. Available from: www.cdc.gov/nchs/data/TechApp03_1-09.pdf. 2005.

56. Office of Management and Budget. Race and ethnic standards for federal statistics and administrative reporting. Statistical Policy Directive 15. 1977.

57. Office of Management and Budget. Revisions to the standards for the classification of federal data on race and ethnicity. Federal Register 62FR58781–58790. Available from: www.whitehouse.gov/omb/fedreg/ombdir15.html. October 30, 1997.

58. Johnson D. Coding and editing multiple race. Presented at the 2004 joint meeting of NAPHSIS and VSCP, June 6–10, 2004, Portland, OR. Available from: www.naphsis.org/index.asp?downloadid=75.

59. Alexander GR, Allen MC. Conceptualization, measurement, and use of gestational age. I. Clinical and public health practice. *J Perinatol* 16(1):53–9. 1996.

60. National Center for Health Statistics. Computer edits for natality data, effective 1993. Instruction manual, part 12. Hyattsville, MD: National Center for Health Statistics. 1995.

61. National Center for Health Statistics. Vital statistics, instructions for classifying the underlying cause of death. NCHS instruction manual; part 2a. Hyattsville, MD: Public Health Service. Published annually.

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

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

64. National Center for Health Statistics. Public-use data file documentation: Multiple cause of death for ICD–10, 2001 data [online]. Hyattsville, MD: Public Health Service. Forthcoming.

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

66. National Center for Health Statistics. Updated comparability ratios. Available from: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/Comparability/icd9_icd10/Comparability_Ratio_tables.xls.

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

68. MacDorman MF, Callaghan WM, Mathews TJ, et al. Trends in preterm-related infant mortality by race and ethnicity: United States, 1999–2004. *Health E-stat*. Hyattsville, MD: National Center for Health Statistics. 2007.

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

3. Infant mortality rates by race and Hispanic origin of mother: United States and each state, Puerto Rico, Virgin Islands, and Guam, 2003–2005 linked files 20

4. Percentage of live births with selected maternal and infant characteristics, by race of mother: United States, 2005 linked file 21

5. Percentage 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, 2005 linked file 21

6. Live births and infant, neonatal, and postneonatal deaths and mortality rates, by race and Hispanic origin of mother and birthweight: United States, 2005 linked file, and percentage change in birthweight-specific infant mortality, 2000–2005 linked files 22

7. Infant deaths and mortality rates for the five leading causes of infant death, by race and Hispanic origin of mother: United States, 2005 linked file 25

8. Number and percentage of preterm-related infant deaths and preterm-related infant mortality rates, by race and Hispanic origin of mother: United States, 2000–2005 linked files 26

List of Detailed Tables

1. Infant mortality rates, live births, and infant deaths, by selected characteristics and race of mother: United States, 2005 linked file 14

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, 2005 linked file 17

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and race of mother: United States, 2005 linked file

Characteristic	Race of mother				
	All races	White	Black	American Indian or Alaska Native	Asian or Pacific Islander
Infant mortality rates per 1,000 live births in specified group					
Total	6.86	5.73	13.26	8.06	4.89
Age at death					
Total neonatal	4.54	3.77	8.92	4.04	3.37
Early neonatal (less than 7 days)	3.63	2.99	7.27	2.95	2.67
Late neonatal (7–27 days)	0.91	0.78	1.65	1.09	0.70
Postneonatal	2.32	1.96	4.33	4.02	1.51
Sex					
Male	7.56	6.34	14.63	8.60	5.20
Female	6.12	5.08	11.84	7.50	4.56
Plurality					
Single births	6.00	5.01	11.55	7.83	4.26
Plural births	31.50	26.28	57.95	*	27.05
Birthweight					
Less than 2,500 grams	57.39	52.03	74.75	53.43	44.15
Less than 1,500 grams	244.95	234.17	266.89	236.50	237.62
1,500–2,499 grams	14.73	14.75	15.35	18.01	11.27
2,500 grams or more	2.30	2.13	3.44	4.43	1.44
Period of gestation					
Less than 32 weeks	183.24	170.38	212.57	139.91	177.98
32–33 weeks	16.69	16.27	18.07	*	17.08
34–36 weeks	7.30	6.93	8.91	10.62	5.61
37–41 weeks	2.43	2.23	3.66	4.55	1.60
37–39 weeks	2.63	2.44	3.88	4.67	1.78
40–41 weeks	2.02	1.85	3.20	4.34	1.24
42 weeks or more	2.66	2.41	4.25	*	1.71
Age of mother					
Under 20 years	10.28	8.77	14.51	9.44	10.88
20–24 years	7.86	6.52	13.23	8.09	6.51
25–29 years	6.03	5.04	12.57	7.06	3.89
30–34 years	5.47	4.63	12.36	7.40	4.58
35–39 years	6.18	5.27	14.04	11.11	4.46
40–54 years	7.85	6.93	15.06	*	6.02
Live-birth order					
1	6.88	5.79	13.43	7.22	4.95
2	6.02	5.15	11.84	7.23	4.05
3	6.62	5.42	12.87	8.12	5.33
4	8.35	6.78	15.03	9.45	6.28
5 or more	10.36	8.47	16.19	10.45	8.62
Marital status					
Married	5.25	4.84	10.79	5.87	4.27
Unmarried	9.61	7.64	14.35	9.31	8.05
Mother's place of birth					
Born in the 50 states and D.C.	7.26	5.86	13.90	8.21	6.89
Born elsewhere	5.08	4.86	7.99	*	4.34

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and race of mother: United States, 2005 linked file—Con.

Characteristic	Race of mother				
	All races	White	Black	American Indian or Alaska Native	Asian or Pacific Islander
	Live births				
Total	4,138,573	3,229,494	633,152	44,815	231,112
Sex					
Male	2,119,101	1,655,917	321,270	22,674	119,240
Female	2,019,472	1,573,577	311,882	22,141	111,872
Plurality					
Single births	3,998,753	3,120,370	609,926	43,704	224,753
Plural births	139,820	109,124	23,226	1,111	6,359
Birthweight					
Less than 2,500 grams	340,152	231,897	86,460	3,313	18,482
Less than 1,500 grams	63,029	39,394	20,413	537	2,685
1,500–2,499 grams	277,123	192,503	66,047	2,776	15,797
2,500 grams or more	3,797,879	2,997,236	546,550	41,493	212,600
Not stated	542	361	142	9	30
Period of gestation					
Less than 32 weeks	83,428	53,632	25,441	922	3,433
32–33 weeks	65,853	46,827	15,218	822	2,986
34–36 weeks	373,663	277,783	73,182	4,519	18,179
37–41 weeks	3,346,237	2,636,998	482,104	34,933	192,202
37–39 weeks	2,199,904	1,723,239	326,451	22,489	127,725
40–41 weeks	1,146,333	913,759	155,653	12,444	64,477
42 weeks or more	239,850	190,725	34,128	3,307	11,690
Not stated	29,542	23,529	3,079	312	2,622
Age of mother					
Under 20 years	421,341	298,935	106,743	7,943	7,720
20–24 years	1,040,449	790,499	203,721	15,334	30,895
25–29 years	1,131,650	899,456	156,163	11,189	64,842
30–34 years	950,739	763,428	100,941	6,619	79,751
35–39 years	483,188	389,316	51,640	2,970	39,262
40–54 years	111,206	87,860	13,944	760	8,642
Live-birth order					
1	1,638,049	1,274,634	242,001	15,654	105,760
2	1,326,675	1,052,201	181,700	12,041	80,733
3	699,690	552,760	110,282	8,128	28,520
4	278,321	212,542	52,097	4,444	9,238
5 or more	178,341	125,563	42,671	4,308	5,799
Not stated	17,497	11,794	4,401	240	1,062
Marital status					
Married	2,611,454	2,206,863	194,525	16,353	193,713
Unmarried	1,527,119	1,022,631	438,627	28,462	37,399
Mother's place of birth					
Born in the 50 states and D.C.	3,106,464	2,499,415	523,049	42,502	41,498
Born elsewhere	1,015,459	719,847	105,187	2,190	188,235
Not stated	16,650	10,232	4,916	123	1,379

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths, by selected characteristics and race of mother: United States, 2005 linked file—Con.

