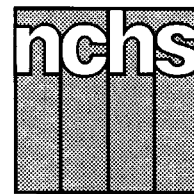


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Infant Mortality Statistics From the 1996 Period Linked Birth/Infant Death Data Set

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Abstract

Objectives—This report presents 1996 period infant mortality statistics from the linked birth/infant death data set (linked file) by a wide variety of maternal and infant characteristics.

Methods—Descriptive tabulations of data are presented.

Results—In general, mortality rates were lowest for infants born to Asian and Pacific Islander mothers (5.2), followed by white (6.1), American Indian (10.0), and black (14.1) mothers. Rates for infants of all Hispanic origin mothers combined (6.1) were comparable to those for infants of non-Hispanic white mothers (6.0). Infant mortality rates for Mexican (5.8), Cuban (5.1), and Central and South American (5.0) mothers were slightly lower than those for infants of non-Hispanic white mothers (6.0), and higher for infants of Puerto Rican mothers (8.6). Infant mortality rates were higher for those infants whose mothers began prenatal care after the first trimester of pregnancy, were teenagers or 40 years of age or older, did not complete high school, were unmarried, or smoked during pregnancy. Infant mortality was also higher for male infants, multiple births, and infants born preterm or at low birthweight. In 1996, 64 percent of all infant deaths occurred to the 7.4 percent of infants born at low birthweight. The leading causes of infant death varied considerably by race and Hispanic origin. For infants of black mothers, Disorders related to short gestation and unspecified low birthweight was the leading cause of infant death, with an infant mortality rate 4 times that for white infants. For American Indian infants, rates for Sudden infant death syndrome and for Accidents and adverse effects were both 3.2 times higher than those for white infants. For Hispanic and Asian and Pacific Islander mothers, infant mortality rates from Sudden infant death syndrome were lower than those for all white infants.

Introduction

This report presents infant mortality data from the 1996 period linked file. In the linked file the information from the death certificate is linked to information from the birth certificate for each infant under 1 year of age who died in the 50 States and the District of Columbia, Puerto Rico, the Virgin Islands, and Guam during 1996. The purpose of the linkage is to use the many additional variables available from the birth certificate to conduct more detailed analyses of infant mortality patterns. This report presents infant mortality data by race and Hispanic origin of the mother, birthweight, period of gestation, sex of infant, plurality, trimester of pregnancy prenatal care began, maternal age, maternal educational attainment, live-birth order, marital status, mother's place of birth, maternal smoking during pregnancy, age at death, and underlying cause of death for the 50 States and the District of Columbia. Data for Puerto Rico, the Virgin Islands, and Guam are available

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

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on the linked file and other vital statistics public-use data tapes (1), and are also discussed in separate reports (2,3). Other variables that are available on the linked file data tapes (1), but which are not discussed in this report include: father's age, race, and Hispanic origin; Apgar score; birth attendant; place of delivery; alcohol use during pregnancy; weight gain during pregnancy; medical risk factors; method of delivery; obstetric procedures; complications of labor/delivery; and abnormal conditions of newborn.

Methods

Data shown in this report are based on birth and infant death certificates registered in all States and the District of Columbia. As part of the Vital Statistics Cooperative Program (VSCP), each State provided matching birth and death certificate numbers for each infant under 1 year of age that died in the State in 1996. 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 1996, 97.8 percent of all infant death records were successfully matched to their corresponding birth records.

Differences between period and cohort data

From 1983–91, NCHS produced linked files in a birth cohort format. For the 1995 birth cohort linked file, the numerator consists of deaths to infants born in 1995 whether the death occurred in 1995 or 1996. Beginning with 1995 data, linked files are produced first using a period format and then subsequently

using a birth cohort format. For the 1995 period linked file, the numerator consists of all infant deaths occurring in 1995 that have been linked to their corresponding birth certificates, whether the birth occurred in 1995 or in 1994. The denominator for both files is the 1995 natality file, which contains all U.S. births occurring in 1995. The 1996 period file consists of all deaths occurring in 1996 as the numerator and the 1996 natality file as the denominator. The release of linked file data in two different formats allows NCHS to meet customer demands for more timely linked files while still meeting the needs of data users who prefer the birth cohort format. While the birth cohort format has methodological advantages, it creates substantial delays in data availability, since it is necessary to 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 (except for special cohort studies).

Weighting

A record weight is added to the linked file to compensate for the 2.2 percent (in 1996) of infant death records that could not be linked to their corresponding birth certificates. This procedure was initiated in 1995. The percent of records linked varied considerably by State (from 93–100 percent, with all but three States—California, Ohio, and Oklahoma—at 95 percent or higher). The percent linked also varied by age at death, from 97.2 percent for infants who died within the first 7 days of life, to 98.5 percent for infants who died during the postneonatal period (28 days–11 months of age). The number of infant deaths in the linked file was weighted to equal the sum of the linked plus unlinked infant deaths by State of residence at birth and age at death (less than 1 day, 1–27 days, and 28 days–11 months). The addition of the weight greatly reduced the potential for bias in comparing infant mortality rates by characteristics.