Characteristic	Race of mother				
	All races	White	Black	American Indian or Alaska Native	Asian or Pacific Islander
	Infant deaths				
Total	28,384	18,500	8,393	361	1,129
Age at death					
Total neonatal	18,782	12,173	5,649	181	779
Early neonatal (less than 7 days)	15,013	9,660	4,603	132	618
Late neonatal (7–27 days)	3,769	2,512	1,047	49	161
Postneonatal	9,602	6,328	2,743	180	350
Sex					
Male	16,015	10,500	4,701	195	620
Female	12,368	8,001	3,692	166	510
Plurality					
Single births	23,979	15,633	7,047	342	957
Plural births	4,405	2,868	1,346	19	172
Birthweight					
Less than 2,500 grams	19,521	12,066	6,463	177	816
Less than 1,500 grams	15,439	9,225	5,448	127	638
1,500–2,499 grams	4,082	2,840	1,014	50	178
2,500 grams or more	8,741	6,372	1,878	184	307
Not stated	121	63	53	–	6
Period of gestation					
Less than 32 weeks	15,287	9,138	5,408	129	611
32–33 weeks	1,099	762	275	11	51
34–36 weeks	2,727	1,926	652	48	102
37–41 weeks	8,116	5,886	1,764	159	307
37–39 weeks	5,796	4,198	1,265	105	227
40–41 weeks	2,320	1,688	498	54	80
42 weeks or more	637	459	145	13	20
Not stated	516	329	148	1	38
Age of mother					
Under 20 years	4,330	2,621	1,549	75	84
20–24 years	8,173	5,153	2,696	124	201
25–29 years	6,824	4,530	1,963	79	252
30–34 years	5,199	3,537	1,248	49	365
35–39 years	2,985	2,051	725	33	175
40–54 years	873	609	210	2	52
Live-birth order					
1	11,272	7,386	3,249	113	524
2	7,984	5,419	2,151	87	327
3	4,632	2,995	1,419	66	152
4	2,325	1,441	783	42	58
5 or more	1,848	1,063	691	45	50
Not stated	322	196	100	8	18
Marital status					
Married	13,713	10,692	2,098	96	828
Unmarried	14,670	7,809	6,295	265	301
Mother's place of birth					
Born in the 50 states and D.C.	22,561	14,656	7,270	349	286
Born elsewhere	5,163	3,496	840	10	817
Not stated	659	348	283	2	26

* Figure does not meet standards of reliability or precision.

– Quantity zero.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals because of 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. In this table, all women (including Hispanic women) are classified only according to their race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states. See reference 2.

Table 2. Infant mortality rates, live births, and infant deaths, by selected characteristics and Hispanic origin of mother and by race of mother for mothers of non-Hispanic origin: United States, 2005 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
Infant mortality rates per 1,000 live births in specified group										
Total	6.86	5.62	5.53	8.30	4.42	4.68	6.43	7.20	5.76	13.63
Age at death										
Total neonatal	4.54	3.86	3.78	5.95	3.05	3.23	4.29	4.70	3.71	9.13
Early neonatal (less than 7 days)	3.63	3.08	3.04	4.78	2.68	2.52	3.26	3.75	2.92	7.43
Late neonatal (7–27 days)	0.91	0.78	0.75	1.17	*	0.71	1.04	0.95	0.79	1.70
Postneonatal	2.32	1.76	1.75	2.37	1.37	1.46	2.14	2.49	2.05	4.50
Sex										
Male	7.56	6.21	6.11	8.95	5.30	5.15	7.35	7.93	6.39	15.06
Female	6.12	5.00	4.92	7.64	3.48	4.19	5.49	6.43	5.09	12.17
Plurality										
Single births	6.00	5.02	4.98	7.21	2.71	4.21	5.80	6.26	4.99	11.89
Plural births	31.50	31.17	30.91	41.40	53.11	23.84	29.34	31.45	25.11	58.48
Birthweight										
Less than 2,500 grams	57.39	55.75	57.41	63.04	42.28	47.75	51.18	57.34	50.28	74.71
Less than 1,500 grams	244.95	245.20	253.76	271.98	168.03	208.04	229.51	242.79	227.29	265.68
1,500–2,499 grams	14.73	15.29	16.08	13.15	*	13.35	15.47	14.58	14.63	15.19
2,500 grams or more	2.30	1.88	1.91	2.16	*	1.53	2.35	2.43	2.23	3.52
Period of gestation										
Less than 32 weeks	183.24	163.79	165.40	202.52	122.39	142.97	154.03	186.72	171.30	212.99
32–33 weeks	16.69	14.87	15.49	*	*	11.57	*	17.29	17.16	17.81
34–36 weeks	7.30	6.60	6.70	7.10	*	5.50	7.67	7.50	7.14	8.80
37–41 weeks	2.43	2.02	2.04	2.42	*	1.67	2.53	2.54	2.31	3.78
37–39 weeks	2.63	2.22	2.28	2.53	*	1.81	2.61	2.75	2.51	4.00
40–41 weeks	2.02	1.66	1.60	2.22	*	1.41	2.36	2.14	1.92	3.31
42 weeks or more	2.66	2.17	2.14	*	*	2.11	*	2.84	2.56	4.35
Age of mother										
Under 20 years	10.28	7.20	6.86	10.35	*	5.46	9.38	11.73	9.98	14.86
20–24 years	7.86	5.48	5.36	7.70	*	4.75	6.17	8.72	7.07	13.62
25–29 years	6.03	4.88	4.72	8.45	*	4.28	5.12	6.32	5.06	12.97
30–34 years	5.47	5.29	5.41	6.84	*	4.19	6.68	5.47	4.43	12.71
35–39 years	6.18	6.02	6.08	7.06	*	5.58	5.93	6.16	5.06	14.30
40–54 years	7.85	7.74	8.33	*	*	5.80	*	7.86	6.63	15.84
Live-birth order										
1	6.88	6.02	5.98	8.96	4.18	5.01	6.43	7.07	5.71	13.81
2	6.02	4.88	4.89	6.38	4.08	3.75	6.36	6.33	5.25	12.33
3	6.62	5.06	4.79	8.72	*	4.55	6.02	7.17	5.62	13.14
4	8.35	6.12	5.76	10.93	*	5.73	6.68	9.29	7.21	15.32
5 or more	10.36	8.05	8.22	9.71	*	6.50	7.46	11.28	8.69	16.47
Marital status										
Married	5.25	5.01	5.08	6.30	3.92	4.27	5.23	5.29	4.79	11.11
Unmarried	9.61	6.28	6.04	9.55	5.30	5.12	7.74	11.00	8.61	14.72
Mother's place of birth:										
Born in the 50 states and D.C.	7.26	6.40	6.21	8.08	4.68	5.21	6.63	7.37	5.78	14.02
Born elsewhere	5.08	5.08	5.09	8.59	3.94	4.60	4.95	5.07	4.14	8.69

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, 2005 linked file—Con.

Characteristic	Hispanic							Non-Hispanic			
	All origins ¹	Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total ²	White	Black	Not stated
Live births											
Total	4,138,573	985,513	693,202	63,341	16,064	151,202	61,704	3,123,206	2,279,959	583,764	29,854
Sex											
Male	2,119,101	503,489	354,215	32,176	8,309	77,485	31,304	1,600,288	1,170,614	296,240	15,324
Female	2,019,472	482,024	338,987	31,165	7,755	73,717	30,400	1,522,918	1,109,345	287,524	14,530
Plurality											
Single births	3,998,753	963,027	678,677	61,288	15,518	147,510	60,034	3,007,095	2,192,768	561,894	28,631
Plural births	139,820	22,486	14,525	2,053	546	3,692	1,670	116,111	87,191	21,870	1,223
Birthweight											
Less than 2,500 grams	340,152	68,037	45,093	6,313	1,230	10,282	5,119	269,545	166,785	82,212	2,570
Less than 1,500 grams	63,029	11,974	7,842	1,217	244	1,817	854	50,504	27,960	19,535	551
1,500–2,499 grams	277,123	56,063	37,251	5,096	986	8,465	4,265	219,041	138,825	62,677	2,019
2,500 grams or more	3,797,879	917,418	648,079	57,014	14,833	140,913	56,579	2,853,349	2,113,009	501,435	27,112
Not stated	542	58	30	14	1	7	6	312	165	117	172
Period of gestation											
Less than 32 weeks	83,428	17,351	11,584	1,590	335	2,602	1,240	65,398	37,157	24,198	679
32–33 weeks	65,853	15,266	10,393	1,224	256	2,333	1,060	50,146	32,345	14,264	441
34–36 weeks	373,663	85,164	58,350	6,198	1,522	13,100	5,994	285,819	195,975	68,598	2,680
37–41 weeks	3,346,237	790,714	556,318	49,974	12,999	122,376	49,047	2,532,144	1,875,338	442,812	23,379
37–39 weeks	2,199,904	510,012	356,869	32,856	8,922	78,407	32,958	1,675,036	1,231,862	301,438	14,856
40–41 weeks	1,146,333	280,702	199,449	17,118	4,077	43,969	16,089	857,108	643,476	141,374	8,523
42 weeks or more	239,850	62,717	44,358	4,139	911	9,493	3,816	175,483	130,477	31,030	1,650
Not stated	29,542	14,301	12,199	216	41	1,298	547	14,216	8,667	2,862	1,025
Age of mother											
Under 20 years	421,341	139,374	103,561	11,015	1,239	13,005	10,554	279,284	166,358	99,510	2,683
20–24 years	1,040,449	287,898	209,156	19,747	3,217	36,806	18,972	745,754	515,571	188,676	6,797
25–29 years	1,131,650	266,590	187,469	16,220	4,052	43,417	15,432	857,152	642,602	142,885	7,908
30–34 years	950,739	186,402	126,179	10,241	4,630	34,869	10,483	757,177	581,682	92,337	7,160
35–39 years	483,188	85,739	54,955	4,956	2,320	18,447	5,061	393,306	305,169	47,412	4,143
40–54 years	111,206	19,510	11,882	1,162	606	4,658	1,202	90,533	68,577	12,944	1,163
Live-birth order											
1	1,638,049	350,707	236,058	24,776	7,169	58,903	23,801	1,275,623	937,926	222,634	11,719
2	1,326,675	301,669	208,777	19,443	5,881	48,843	18,725	1,016,410	761,729	166,633	8,596
3	699,690	193,220	141,882	11,118	2,114	26,813	11,293	502,091	366,600	101,797	4,379
4	278,321	85,290	65,158	4,666	554	10,122	4,790	191,116	130,164	48,507	1,915
5 or more	178,341	52,047	39,905	3,091	234	6,002	2,815	124,787	75,252	40,366	1,507
Not stated	17,497	2,580	1,422	247	112	519	280	13,179	8,288	3,827	1,738
Marital status											
Married	2,611,454	512,859	369,776	24,282	10,211	76,852	31,738	2,079,633	1,702,278	176,003	18,962
Unmarried	1,527,119	472,654	323,426	39,059	5,853	74,350	29,966	1,043,573	577,681	407,761	10,892
Mother's place of birth											
Born in the 50 states and D.C.	3,106,464	363,833	245,187	43,195	7,689	19,964	47,798	2,720,398	2,139,044	505,632	22,233
Born elsewhere	1,015,459	619,603	446,971	19,779	8,366	130,957	13,530	389,566	133,312	73,853	6,290
Not stated	16,650	2,077	1,044	367	9	281	376	13,242	7,603	4,279	1,331

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, 2005 linked file—Con.

Characteristic	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	28,384	5,537	3,833	526	71	708	397	22,472	13,134	7,958	375
Age at death											
Total neonatal	18,782	3,802	2,623	377	49	489	265	14,679	8,452	5,332	300
Early neonatal (less than 7 days)	15,013	3,032	2,105	303	43	381	201	11,701	6,662	4,338	280
Late neonatal (7–27 days)	3,769	770	518	74	6	108	64	2,978	1,790	994	20
Postneonatal	9,602	1,734	1,210	150	22	220	132	7,792	4,682	2,626	76
Sex											
Male	16,015	3,126	2,165	288	44	399	230	12,683	7,482	4,460	205
Female	12,368	2,410	1,668	238	27	309	167	9,788	5,652	3,498	170
Plurality											
Single births	23,979	4,836	3,383	442	42	621	348	18,820	10,945	6,679	323
Plural births	4,405	701	449	85	29	88	49	3,652	2,189	1,279	53
Birthweight											
Less than 2,500 grams	19,521	3,793	2,589	398	52	491	262	15,456	8,386	6,142	272
Less than 1,500 grams	15,439	2,936	1,990	331	41	378	196	12,262	6,355	5,190	241
1,500–2,499 grams	4,082	857	599	67	11	113	66	3,194	2,031	952	31
2,500 grams or more	8,741	1,726	1,236	123	18	216	133	6,925	4,710	1,767	91
Not stated	121	18	8	5	1	2	2	91	38	48	12
Period of gestation											
Less than 32 weeks	15,287	2,842	1,916	322	41	372	191	12,211	6,365	5,154	234
32–33 weeks	1,099	227	161	15	5	27	18	867	555	254	5
34–36 weeks	2,727	562	391	44	9	72	46	2,145	1,400	604	21
37–41 weeks	8,116	1,597	1,133	121	15	204	124	6,435	4,332	1,673	84
37–39 weeks	5,796	1,131	813	83	7	142	86	4,604	3,094	1,205	61
40–41 weeks	2,320	466	320	38	8	62	38	1,831	1,238	468	23
42 weeks or more	637	136	95	10	–	20	10	499	334	135	3
Not stated	516	173	136	14	1	13	8	315	147	138	29
Age of mother											
Under 20 years	4,330	1,004	710	114	11	71	99	3,276	1,660	1,479	49
20–24 years	8,173	1,578	1,122	152	13	175	117	6,506	3,646	2,569	89
25–29 years	6,824	1,302	885	137	15	186	79	5,413	3,251	1,853	108
30–34 years	5,199	986	682	70	17	146	70	4,140	2,576	1,174	73
35–39 years	2,985	516	334	35	13	103	30	2,423	1,545	678	46
40–54 years	873	151	99	18	2	27	4	712	455	205	10
Live-birth order											
1	11,272	2,112	1,411	222	30	295	153	9,025	5,359	3,074	136
2	7,984	1,471	1,020	124	24	183	119	6,438	4,001	2,055	75
3	4,632	977	679	97	11	122	68	3,600	2,059	1,338	56
4	2,325	522	375	51	5	58	32	1,776	939	743	27
5 or more	1,848	419	328	30	–	39	21	1,408	654	665	21
Not stated	322	35	18	2	1	10	4	226	122	82	61
Marital status											
Married	13,713	2,567	1,880	153	40	328	166	10,995	8,160	1,955	151
Unmarried	14,670	2,970	1,953	373	31	381	232	11,476	4,973	6,003	224
Mother's place of birth											
Born in the 50 states and D.C.	22,561	2,329	1,523	349	36	104	317	20,038	12,371	7,091	194
Born elsewhere	5,163	3,149	2,277	170	33	602	67	1,977	552	642	38
Not stated	659	59	34	8	2	2	13	456	211	225	144

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

– Quantity zero.

¹Includes origin not stated.²Includes races other than black or white.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals because of rounding. "Not stated" responses were included in totals but not distributed among groups for rate computations. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states. See reference 2.