The 1996 linked file includes 27,809 unweighted infant death records. An additional 623 records could not be linked to their corresponding birth certificates because the birth certificate could not be

identified. Thus, the linked file was weighted to match the total of 28,432 linked plus unlinked records. Since the data included in this report are tabulated by place of residence of the mother, 13 infant deaths to mothers whose usual place of residence is outside of the United States were excluded from tables shown in this report, leading to a weighted total of 28,419 infant deaths.

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

Although the time periods are the same, numbers of infant deaths and infant mortality rates in the 1996 period linked file are not identical to the numbers in the 1996 vital statistics mortality file (2). Although the overall infant mortality rate of 7.3 for 1996 is the same between the two data sources, infant mortality rates by characteristics, such as race, Hispanic origin and cause of death are not identical. The differences in numbers of infant deaths between the two files can be traced to three different causes:

1. geographic coverage differences
2. additional quality control
3. weighting

Differences in geographic coverage are due to the fact that for the vital statistics mortality file all deaths occurring in the 50 States and the District of Columbia are included regardless of the place of birth of the infant. In contrast, to be included in the linked file, both the birth and death must occur in the 50 States and the District of Columbia. Also, the linkage process subjects infant death records to an additional round of quality control review. Every year, a few records are voided from the file at this stage because they are found to be fetal deaths, deaths at ages greater than 1 year, or duplicate death certificates. Finally, 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.

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. Thus, teenage mothers are more likely to also be unmarried and of a low-income status. 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 analysis, and is the aim of the current report.

Race and Hispanic origin data—Infant mortality rates are presented for detailed race and Hispanic origin groups. The linked file is particularly useful for computing accurate infant mortality rates for these groups because the race 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 data—the more “traditional” source of infant mortality data—race information for the denominator is the race of the mother as reported on the birth certificate, whereas the race information for the numerator is the race of the decedent as reported on the death certificate (2). Race information reported on the birth certificate is generally considered to be more accurate than that on the death certificate because on the birth certificate, race of each parent is usually reported by the mother at the time of delivery, whereas on the death certificate, race of the deceased infant is reported by the funeral director based on information provided by an informant or on observation (4,5). This difference in the method of reporting race data has a larger impact for races other than white and black, and can lead to differences in race-specific infant mortality rates between the two data sources (4,5).

Infant mortality rates for five detailed Asian and Pacific Islander groups, including Vietnamese, Asian Indian, Korean, Samoan, and Guamanian, are presented for an eight-State reporting area: California, Hawaii, Illinois, Minnesota,

New Jersey, New York, Texas, and Washington. More than 60 percent of the U.S. population for each of these additional Asian and Pacific Islander groups lived in the eight-State reporting area: Asian Indian, Korean, and Vietnamese, 64–68 percent; Guamanian, 75 percent; and Samoan, 85 percent (6,7).

Race and Hispanic origin of mother are reported as separate items on the birth certificate; thus, a mother of Hispanic origin may be of any race. Although the overwhelming majority of Hispanic-origin births are to white women (97 percent in 1996), there are notable differences in infant mortality trends between Hispanic and non-Hispanic white women. Therefore, data for these groups are presented separately. Race and ethnic differentials in infant mortality rates by characteristics may reflect differences in income, educational levels, access to health care, health insurance, and other factors.

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 additional information on marital status, period of gestation, birthweight, and cause-of-death classification are presented in the Technical notes.

Results and discussion

Infant mortality by race and Hispanic origin of mother

In 1996, the overall infant mortality rate from the linked file was 7.3 infant deaths per 1,000 live births, a decrease of 3.9 percent from the 1995 rate of 7.6 (8). Infant mortality rates varied considerably by race of mother (table A). Mortality rates were lowest for infants born to Asian and Pacific Islander mothers (5.2), followed by white (6.1), American Indian (10.0), and black (14.1) mothers. When these differentials are examined by age at death, it is apparent that the high mortality rate for infants of American Indian mothers is due primarily to a postneonatal mortality rate, which is 2.5 times that for infants of white mothers. For infants

of black mothers, both neonatal and postneonatal mortality rates are 2.3–2.4 times those for infants of white mothers.

Among the Asian and Pacific Islander groups enumerated in the eight-State reporting area, infant mortality rates for Chinese (3.3), Japanese (3.7), Hawaiian (5.8), and Filipino (6.0) mothers were comparable to those reported for the entire United States (table B). Infant mortality rates for Vietnamese, Asian Indian, and Korean mothers ranged from 4.9 for infants of Asian Indian mothers to 5.6 for infants of Vietnamese mothers. Among the Pacific Islander groups, it was not possible to compute reliable infant mortality rates for infants of Samoan and Guamanian mothers because of the small number of infant deaths.