Table 3. Infant mortality rates by race and Hispanic origin of mother: United States and each state, Puerto Rico, Virgin Islands, and Guam, 2003–2005 linked files

[By place of residence]

State	Race and Hispanic origin of mother							
	Total	Race				Hispanic origin		
		White	Black	American Indian or Alaska Native	Asian or Pacific Islander	Hispanic	Non-Hispanic white	Non-Hispanic black
Infant mortality rates per 1,000 live births in specified group								
United States ¹	6.83	5.71	13.33	8.40	4.79	5.60	5.71	13.61
Alabama	8.96	6.91	13.73	*	*	7.69	6.82	13.65
Alaska	6.45	5.04	*	9.16	*	*	5.29	*
Arizona	6.69	6.40	10.67	8.30	6.69	6.70	6.02	11.22
Arkansas	8.29	7.11	13.48	*	*	6.02	7.22	13.58
California	5.22	4.93	11.30	6.24	4.17	4.99	4.63	11.40
Colorado	6.27	5.81	16.28	*	5.73	7.04	5.23	16.26
Connecticut	5.53	4.62	12.64	*	*	7.43	3.88	12.68
Delaware	9.03	6.43	16.73	*	*	6.15	6.46	16.80
District of Columbia	12.22	4.55	15.83	*	*	7.18	3.38	17.20
Florida	7.24	5.63	12.36	*	5.85	5.17	5.79	12.92
Georgia	8.35	6.03	13.35	*	5.78	5.46	6.13	13.27
Hawaii	6.67	4.60	14.78	*	7.21	7.90	3.95	15.48
Idaho	6.12	6.10	*	*	*	6.15	6.08	*
Illinois	7.53	6.00	15.30	*	4.53	6.17	5.95	15.27
Indiana	7.87	7.03	15.09	*	*	6.78	7.06	15.11
Iowa	5.40	5.13	11.02	*	*	5.20	5.12	10.97
Kansas	7.12	6.55	14.21	*	5.57	6.16	6.66	14.33
Kentucky	6.79	6.39	10.92	*	*	7.57	6.36	10.92
Louisiana	9.79	7.04	13.92	*	*	5.65	7.09	13.94
Maine	5.87	5.79	*	*	*	*	5.76	*
Maryland	8.00	5.33	13.19	*	4.34	5.80	5.21	13.66
Massachusetts	4.89	4.39	9.20	*	3.79	6.51	3.97	10.02
Michigan	8.02	6.30	16.38	*	5.12	7.64	6.15	16.38
Minnesota	4.78	4.33	8.70	8.59	3.82	4.25	4.27	8.86
Mississippi	10.74	6.91	15.54	*	*	*	6.99	15.56
Missouri	7.63	6.61	13.72	*	6.12	6.57	6.59	13.85
Montana	6.35	5.92	*	9.32	*	*	5.67	*
Nebraska	5.89	5.36	13.68	*	*	5.68	5.13	14.01
Nevada	5.86	5.21	12.08	*	5.76	4.49	5.62	12.23
New Hampshire	5.02	4.87	*	*	*	*	4.83	*
New Jersey	5.44	4.17	11.06	*	4.98	5.20	3.70	11.88
New Mexico	6.13	5.88	*	7.63	*	5.30	6.86	*
New York	6.02	4.84	11.02	*	3.91	5.50	4.65	11.77
North Carolina	8.58	6.36	15.81	10.22	5.89	6.61	6.33	15.77
North Dakota	6.35	5.97	*	8.59	*	*	5.97	*
Ohio	7.82	6.46	15.34	*	4.48	6.50	6.42	15.56
Oklahoma	7.86	7.32	13.09	7.89	*	6.04	7.54	12.96
Oregon	5.68	5.50	8.22	10.98	5.81	5.52	5.50	8.58
Pennsylvania	7.30	6.09	13.98	*	4.90	7.61	5.78	13.55
Rhode Island	6.20	5.56	9.99	*	*	7.40	4.52	10.80
South Carolina	9.03	6.44	13.97	*	*	7.32	6.41	14.22
South Dakota	7.18	6.01	*	12.73	*	*	6.15	*
Tennessee	8.87	6.96	15.68	*	8.06	6.48	7.02	16.29
Texas	6.45	5.78	12.29	*	4.30	5.62	5.92	12.41
Utah	4.92	4.70	*	*	7.72	5.76	4.54	*
Vermont	5.37	5.31	*	*	*	*	5.30	*
Virginia	7.50	5.91	13.50	*	4.52	5.42	5.95	13.72
Washington	5.39	5.14	8.50	9.46	4.84	4.86	4.98	8.96
West Virginia	7.73	7.57	12.38	*	*	*	7.51	12.03
Wisconsin	6.34	5.19	16.42	8.24	6.58	6.06	5.11	16.42
Wyoming	6.95	6.54	*	*	*	*	6.78	*
Puerto Rico	8.91	8.70	10.77	---	---	---	---	---
Virgin Islands	7.45	*	8.06	*	*	*	*	*
Guam	11.13	*	*	*	11.53	*	*	*

* Figure does not meet standards of reliability or precision; based on fewer than 20 deaths in the numerator. --- Data not available. ¹Excludes 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. Multiple-race data on the birth certificate was reported for 6 states in 2003, 15 in 2004, and 19 in 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table 4. Percentage of live births with selected maternal and infant characteristics, by race of mother: United States, 2005 linked file

Characteristic	All races	White	Black	American Indian or Alaska Native	Asian or Pacific Islander
Birthweight					
Less than 1,500 grams	1.52	1.22	3.22	1.20	1.16
Less than 2,500 grams	8.2	7.2	13.7	7.4	8.0
Preterm births ¹	12.7	11.8	18.3	14.1	10.7
Births to mothers under 20 years of age	10.2	9.2	17.0	17.8	3.1
Fourth and higher order births	11.1	10.4	15.2	19.7	6.4
Births to unmarried mothers	36.9	31.2	69.8	63.8	15.3
Mothers born in the 50 states and D.C.	75.4	79.0	85.6	96.5	17.7

¹Born prior to 37 completed weeks of gestation.

NOTES: Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table 5. Percentage 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, 2005 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	1.52	1.22	1.13	1.92	1.52	1.20	1.38	1.62	1.23	3.35
Less than 2,500 grams	8.2	6.9	6.5	10.0	7.7	6.8	8.3	8.6	7.3	14.1
Preterm births ³	12.7	12.1	11.8	14.3	13.2	12.0	13.6	12.9	11.7	18.4
Births to mothers under 20 years of age	10.2	14.1	14.9	17.4	7.7	8.6	17.1	8.9	7.3	17.0
Fourth and higher order births	11.1	14.0	15.2	12.3	4.9	10.7	12.4	10.2	9.0	15.3
Births to unmarried mothers	36.9	48.0	46.7	61.7	36.4	49.2	48.6	33.4	25.3	69.9
Mothers born in the 50 states and D.C.	75.4	37.0	35.4	68.6	47.9	13.2	77.9	87.4	94.1	87.3

¹Includes origin not stated.

²Includes races other than black or white.

³Born prior to 37 completed weeks of gestation.