Mortality rates for infants born to Hispanic origin mothers ranged from 5.0 for Central and South American mothers to 8.6 for Puerto Rican mothers (table C). The rate for Central and South American mothers was 17 percent lower, and the rate for Puerto Rican mothers was 43 percent higher than that for non-Hispanic white mothers. Infants of Puerto Rican mothers had higher mortality rates during both the neonatal and postneonatal periods.

Infant mortality by selected infant and maternal characteristics

Infant mortality rates by a variety of infant and maternal characteristics are presented in table 1 for infants of white, black, American Indian, and Asian or Pacific Islander mothers and in table 2 for infants of Hispanic mothers.

Sex of infant—The infant mortality rate for all races combined was 8.0 for male infants, 21 percent higher than the rate of 6.6 for female infants. In 1996 infant mortality rates were higher for male than for female infants for each race and Hispanic origin group, although differences were not statistically significant for infants of American Indian, Cuban, and Central and South American mothers.

Multiple births—The risk of infant death increases with the increasing number of infants in the pregnancy (9). For all races combined, the infant mortality rate for plural births was 33.5, about 5 times the rate of 6.6 for single births. Infant

Table A. Infant, neonatal, and postneonatal deaths and mortality rates by specified race or national origin of mother: United States, 1996 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	3,891,494	28,419	18,556	9,863	7.3	4.8	2.5
White	3,093,057	18,774	12,260	6,513	6.1	4.0	2.1
Black	594,781	8,406	5,562	2,844	14.1	9.4	4.8
American Indian ¹	37,880	377	178	199	10.0	4.7	5.3
Asian or Pacific Islander	165,776	862	555	307	5.2	3.3	1.9
Chinese	28,500	90	55	35	3.2	1.9	1.2
Japanese	8,902	37	20	17	4.2	2.2	*
Hawaiian	5,907	33	19	14	5.6	*	*
Filipino	31,106	181	126	55	5.8	4.1	1.8
Other Asian or Pacific Islander	91,361	520	335	186	5.7	3.7	2.0

* Figure does not meet standard of reliability or precision.

¹Includes Aleuts and Eskimos.

Table B. Infant, neonatal, and postneonatal deaths and mortality rates by race or national origin of mother: Total of 8 States, 1996 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	1,591,334	10,394	6,741	3,652	6.5	4.2	2.3
Total Asian or Pacific Islander	117,745	597	378	219	5.1	3.2	1.9
Asian:							
Chinese	22,299	74	45	29	3.3	2.0	1.3
Japanese	6,934	26	14	12	3.7	.	.
Filipino	25,415	152	104	48	6.0	4.1	1.9
Vietnamese	12,432	70	47	23	5.6	3.8	1.9
Asian Indian	15,593	76	46	30	4.9	3.0	1.9
Korean	8,200	31	19	12	3.8	.	.
Pacific Islander:							
Hawaiian	5,501	32	19	13	5.8	.	.
Samoan	1,629	16	8	7	.	.	.
Guamanian	505	2	2	0	.	.	.
Remaining Asian or Pacific Islander	19,237	118	73	45	6.1	3.8	2.3
White	1,269,107	7,063	4,627	2,436	5.6	3.6	1.9
Black	196,107	2,652	1,693	959	13.5	8.6	4.9
American Indian ¹	8,375	82	43	39	9.8	5.1	4.7

* Figure does not meet standard of reliability or precision.

¹Includes Aleuts and Eskimos.

NOTE: States included are California, Hawaii, Illinois, Minnesota, New Jersey, New York, Texas, and Washington.

Table C. 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, 1996 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	3,891,494	28,419	18,556	9,863	7.3	4.8	2.5
Total Hispanic	701,339	4,246	2,771	1,474	6.1	4.0	2.1
Mexican	489,666	2,861	1,842	1,019	5.8	3.8	2.1
Puerto Rican	54,863	472	306	165	8.6	5.6	3.0
Cuban	12,613	64	46	18	5.1	3.6	*
Central and South American	97,888	491	333	158	5.0	3.4	1.6
Other and unknown Hispanic	46,309	358	244	114	7.7	5.3	2.5
Non-Hispanic total ²	3,133,484	23,632	15,346	8,286	7.5	4.9	2.6
Non-Hispanic white	2,358,989	14,249	9,227	5,022	6.0	3.9	2.1
Non-Hispanic black	578,099	8,209	5,424	2,785	14.2	9.4	4.8
Not stated	56,671	541	439	103	...	...	...

* Figure does not meet standard of reliability or precision.

... Category not applicable.

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

²Includes races other than white or black.

mortality rates for plural births were significantly higher than rates for single births for all race and Hispanic-origin groups. The infant mortality rate for plural births in 1996 was 6 percent lower than the rate reported in 1995 (35.5). Among the race and ethnic groups studied, the only significant decrease in infant mortality rates for plural births between 1995 and 1996 were for infants of Mexican (36.4 to 27.2) and Puerto Rican (42.9 to 22.5) mothers. Multiple pregnancy can lead to an accentuation of maternal risks and complications associated with pregnancy (10–12). Multiple births are also much more likely to be born preterm and at low birthweight, and thus at higher risk for infant death (9–12).

Birthweight and period of gestation—Birthweight and period of gestation are the two most important predictors of an infant’s subsequent health and survival. In 1996, 64 percent of all infant deaths occurred to the 7.4 percent of infants born at low birthweight (less than

2,500 grams). Infants born too small and too soon have a much greater risk of death and disability than those born at term (37–41 weeks of gestation) or with birthweights of 2,500 grams or more (13–15). The percent of infants born at low birthweight ranged from a low of 5 percent for births to Chinese mothers to a high of 13 percent for births to black mothers (tables 3 and 4). The percent of preterm births (those born before 37 completed weeks of gestation) ranged from a low of 7 percent for births to Chinese mothers to a high of 17 percent for births to black mothers. Infant mortality rates were much higher for low birthweight infants than for infants with birthweights of 2,500 grams or more for all race and ethnic groups studied. Overall, the infant mortality rate for very low birthweight infants (those with birthweights of less than 1,500 grams) was 259.3, over 90 times the rate of 2.8 for infants with birthweights of 2,500 grams or more. The rate for moderately low birthweight infants

(those with birthweights of 1,500–2,499 grams) was 17.4, about six times the rate for infants with birthweights of 2,500 grams or more. Similarly, very preterm infants (those born at less than 28 weeks of gestation) had 144 times the mortality risk of infants born at term (37–41 weeks of gestation), and moderately preterm infants (those born at 28–36 weeks of gestation) were five times more likely to die in infancy than infants born at term.

Infant mortality rates for more detailed birthweight categories are presented in table 5. About 9 out of 10 infants with birthweights of less than 500 grams die within the first year of life—most within the first few days of life (table 5 and figure 1). An infant’s chances of survival increase rapidly thereafter with increasing birthweight. At birthweights of 1,250–1,499 grams, about 95 out of 100 infants now survive the first year of life. Infant mortality rates are lowest at birthweights of 4,000–4,499 grams, with small increases among the