NOTES: Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table 6. Live births and infant, neonatal, and postneonatal deaths and mortality rates, by race and Hispanic origin of mother and birthweight: United States, 2005 linked file, and percentage change in birthweight-specific infant mortality, 2000–2005 linked files

Race and Hispanic origin and birthweight	Number in 2005				Mortality rate per 1,000 live births in 2005			Percent change in infant mortality rate 2000–2005
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races	4,138,573	28,384	18,782	9,602	6.86	4.54	2.32	-0.4
Less than 2,500 grams	340,152	19,521	15,701	3,820	57.39	46.16	11.23	**–3.4
Less than 1,500 grams	63,029	15,439	13,404	2,035	244.95	212.66	32.29	0.3
Less than 500 grams	7,274	6,232	6,097	134	856.75	838.19	18.42	1.3
500–749 grams	11,754	5,502	4,648	854	468.10	395.44	72.66	-1.7
750–999 grams	12,526	1,884	1,373	510	150.41	109.61	40.72	-3.5
1,000–1,249 grams	14,352	1,023	738	285	71.28	51.42	19.86	-7.8
1,250–1,499 grams	17,123	799	548	251	46.66	32.00	14.66	2.3
1,500–1,999 grams	66,584	1,789	1,134	655	26.87	17.03	9.84	-5.0
2,000–2,499 grams	210,539	2,293	1,163	1,130	10.89	5.52	5.37	**–7.2
2,500 grams or more	3,797,879	8,741	2,963	5,778	2.30	0.78	1.52	**–6.9
2,500–2,999 grams	748,527	3,136	1,224	1,912	4.19	1.64	2.55	**–8.3
3,000–3,499 grams	1,597,746	3,437	1,049	2,388	2.15	0.66	1.49	**–9.7
3,500–3,999 grams	1,115,475	1,635	500	1,135	1.47	0.45	1.02	**–12.0
4,000–4,499 grams	289,269	418	134	284	1.45	0.46	0.98	-1.4
4,500–4,999 grams	42,143	93	43	50	2.21	1.02	1.19	7.8
5,000 grams or more	4,719	21	13	8	4.45	*	*	-27.3
Not stated	542	121	117	4	...	...	...	...
White	3,229,494	18,500	12,173	6,328	5.73	3.77	1.96	0.4
Less than 2,500 grams	231,897	12,066	9,829	2,237	52.03	42.39	9.65	**–3.8
Less than 1,500 grams	39,394	9,225	8,126	1,100	234.17	206.28	27.92	0.6
Less than 500 grams	4,058	4,058	3,431	60	860.28	845.49	14.79	1.1
500–749 grams	6,866	3,285	2,852	433	478.44	415.38	63.06	-2.1
750–999 grams	7,732	1,235	953	282	159.73	123.25	36.47	-0.7
1,000–1,249 grams	9,222	686	504	181	74.39	54.65	19.63	-7.1
1,250–1,499 grams	11,516	529	385	144	45.94	33.43	12.50	3.6
1,500–1,999 grams	45,938	1,224	823	401	26.64	17.92	8.73	-6.3
2,000–2,499 grams	146,565	1,617	880	736	11.03	6.00	5.02	**–7.9
2,500 grams or more	2,997,236	6,372	2,283	4,089	2.13	0.76	1.36	**–4.9
2,500–2,999 grams	533,839	2,182	913	1,269	4.09	1.71	2.38	**–6.8
3,000–3,499 grams	1,241,931	2,505	817	1,688	2.02	0.66	1.36	**–7.8
3,500–3,999 grams	930,616	1,266	405	861	1.36	0.44	0.93	**–9.9
4,000–4,499 grams	250,377	331	104	227	1.32	0.42	0.91	-2.2
4,500–4,999 grams	36,489	70	33	36	1.92	0.90	0.99	7.9
5,000 grams or more	3,984	18	11	7	*	*	*	*
Not stated	361	63	61	2	...	...	...	...
Black	633,152	8,393	5,649	2,743	13.26	8.92	4.33	-1.6
Less than 2,500 grams	86,460	6,463	5,070	1,393	74.75	58.64	16.11	-1.3
Less than 1,500 grams	20,413	5,448	4,612	836	266.89	225.93	40.95	0.0
Less than 500 grams	2,864	2,444	2,376	69	853.35	829.61	24.09	2.0
500–749 grams	4,340	1,945	1,567	378	448.16	361.06	87.10	-2.2
750–999 grams	4,172	563	357	207	134.95	85.57	49.62	-4.7
1,000–1,249 grams	4,378	275	184	91	62.81	42.03	20.79	-12.4
1,250–1,499 grams	4,659	221	129	92	47.44	27.69	19.75	5.8
1,500–1,999 grams	16,632	456	238	218	27.42	14.31	13.11	-1.5
2,000–2,499 grams	49,415	558	219	339	11.29	4.43	6.86	-3.2
2,500 grams or more	546,550	1,878	528	1,349	3.44	0.97	2.47	**–12.0
2,500–2,999 grams	154,649	772	248	524	4.99	1.60	3.39	**–11.5
3,000–3,499 grams	241,637	741	175	566	3.07	0.72	2.34	**–15.0
3,500–3,999 grams	121,098	287	75	212	2.37	0.62	1.75	**–16.3
4,000–4,499 grams	25,089	62	23	38	2.47	0.92	1.51	2.9
4,500–4,999 grams	3,623	16	8	8	*	*	*	*
5,000 grams or more	454	1	–	1	*	*	*	*
Not stated	142	53	52	1	...	...	...	...

See footnotes at end of table.

Table 6. Live births and infant, neonatal, and postneonatal deaths and mortality rates, by race and Hispanic origin of mother and birthweight: United States, 2005 linked file, and percentage change in birthweight-specific infant mortality, 2000–2005 linked files—Con.

Race and Hispanic origin and birthweight	Number in 2005				Mortality rate per 1,000 live births in 2005			Percent change in infant mortality rate 2000–2005
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
American Indian or Alaska Native	44,815	361	181	180	8.06	4.04	4.02	-2.9
Less than 2,500 grams	3,313	177	135	41	53.43	40.75	12.38	-14.2
Less than 1,500 grams	537	127	107	20	236.50	199.26	37.24	-11.5
Less than 500 grams	58	46	46	—	793.10	793.10	*	-11.7
500–749 grams	91	41	35	6	450.55	384.62	*	-0.9
750–999 grams	109	11	6	5	*	*	*	*
1,000–1,249 grams	137	18	14	4	*	*	*	*
1,250–1,499 grams	142	10	5	5	*	*	*	*
1,500–1,999 grams	651	20	15	5	30.72	*	*	*
2,000–2,499 grams	2,125	29	13	16	13.65	*	*	-12.8
2,500 grams or more	41,493	184	45	139	4.43	1.08	3.35	3.5
2,500–2,999 grams	7,388	53	14	38	7.17	*	5.14	16.6
3,000–3,499 grams	16,661	69	16	53	4.14	*	3.18	-12.8
3,500–3,999 grams	12,781	41	9	31	3.21	*	2.43	6.3
4,000–4,499 grams	3,834	15	4	11	*	*	*	*
4,500–4,999 grams	721	5	—	5	*	*	*	*
5,000 grams or more	108	2	2	—	*	*	*	*
Not stated	9	—	—	—	...	...	...	...
Asian or Pacific Islander	231,112	1,129	779	350	4.89	3.37	1.51	0.4
Less than 2,500 grams	18,482	816	668	148	44.15	36.14	8.01	-0.6
Less than 1,500 grams	2,685	638	559	79	237.62	208.19	29.42	1.5
Less than 500 grams	294	250	244	6	850.34	829.93	*	-1.9
500–749 grams	457	231	193	37	505.47	422.32	80.96	10.4
750–999 grams	513	74	58	16	144.25	113.06	*	-14.8
1,000–1,249 grams	615	45	36	9	73.17	58.54	*	6.6
1,250–1,499 grams	806	39	29	10	48.39	35.98	*	-31.7
1,500–1,999 grams	3,363	89	57	31	26.46	16.95	9.22	-4.4
2,000–2,499 grams	12,434	89	51	38	7.16	4.10	3.06	-13.2
2,500 grams or more	212,600	307	106	201	1.44	0.50	0.95	-12.2
2,500–2,999 grams	52,651	130	50	80	2.47	0.95	1.52	-7.1
3,000–3,499 grams	97,517	123	42	81	1.26	0.43	0.83	3.3
3,500–3,999 grams	50,980	43	12	30	0.84	*	0.59	-36.8
4,000–4,499 grams	9,969	10	2	8	*	*	*	*
4,500–4,999 grams	1,310	2	1	1	*	*	*	*
5,000 grams or more	173	—	—	—	*	*	*	*
Not stated	30	6	5	1	...	...	...	...
Hispanic	985,513	5,537	3,803	1,734	5.62	3.86	1.76	0.5
Less than 2,500 grams	68,037	3,793	3,109	683	55.75	45.70	10.04	-0.7
Less than 1,500 grams	11,974	2,936	2,572	363	245.20	214.80	30.32	4.1
Less than 500 grams	1,311	1,123	1,104	19	856.60	842.11	*	4.2
500–749 grams	2,285	1,098	944	154	480.53	413.13	67.40	0.6
750–999 grams	2,371	355	268	87	149.73	113.03	36.69	-8.5
1,000–1,249 grams	2,717	193	139	53	71.03	51.16	19.51	-5.9
1,250–1,499 grams	3,290	167	117	50	50.76	35.56	15.20	3.3
1,500–1,999 grams	12,731	384	262	122	30.16	20.58	9.58	-8.0
2,000–2,499 grams	43,332	473	275	198	10.92	6.35	4.57	-5.6
2,500 grams or more	917,418	1,726	675	1,050	1.88	0.74	1.14	** -9.2
2,500–2,999 grams	176,509	632	287	345	3.58	1.63	1.95	-6.3
3,000–3,499 grams	399,411	654	231	422	1.64	0.58	1.06	** -15.5
3,500–3,999 grams	266,429	333	110	223	1.25	0.41	0.84	** -15.5
4,000–4,499 grams	64,723	80	30	50	1.24	0.46	0.77	-0.8
4,500–4,999 grams	9,171	18	10	8	*	*	*	*
5,000 grams or more	1,175	8	6	2	*	*	*	*
Not stated	58	18	18	—	...	...	...	...