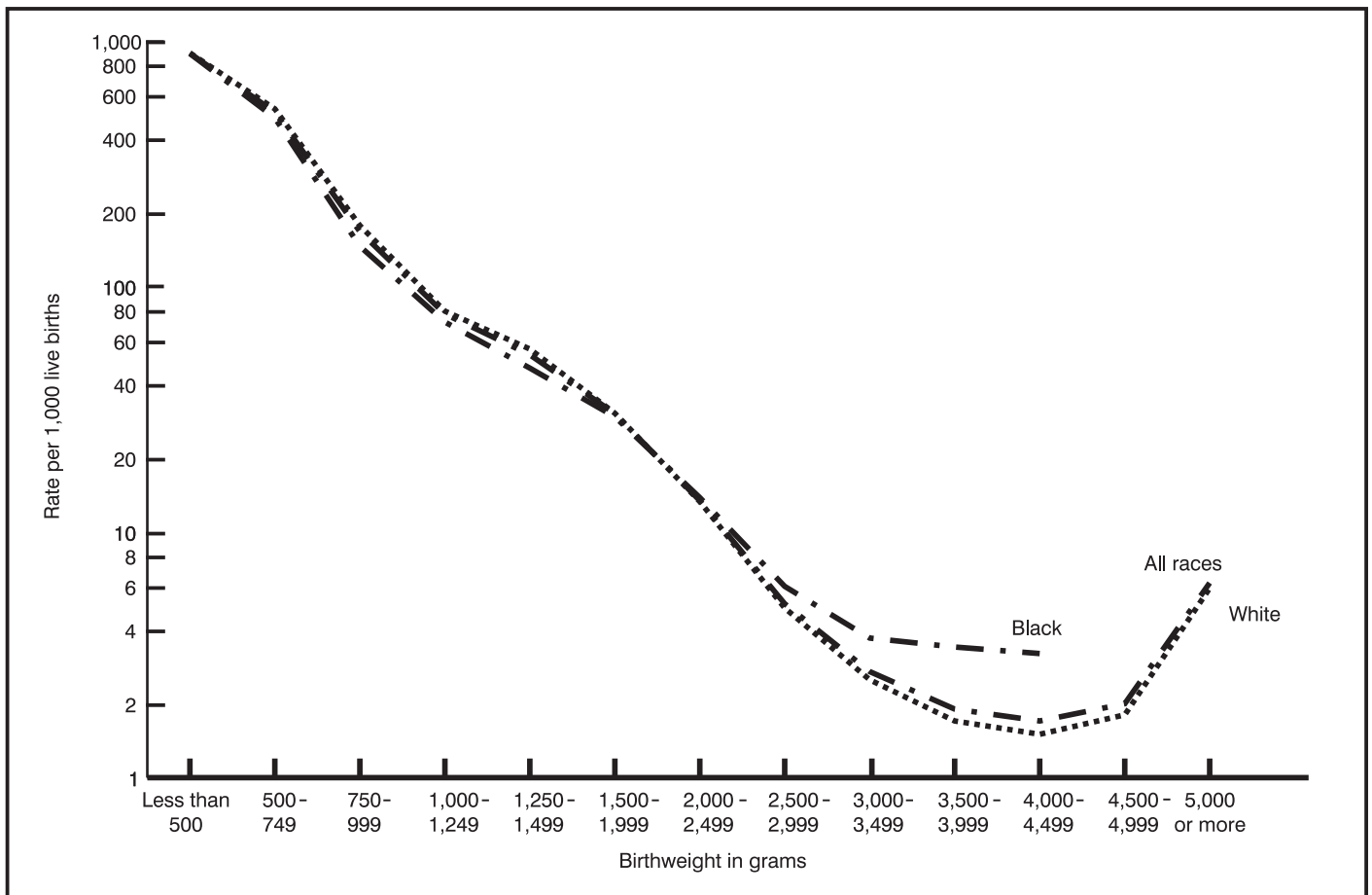


Figure 1. Infant mortality rates by birthweight: United States, 1996 linked file

heaviest infants. Infant mortality rates are lower for black than for white infants at individual birthweight categories under 2,000 grams, but are higher at birthweights of 2,000 grams or more. From 1995–96, infant mortality rates declined most rapidly (by 8–10 percent) for infants weighing 750–999, 1,000–1,249, and 1,500–1,999 grams at birth. Infant mortality rates also declined substantially (by 6.7 percent) for infants weighing 2,500 grams or more at birth.

Prenatal care—The effects of prenatal care are sometimes difficult to measure (16,17). However, early comprehensive prenatal care can promote healthier pregnancies by providing health behavior advice and early detection and treatment of maternal complications that may influence the infant's subsequent health and survival (18–20). In general, infant mortality is lower for women who begin prenatal care in the first trimester of pregnancy than for those who begin care after the first trimester or not at all. However, for all races combined, infants of mothers who began prenatal care in the third trimester had a lower infant mortality rate (6.7) than those who began care in the second trimester (7.7). This is because women who began prenatal care in the third trimester had to have a period of gestation of at least 7 months, thereby reducing the probability that the infant would be born preterm or at low birthweight (21). Because the relationship between month of pregnancy prenatal care began and period of gestation is complex, prenatal care data for the purposes of this report are grouped into two groups: mothers beginning prenatal care in the first trimester and those beginning prenatal care after the first trimester or not at all.

For all races combined, the infant mortality rate for mothers beginning prenatal care after the first trimester or not at all fell from 9.9 in 1995 to 9.3 in 1996. Infants of mothers who began prenatal care during the first trimester of pregnancy had an infant mortality rate of 6.5 in 1996 compared with a rate of 6.6 in 1995.

The proportion of mothers beginning prenatal care in the first trimester of pregnancy ranged from a low of 68 percent for infants of American Indian mothers to a high of 89 percent for infants of

Japanese and Cuban mothers (tables 3 and 4). For each race and Hispanic-origin group, infants of mothers who began prenatal care during the first trimester had lower infant mortality rates than infants of mothers who began care after the first trimester or not at all, although for infants of American Indian, Puerto Rican, and Central and South American mothers, the differences were not statistically significant. For infants of Cuban mothers, there were not enough infant deaths in the “after first trimester” category to compute reliable rates.

Maternal age—Infant mortality exhibits a curvilinear relationship with maternal age with rates being highest for teenage mothers, lowest for mothers in their late twenties and early thirties, and again higher for mothers in their forties. From 1995–96, infant mortality rates declined for mothers in each 5-year age group, although the difference was statistically significant only for mothers in the 35–39 year age group. The percent of births to teenage mothers was lowest for Chinese mothers (1 percent) and highest for black and Puerto Rican mothers (23 percent) (tables 3 and 4). Infant mortality rates were higher for infants of teenage mothers than for infants of mothers in their twenties for all race and Hispanic origin groups, although the differences were statistically significant for infants of white and Mexican mothers only. For Cuban mothers there were not enough infant deaths to teenage mothers to be able to compute reliable rates. Infant mortality rates were also higher for women in their forties than for women in their twenties and thirties for all race and ethnic groups for whom there was sufficient data to compute reliable rates, and significantly higher for infants born to white and Asian and Pacific Islander mothers. Rates could not be computed for women in their forties for Puerto Rican, Cuban, and American Indian mothers. Recent studies suggest that the higher mortality risk for younger mothers may be related to the preponderance of teenage mothers who are from disadvantaged backgrounds, while for older mothers, both biological and sociological factors may play a role (22–25).

Maternal education—The percent of births to mothers who had completed

high school or more ranged from a low of 42 percent for Mexican mothers to a high of 97 percent for Japanese mothers (tables 3 and 4). Infant mortality rates generally decreased with increasing levels of maternal education (tables 1 and 2). These differentials may reflect in part socioeconomic differences because women with more education tend to have higher family income levels (26). However, for all mothers except for black and American Indian mothers, infant mortality rates were lower for infants of mothers with 0–8 years of education than for infants of mothers with 9–11 years of education, although the differences were statistically significant only for white mothers. This may be due in part to the very different population composition of the women with 0–8 years of education, most of whom were born outside the 50 States and the District of Columbia (27). In general, infants of women born outside the 50 States and the District of Columbia have lower infant mortality rates than infants of women born in the 50 States and the District of Columbia (see section on *Nativity* below).

Live birth order—The proportion of women with fourth and higher order births ranged from a low of 3 percent for Chinese mothers to a high of 20 percent for American Indian mothers. Infant mortality rates are generally slightly higher for first births than for second births, and then increase gradually with increasing birth order.

Marital status—Marital status interacts with a wide variety of other factors, such as the degree of economic and social support for the mother and child; whether or not the pregnancy was wanted; as well as maternal age, educational level, and prenatal care attendance (28–30). For all races combined, infant mortality rates decreased from 1995–96 for both married (from 5.9 to 5.8) and unmarried (from 11.0 to 10.5) mothers, although the decline was statistically significant only for unmarried mothers. The infant mortality rate for unmarried mothers was 1.8 times greater than the rate for married mothers. The percent of births to unmarried women ranged from a low of 9 percent for Chinese mothers to a high of 70 percent for black mothers. Infant mortality rates were higher for infants of unmarried than of

married women for all of the race and ethnic groups studied. Reliable rates could not be calculated for Cuban mothers because of an insufficient number of infant deaths.

Nativity—The mortality rate for infants of mothers born in the 50 States and the District of Columbia was 7.5, more than one-third higher than the rate of 5.5 for infants of mothers born elsewhere. From 1995–96, infant mortality rates decreased both for mothers born in the 50 States and the District of Columbia and for those born elsewhere, although the decline was not statistically significant for mothers born outside the 50 States and the District of Columbia. The mortality rate for infants of mothers born in the 50 States and the District of Columbia declined from 7.8 in 1995 to 7.5 in 1996. The mortality rate for infants of mothers born outside of the 50 States and the District of Columbia was 5.8 in 1995 compared with 5.5 in 1996. The percent of births to mothers born in the 50 States and the District of Columbia ranged from a low of 8–10 percent for Central and South American and Chinese mothers to a high of 95–98 percent for American Indian, Hawaiian, and non-Hispanic white mothers.

A variety of different hypotheses have been advanced to account for the lower infant mortality rates for mothers born outside the 50 States and the District of Columbia. These include possible differences in level of familial integration and social support for new mothers between women born in the 50 States and the District of Columbia and those born elsewhere (31,32), and differences in the characteristics of women born in the 50 States and the District of Columbia and those born elsewhere with regard to socioeconomic and educational status, and risk behaviors such as smoking and alcohol use (32,33).

Maternal smoking—Maternal smoking during pregnancy increases the risk of low birthweight, preterm delivery, intrauterine growth retardation, and infant mortality (34,35). From 1995–96 infant mortality rates declined both for smokers (from 11.5 to 11.1) and for nonsmokers (from 7.1 to 6.8), although the decline for smokers was not statistically significant. The percentage of women who smoked

during pregnancy ranged from a low of 1 percent for Chinese mothers to a high of 21 percent for American Indian mothers. For each race and Hispanic-origin group, women who smoked during pregnancy had higher infant mortality rates than nonsmokers. Reliable rates could not be calculated for Cuban and Central and South American mothers due to an insufficient number of infant deaths. Tobacco use during pregnancy facilitates 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 (36,37).

Leading causes of infant death

Infant mortality rates for the five leading causes of death by race and ethnicity are presented in table 6. For all races combined, white, Asian and Pacific Islander, and Hispanic mothers, Congenital anomalies was the leading cause of infant death in 1996, followed by Disorders relating to short gestation and unspecified low birthweight (low birthweight), Sudden infant death syndrome (SIDS), Respiratory distress syndrome (RDS), and Newborn affected by maternal complications of pregnancy (maternal complications). For infants of black mothers, low birthweight was the leading cause of infant death, followed by Congenital anomalies, and SIDS. For infants of American Indian mothers, SIDS was the leading cause of death, followed by Congenital anomalies and low birthweight.

Several causes of death contributed to the overall higher infant mortality rates for black than for white mothers. For infants of black mothers, mortality rates from Congenital anomalies were 18 percent higher than for infants of white mothers. For low birthweight, the mortality rate was 273.5 for infants of black mothers, 4 times the rate of 68.8 for infants of white mothers. For SIDS, RDS, and maternal complications, rates were 2.4–2.9 times higher for infants of black than for infants of white mothers.