See footnotes at end of table.

Table 6. Live births and infant, neonatal, and postneonatal deaths and mortality rates, by race and Hispanic origin of mother and birthweight: United States, 2005 linked file, and percentage change in birthweight-specific infant mortality, 2000–2005 linked files—Con.

Race and Hispanic origin and birthweight	Number in 2005				Mortality rate per 1,000 live births in 2005			Percent change in infant mortality rate 2000–2005
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
Non-Hispanic white	2,279,959	13,134	8,452	4,682	5.76	3.71	2.05	1.1
Less than 2,500 grams	166,785	8,386	6,793	1,593	50.28	40.73	9.55	**–4.8
Less than 1,500 grams	27,960	6,355	5,593	762	227.29	200.04	27.25	–1.0
Less than 500 grams	2,761	2,376	2,334	42	860.56	845.35	15.21	0.1
500–749 grams	4,704	2,220	1,932	288	471.94	410.71	61.22	–4.1
750–999 grams	5,469	891	690	201	162.92	126.17	36.75	2.4
1,000–1,249 grams	6,643	497	369	128	74.82	55.55	19.27	–7.5
1,250–1,499 grams	8,383	371	269	102	44.26	32.09	12.17	2.4
1,500–1,999 grams	33,767	868	581	287	25.71	17.21	8.50	–4.5
2,000–2,499 grams	105,058	1,162	618	544	11.06	5.88	5.18	–7.4
2,500 grams or more	2,113,009	4,710	1,622	3,088	2.23	0.77	1.46	–2.6
2,500–2,999 grams	364,991	1,581	640	942	4.33	1.75	2.58	–6.3
3,000–3,499 grams	857,590	1,870	582	1,287	2.18	0.68	1.50	–4.4
3,500–3,999 grams	672,643	946	297	649	1.41	0.44	0.96	–7.8
4,000–4,499 grams	187,384	251	75	177	1.34	0.40	0.94	–1.5
4,500–4,999 grams	27,559	51	23	28	1.85	0.83	1.02	4.5
5,000 grams or more	2,842	10	5	5	*	*	*	*
Not stated	165	38	37	1	...	...	...	...
Non-Hispanic black	583,764	7,958	5,332	2,626	13.63	9.13	4.50	0.3
Less than 2,500 grams	82,212	6,142	4,798	1,345	74.71	58.36	16.36	–1.2
Less than 1,500 grams	19,535	5,190	4,382	809	265.68	224.32	41.41	0.0
Less than 500 grams	2,725	2,322	2,256	67	852.11	827.89	24.59	1.9
500–749 grams	4,163	1,855	1,488	367	445.59	357.43	88.16	–2.1
750–999 grams	4,017	540	340	200	134.43	84.64	49.79	–4.4
1,000–1,249 grams	4,192	266	176	90	63.45	41.98	21.47	–12.1
1,250–1,499 grams	4,438	207	122	85	46.64	27.49	19.15	4.9
1,500–1,999 grams	15,786	425	215	210	26.92	13.62	13.30	–3.3
2,000–2,499 grams	46,891	527	201	326	11.24	4.29	6.95	–4.4
2,500 grams or more	501,435	1,767	487	1,280	3.52	0.97	2.55	**–10.9
2,500–2,999 grams	144,911	735	226	508	5.07	1.56	3.51	**–10.6
3,000–3,499 grams	221,988	694	167	528	3.13	0.75	2.38	**–14.2
3,500–3,999 grams	108,763	263	65	199	2.42	0.60	1.83	**–15.4
4,000–4,499 grams	22,164	57	21	36	2.57	0.95	1.62	7.1
4,500–4,999 grams	3,204	16	8	8	*	*	*	*
5,000 grams or more	405	1	–	1	*	*	*	*
Not stated	117	48	47	1	...	...	...	...

** Significant at $p < 0.05$.

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

... Category not applicable.

– Quantity zero.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals because of rounding. Neonatal is less than 28 days and postneonatal is 28 days to under 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table 7. Infant deaths and mortality rates for the five leading causes of infant death, by race and Hispanic origin of mother: United States, 2005 linked file

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

Cause of death (based on the <i>International Classification of Diseases, Tenth Revision, 1992</i>)	All races			Non-Hispanic white ¹			Non-Hispanic black			American Indian or Alaska Native ²			Asian or Pacific Islander ³		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes . . . . .	...	28,384	685.8	...	13,134	576.1	...	7,958	1,363.2	...	361	805.5	...	1,129	488.5
Congenital malformations, deformations, and chromosomal abnormalities . . (Q00–Q99)	1	5,571	134.6	1	2,851	125.0	2	978	167.5	1	73	162.9	1	259	112.1
Disorders related to short gestation and low birth weight, not elsewhere classified . . (P07)	2	4,698	113.5	2	1,725	75.7	1	1,780	304.9	3	44	98.2	2	179	77.5
Sudden infant death syndrome (R95)	3	2,234	54.0	3	1,264	55.4	4	580	99.4	2	50	111.6	4	55	23.8
Newborn affected by maternal complications of pregnancy. (P01)	4	1,769	42.7	4	734	32.2	3	619	106.0	7	7	*	3	68	29.4
Newborn affected by complications of placenta, cord and membranes (P02)	5	1,095	26.5	6	548	24.0	5	286	49.0	5	9	*	8	34	14.7
		Total Hispanic			Mexican			Puerto Rican ⁴			Central and South American ⁵				
		Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate		
All causes . . . . .	...	5,537	561.8	...	3,833	552.9	...	526	830.4	...	708	468.2			
Congenital malformations, deformations, and chromosomal abnormalities . . (Q00–Q99)	1	1,373	139.3	1	1,020	147.1	2	87	137.4	1	174	115.1			
Disorders related to short gestation and low birth weight, not elsewhere classified . . (P07)	2	892	90.5	2	595	85.8	1	104	164.2	2	117	77.4			
Sudden infant death syndrome (R95)	4	277	28.1	4	198	28.6	4	25	39.5	5	27	17.9			
Newborn affected by maternal complications of pregnancy. (P01)	3	299	30.3	3	209	30.1	3	41	64.7	6	22	14.6			
Newborn affected by complications of placenta, cord and membranes P02)	5	203	20.6	5	139	20.1	6	21	33.2	3	33	21.8			

... Category not applicable.

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

¹For Non-Hispanic white mothers, Accidents (unintentional injuries) was the fifth leading cause of infant death, with 583 deaths and a rate of 25.6.²For American Indians or Alaska Natives, Accidents (unintentional injuries) was the fourth leading cause of death, with 23 deaths and a rate of 51.3.³For Asian or Pacific Islanders, Bacterial sepsis of newborn was the fifth leading cause of death, with 40 deaths and a rate of 17.3.⁴For Puerto Ricans, Bacterial sepsis of newborn was the fifth leading cause of death, with 23 deaths and a rate of 36.3.⁵For Central and South Americans, Respiratory distress of newborn was the fourth leading cause of death, with 31 deaths and a rate of 20.5.

NOTES: Reliable cause-specific infant mortality rates cannot be computed for Cubans because of the small number of infant deaths (71). Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 2. Nineteen states reported multiple-race data on the birth certificate for 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Table 8. Number and percentage of preterm-related infant deaths and preterm-related infant mortality rates, by race and Hispanic origin of mother: United States, 2000–2005 linked files

Year	All races and origins	Non-Hispanic white	Non-Hispanic black	American Indian or Alaska Native	Asian or Pacific Islander	Total Hispanic ¹	Mexican	Puerto Rican	Central and South American
Number of preterm-related infant deaths									
2005	10,364	4,206	3,655	86	401	1,880	1,266	218	241
2004	10,180	4,171	3,641	83	378	1,752	1,192	195	238
2003	10,331	4,358	3,615	91	364	1,761	1,163	200	256
2002	9,965	4,342	3,581	90	321	1,540	1,018	190	192
2001	9,767	4,289	3,561	79	280	1,436	951	196	189
2000	9,673	4,141	3,586	96	298	1,411	929	189	170
Percent of total infant deaths that are preterm related									
2005	36.5	32.0	45.9	23.8	35.5	34.0	33.0	41.4	34.0
2004	36.5	32.1	46.3	22.4	35.3	33.4	32.2	40.7	35.7
2003	36.9	32.9	46.1	24.2	34.1	34.2	32.4	41.8	37.4
2002	35.6	32.6	44.6	24.6	31.9	31.3	29.9	40.3	30.1
2001	35.5	32.2	44.9	19.6	29.6	31.0	29.8	39.9	31.3
2000	34.6	30.8	43.7	27.7	30.5	30.9	29.4	39.6	32.3
Preterm-related infant mortality rate ²									
2005	2.50	1.84	6.26	1.92	1.74	1.91	1.83	3.44	1.59
2004	2.48	1.82	6.29	1.89	1.65	1.85	1.76	3.19	1.66
2003	2.53	1.88	6.28	2.11	1.65	1.93	1.78	3.42	1.89
2002	2.48	1.89	6.19	2.12	1.52	1.76	1.62	3.31	1.52
2001	2.43	1.84	6.04	1.89	1.40	1.69	1.56	3.40	1.56
2000	2.38	1.75	5.93	2.30	1.49	1.73	1.60	3.25	1.50

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

²Rate per 1,000 live births in specified group.

NOTES: Preterm-related deaths are those where the infant was born preterm (before 37 completed weeks of gestation) with the underlying cause of death assigned to one of the following *International Classification of Diseases, Tenth Revision* categories: K550, P000, P010, P011, P015, P020, P021, P027, P070–P073, P102, P220–229, P250–279, P280, P281, P360–369, P520–523, and P77. Nineteen states reported multiple-race data on the birth certificate for all of 2005. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see reference 2.

Technical Notes

Differences between period and cohort data

From 1983–1991, NCHS produced linked files in a birth cohort format (52). Beginning with 1995 data, linked files were produced first using a period format and then using a birth cohort format. The 2005 period linked file contains a numerator file that consists of all infant deaths occurring in 2005 that have been linked to their corresponding birth certificates, whether the birth occurred in 2004 or in 2005. In contrast, the 2005 birth cohort linked file will contain a numerator file that consists of all infant deaths to babies born in 2005, whether the death occurred in 2005 or 2006.

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

For the 2005 file, NCHS accepted birth records that could be linked to infant deaths even if registered after the closure of the 2005 birth file (fewer than 100 cases). This improved the infant birth/death linkage and made the denominator file distinctly different from the official 2005 birth file.

Weighting

A record weight was added to the linked file to compensate for the 1.3 percent (in 2005) of infant death records that could not be linked to their corresponding birth certificates. This procedure was initiated in 1995. Records for Puerto Rico, the Virgin Islands, and Guam were not weighted. The percentage of records linked varied by registration area (from 94.0 to 100.0 percent, with all but five areas—California, Louisiana, Nevada, Ohio, 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 2005 linked file started with 28,466 infant death records. Of these 28,466 records, 28,101 were linked; 365 were unlinked because corresponding birth certificates could not be identified. The 28,466 linked and unlinked records contained 82 records of infants whose mother's usual place of residence was outside of the United States. These 82 records were excluded to derive a weighted total of 28,384 infant deaths. Thus, all total calculations for 2005 in this report used a weighted total of 28,384 infant deaths.

2005 Vermont birth data

State-specific data for Vermont in the 2005 natality file and presented in the report "Births: Final Data for 2005" are based on an incomplete file of Vermont birth records (2). The total number of Vermont resident births is included in this publication, which differs from the 2005 natality file and accompanying report (2).

Table I. Percentage of infant death records that were linked to their corresponding birth records: United States and each state, Puerto Rico, Virgin Islands, and Guam, 2005 linked file

State	Percent linked by state of occurrence of death
United States ¹	98.7
Alabama	100.0
Alaska	100.0
Arizona	97.9
Arkansas	100.0
California	96.4
Colorado	99.8
Connecticut	100.0
Delaware	100.0
District of Columbia	100.0
Florida	99.8
Georgia	99.8
Hawaii	100.0
Idaho	100.0
Illinois	98.3
Indiana	99.7
Iowa	100.0
Kansas	100.0
Kentucky	99.4
Louisiana	94.0
Maine	100.0
Maryland	100.0
Massachusetts	99.8
Michigan	100.0
Minnesota	99.7
Mississippi	100.0
Missouri	99.7
Montana	100.0
Nebraska	100.0
Nevada	96.7
New Hampshire	100.0
New Jersey	99.2
New Mexico	99.4
New York	98.9
New York City	99.7
North Carolina	99.8
North Dakota	100.0
Ohio	97.4
Oklahoma	99.5
Oregon	98.6
Pennsylvania	99.5
Rhode Island	100.0
South Carolina	99.8
South Dakota	100.0
Tennessee	100.0
Texas	96.1
Utah	100.0
Vermont	100.0
Virginia	100.0
Washington	99.8
West Virginia	100.0
Wisconsin	100.0
Wyoming	100.0
Puerto Rico	99.8
Virgin Islands	100.0
Guam	100.0

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

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

The overall infant mortality rate of 6.86 from the 2005 period linked file is nearly the same as the 2005 vital statistics mortality file

(6.87) (3). The number of infant deaths differs slightly from the number in the mortality file (28,440) (3). Differences in the number of infant deaths between the two data sources are primarily due to geographic coverage differences. For the vital statistics mortality file, all deaths occurring in the 50 states and the District of Columbia are included regardless of the place of birth of the infant. In contrast, to be included in the U.S. linked file, both the birth and the death must occur in the 50 states and the District of Columbia (the territory linked file is a separate file). Also, although every effort has been made to design weights that will accurately reflect the distribution of deaths by characteristics, weighting may contribute to small differences in numbers and rates by specific variables between these two data sets.

The 1989 and 2003 revisions of the U.S. Standard Certificate of Live Birth

This report includes 2005 data on items that are collected on both the 1989 Revision of the U.S. Standard Certificate of Live Birth (unrevised) and the 2003 Revision of the U.S. Standard Certificate of Live Birth (revised) (2). The 2003 revision is described in detail elsewhere (53–55). Twelve states (Florida, Idaho, Kansas, Kentucky, Nebraska, New Hampshire, New York (excluding New York City), Pennsylvania, South Carolina, Tennessee, Texas, and Washington) implemented the revised birth certificate as of January 1, 2005. Puerto Rico also implemented the revised birth certificate as of January 1, 2005. Vermont implemented the revised birth certificate in 2005, but after January 1. The 12 revised states represent 31 percent of all 2005 births.

Data for educational attainment, prenatal care, and tobacco use, although collected on both the revised and unrevised certificates, are not considered comparable between revisions and are presented separately in this report. Data items exclusive to either the 1989 or the 2003 birth certificate revisions are not shown in this report.