For infants of American Indian mothers, mortality rates were much higher than those for infants of white mothers

for SIDS and for Accidents and adverse effects. The SIDS rate for infants of American Indian mothers was 203.3, 3.2 times the rate of 64.3 for infants of white mothers. In 1996, SIDS accounted for one-fifth of all infant deaths to American Indian mothers. As most SIDS deaths occur during the postneonatal period, the high SIDS rate for infants of American Indian mothers accounts for much of their elevated risk of postneonatal mortality. Mortality rates from Accidents and adverse effects were also substantially higher for infants of American Indian mothers than for infants of white mothers. The rate was 58.1 for infants of American Indian mothers, 3.2 times the rate of 17.9 for infants of white mothers. Accidents and adverse effects was the fourth leading cause of death for infants of American Indian mothers, and the seventh leading cause of death for infants of white mothers.

For infants of Asian and Pacific Islander and Hispanic origin mothers, SIDS rates were substantially lower than for white mothers. The SIDS rate for Asian and Pacific Islander mothers was 44.0, one-third lower than the rate of 64.3 for white mothers. The SIDS rate for Hispanic-origin mothers was 48.5, one-fourth lower than the rate for all white mothers.

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Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and specified race of mother: United States, 1996 linked file

Characteristics	All races	Race of mother			
		White	Black	American Indian ¹	Asian/Pacific Islander
Infant mortality rates per 1,000 live births in specified group					
Total	7.3	6.1	14.1	10.0	5.2
Age at death:					
Total neonatal	4.8	4.0	9.4	4.7	3.3
Early neonatal (< 7 days)	3.8	3.2	7.6	3.7	2.8
Late neonatal (7-27 days)	0.9	0.8	1.7	1.0	0.6
Postneonatal	2.5	2.1	4.8	5.3	1.9
Sex:					
Male	8.0	6.7	15.4	10.9	5.8
Female	6.6	5.4	12.8	9.0	4.6
Plurality:					
Single births	6.6	5.4	12.9	9.3	4.9
Plural births	33.5	29.4	54.7	40.7	22.3
Birthweight:					
Less than 1,500 grams	259.3	249.0	280.4	270.7	238.2
1,500-2,499 grams	17.4	17.4	17.7	30.5	14.3
2,500 grams or more	2.8	2.5	4.2	5.1	2.0
Period of gestation:					
Less than 28 weeks	418.8	424.0	411.5	405.7	414.8
28-36 weeks	14.9	14.5	16.4	18.1	12.1
37-41 weeks	2.9	2.6	4.6	5.4	2.2
42 weeks or more	3.4	3.1	5.4	6.7	2.5
Trimester of pregnancy prenatal care began:					
First trimester	6.5	5.5	12.9	8.9	4.7
After first trimester or no care	9.3	7.7	14.7	10.2	6.3
Second trimester	7.7	6.8	11.2	8.7	5.3
Third trimester	6.7	6.0	8.8	9.9	4.8
No prenatal care	35.2	26.3	49.9	29.0	30.9
Age of mother:					
Under 20 years	10.5	8.9	14.5	13.2	8.5
20-24 years	8.2	6.9	13.7	9.6	6.4
25-29 years	6.3	5.3	13.8	8.0	4.2
30-34 years	5.9	5.0	14.2	9.3	4.1
35-39 years	6.7	5.7	15.0	10.0	5.8
40-49 years	8.6	7.2	17.0	*	10.8
Educational attainment of mother:					
0-8 years	7.6	6.8	16.0	13.6	6.2
9-11 years	10.0	8.4	15.4	12.5	6.9
12 years	7.8	6.4	13.8	9.5	6.2
13-15 years	6.1	5.0	12.2	8.0	4.1
16 years and over	4.5	4.1	10.3	*	3.9
Live-birth order:					
1	7.1	6.0	13.7	10.3	4.7
2	6.6	5.6	12.9	9.3	4.6
3	7.3	6.0	13.7	8.0	6.0
4	8.9	7.1	15.8	9.8	8.1
5 or more	11.8	8.9	19.9	13.3	9.4
Marital status:					
Married	5.8	5.3	12.1	7.9	4.9
Unmarried	10.5	8.2	15.0	11.5	6.5
Mother's place of birth:					
Born in the 50 States and D.C.	7.5	6.1	14.2	10.0	5.7
Born elsewhere	5.5	5.2	9.2	*	5.0
Maternal smoking during pregnancy: ²					
Smoker	11.1	9.5	21.3	13.4	9.1
Nonsmoker	6.8	5.5	13.0	8.6	5.1