Marital status

National estimates of births to unmarried women are based on two methods of determining marital status. In 2005, 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 the ["Technical Notes"](#) in ["Births: Final Data for 2005"](#) (2).

Multiple race

For the birth certificates in the 2005 data year, multiple race was reported by 19 states (both revised and nonrevised)—California, Florida, Hawaii, Idaho, Kansas, Kentucky, Michigan (for births at selected facilities only), Minnesota, Nebraska, New Hampshire, New York (excluding New York City), Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont (for births occurring only from July 1, 2005), and Washington (2). Data from the vital records of the

remaining states, the District of Columbia, and New York City followed the 1977 OMB standards in which a single race is reported (56,57). In addition, these areas also reported the minimum set of four races as stipulated in the 1977 standards, compared with the minimum of five races for the 1997 standards (2).

To provide uniformity and comparability of the data during the transition period, before multiple-race data are available for all reporting areas, the responses of those who reported more than one race are bridged to a single race. Multiple race is imputed to a single race (one of the following: AIAN, API, black, or white) according to the combination of races, Hispanic origin, sex, and age indicated on the birth certificate using methods described elsewhere (2,8,58).

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. This measure is subject to error for several reasons, including imperfect maternal recall or misidentification of the LMP because of postconception bleeding, delayed ovulation, or intervening early miscarriage. These data are edited for LMP-based gestational ages that are clearly inconsistent with the infant's plurality and birthweight (see below); however, reporting problems for this item persist, and many occur more frequently among some subpopulations and among births with shorter gestations (59,60).

The U.S. Standard Certificate of Live Birth contains an item, "clinical estimate of gestation," which is compared with length of gestation computed from the date the LMP began when the latter appears to be inconsistent with birthweight. This is done for normal weight births of apparently short gestations and very low birthweight births reported to be full term. The clinical estimate was also used if the LMP date was not reported. The period of gestation for 5.8 percent of the births in 2005 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 0.06 percent of all birth records in 2005 (2).

For the linked file, not stated birthweight was imputed for 3,449 records (or 0.08 percent of the birth records) in 2005 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 percentage of records with birthweight not stated was higher for infant deaths (3.74 percent before imputation) than for live births (0.09 percent before imputation). The imputation reduced the percentage of not stated records to 0.45 percent for infant deaths and 0.01 percent for births. The not stated birthweight cases in the natality/birth file, as distinct from the linked file, are not imputed (2).

Cause-of-death classification

The mortality statistics presented in this report were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify and code causes of death in accordance with the current revision of the *International Statistical Classification of Diseases and Related Health Problems* (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 it 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* (61,62).

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 (63,64).

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 ICD–10 (4); during the period 1979–1998, causes were coded and classified according to the ICD–9 (5).

Changes in classification of causes of death due to these revisions may result in discontinuities in cause-of-death trends. Measures of this discontinuity are essential to the interpretation of mortality trends and are discussed in detail in other NCHS publications (3,65,66).

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

Preterm-related causes of death

Preterm-related causes of death are those causes that have a direct etiological connection to preterm birth. For an underlying cause of death to be considered preterm-related, 75 percent or more of infants whose deaths were attributed to that cause had to be born preterm, and the cause of death had to be a direct consequence of preterm birth based on a clinical evaluation and review of the

literature. The cause-of-death categories included in this grouping are shown in [Table 8](#). Causes that are incidental to preterm birth (for example, a motor vehicle accident to a preterm infant) are not included. This grouping of preterm-related causes probably underestimates the total impact of preterm-related infant death, as some ICD categories (notably those beginning with the words “Other” and “All other”) had a high percentage of preterm infant deaths but lacked sufficient specificity to be able to establish the etiologic connection to prematurity with any degree of certainty. Further details on the development of this cause-of-death grouping are available in related publications (50,51,68).

Computation of rates

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

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

Random variation in infant mortality rates

The number of infant deaths and live births reported for an area represent complete counts of such events. As such, they are not subject to sampling error, although they are subject to nonsampling error in the registration process. However, when the figures are used for analytic purposes, such as the comparison of rates over time, for different areas or among different subgroups, the number of events that actually occurred may be considered as one of a large series of possible results that could have arisen under the same circumstances (69). As a result, numbers of births, deaths, and infant mortality rates are subject to random variation. The probable range of values may be estimated from the actual figures according to certain statistical assumptions.

In general, distributions of vital events may be assumed to follow the normal distribution. When the number of events is large, the relative

standard error is usually small. When the number of events is small (perhaps less than 100) and the probability of such an event is small, considerable caution must be observed in interpreting the data. Such infrequent events may be assumed to follow a Poisson probability distribution (2,3). 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:

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

where D is the number of deaths, and

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

where B is the number of births.

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

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

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

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

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

The RSE of the IMR for the example above

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

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

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

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

Thus, for group A:

$$\text{Lower: } 6.09 - \left(1.96 \cdot 6.09 \cdot \frac{4.5}{100}\right) = 5.55.$$

$$\text{Upper: } 6.09 + \left(1.96 \cdot 6.09 \cdot \frac{4.5}{100}\right) = 6.63.$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

If $|z|$ is greater than or equal to 1.96, then the difference is statistically significant at the 0.05 level, and if $|z|$ is less than 1.96, the difference is not significant.

Availability of linked file data

Linked file data are available for download at the NCHS Internet site: www.cdc.gov/nchs. Data are also available in selected issues of *Vital and Health Statistics*, Series 20 reports, and the *National Vital Statistics Reports* (formerly the *Monthly Vital Statistics Reports*) through NCHS.

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

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

Contents

[Abstract](#) 1
[Introduction](#) 2
[Methods](#) 2
[Results and Discussion](#) 3
[References](#) 11
[List of Detailed Tables](#) 12
[Technical Notes](#) 27

Acknowledgments

This report was prepared in the Division of Vital Statistics (DVS) under the general direction of Stephanie J. Ventura, Chief of the Reproductive Statistics Branch (RSB) and Charles J. Rothwell, Director, DVS. Nicholas Pace, Chief of Systems, Programming, and Statistical Resources Branch (SPSRB), and Steve Steimel, Candace Cosgrove, Annie Liu, Jordan Sacks, Manju Sharma, and Sergey Yagodin (SPSRB) provided computer programming support and statistical tables. Yashu Patel of RSB and Thomas Dunn of SPSRB provided assistance with content review. The Registration Methods staff and the Data Acquisition and Evaluation Branch provided consultation to state vital statistics offices regarding collection of the birth and death certificate data on which this report is based. This report was edited by Megan M. Cox and Demarius V. Miller, CDC/CCHIS/ NCHM/Division of Creative Services, Writer-Editor Services Branch, and typeset by Jacqueline M. Davis of CDC/CCHIS/NCHM/Division of Creative Services. Graphics were produced by Jarmila G. Ogburn, CDC/CCHIS/ NCHM/Division of Creative Services.

Copyright information

All material appearing in this report is in the public domain and may be reproduced or copied without permission; citation as to source, however, is appreciated.

Suggested citation

Mathews TJ, MacDorman MF. Infant mortality statistics from the 2005 period linked birth/infant death data set. National vital statistics reports; vol 57 no 2. Hyattsville, MD: National Center for Health Statistics. 2008.

National Center for Health Statistics

Director
Edward J. Sondik, Ph.D.

Acting Co-Deputy Directors
Jennifer H. Madans, Ph.D.
Michael H. Sadagursky

Division of Vital Statistics
Director, Charles J. Rothwell

**U.S. DEPARTMENT OF
HEALTH & HUMAN SERVICES**

Centers for Disease Control and Prevention
National Center for Health Statistics
3311 Toledo Road
Hyattsville, MD 20782

MEDIA MAIL POSTAGE & FEES PAID CDC/NCHS PERMIT NO. G-284

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

To receive this publication regularly, contact
the National Center for Health Statistics by
calling 1-800-232-4636
E-mail: cdcinfo@cdc.gov
Internet: www.cdc.gov/nchs