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and specified race of mother: United States, 1996 linked file—Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian ¹	Asian/Pacific Islander
Live births					
Total	3,891,494	3,093,057	594,781	37,880	165,776
Sex:					
Male	1,990,480	1,584,423	301,474	19,233	85,350
Female	1,901,014	1,508,634	293,307	18,647	80,426
Plurality:					
Single births	3,784,805	3,007,997	577,057	37,069	162,682
Plural births	106,689	85,060	17,724	811	3,094
Birthweight:					
Less than 1,500 grams	54,151	34,034	18,005	458	1,654
1,500-2,499 grams	234,030	162,409	59,551	1,999	10,071
2,500 grams or more	3,601,121	2,895,116	516,749	35,392	153,864
Not stated	2,192	1,498	476	31	187
Period of gestation:					
Less than 28 weeks	27,456	15,912	10,596	244	704
28-36 weeks	395,651	284,011	91,943	4,203	15,494
37-41 weeks	3,093,025	2,491,649	438,434	28,756	134,186
42 weeks or more	334,713	270,957	48,351	4,208	11,197
Not stated	40,649	30,528	5,457	469	4,195
Trimester of pregnancy prenatal care began:					
First trimester	3,102,972	2,541,849	406,278	24,949	129,896
After first trimester or no care	687,704	483,318	162,463	11,924	29,999
Second trimester	536,402	383,106	120,726	8,765	23,805
Third trimester	106,759	74,080	25,249	2,434	4,996
No prenatal care	44,543	26,132	16,488	725	1,198
Not stated	100,818	67,890	26,040	1,007	5,881
Age of mother:					
Under 20 years	502,725	350,211	135,789	7,933	8,792
20-24 years	945,210	726,669	179,361	12,142	27,038
25-29 years	1,071,287	878,449	133,204	8,844	50,790
30-34 years	897,913	747,436	94,295	5,816	50,366
35-39 years	399,510	329,782	43,716	2,606	23,406
40-49 years	74,849	60,510	8,416	539	5,384
Educational attainment of mother:					
0-8 years	233,596	202,837	18,573	1,544	10,642
9-11 years	626,175	456,141	145,688	10,735	13,611
12 years	1,281,198	992,327	229,655	15,106	44,110
13-15 years	847,139	673,793	131,046	7,493	34,807
16 years and over	847,824	728,558	58,299	2,330	58,637
Not stated	55,562	39,401	11,520	672	3,969
Live-birth order:					
1	1,589,512	1,271,157	230,370	13,654	74,331
2	1,251,760	1,014,793	171,424	10,131	55,412
3	624,631	496,684	100,149	6,526	21,272
4	240,074	182,191	47,035	3,677	7,171
5 or more	162,375	110,700	41,243	3,754	6,678
Not stated	23,142	17,532	4,560	138	912
Marital status:					
Married	2,631,188	2,297,625	179,568	15,894	138,101
Unmarried	1,260,306	795,432	415,213	21,986	27,675
Mother's place of birth:					
Born in the 50 States and D.C.	3,138,175	2,545,042	530,956	36,497	25,680
Born elsewhere	743,352	542,145	60,281	1,292	139,634
Not stated	9,967	5,870	3,544	91	462
Maternal smoking during pregnancy: ²					
Smoker	418,280	354,854	53,460	6,659	3,307
Nonsmoker	2,649,899	2,056,100	471,541	24,630	97,628
Not stated	48,889	38,103	7,865	994	1,927

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and specified race of mother: United States, 1996 linked file—Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian ¹	Asian/ Pacific Islander
		Infant deaths			
Total	28,419	18,774	8,406	377	862
Age at death:					
Total neonatal	18,556	12,260	5,562	178	555
Early neonatal (< 7 days)	14,947	9,798	4,549	140	460
Late neonatal (7-27 days)	3,609	2,462	1,012	39	96
Postneonatal	9,863	6,513	2,844	199	307
Sex:					
Male	15,957	10,608	4,649	209	492
Female	12,461	8,166	3,757	168	370
Plurality:					
Single births	24,847	16,273	7,437	344	793
Plural births	3,572	2,501	969	33	69
Birthweight:					
Less than 1,500 grams	14,043	8,476	5,049	124	394
1,500-2,499 grams	4,083	2,821	1,056	61	144
2,500 grams or more	9,963	7,292	2,177	182	311
Not stated	331	184	125	9	12
Period of gestation:					
Less than 28 weeks	11,498	6,746	4,360	99	292
28-36 weeks	5,888	4,121	1,504	76	187
37-41 weeks	9,016	6,538	2,021	156	300
42 weeks or more	1,148	833	259	28	28
Not stated	870	536	262	18	54
Trimester of pregnancy prenatal care began:					
First trimester	20,017	13,943	5,246	221	608
After first trimester or no care	6,426	3,723	2,393	122	188
Second trimester	4,144	2,591	1,350	76	127
Third trimester	714	444	222	24	24
No prenatal care	1,568	687	822	21	37
Not stated	1,975	1,108	767	34	66
Age of mother:					
Under 20 years	5,271	3,124	1,967	105	75
20-24 years	7,739	4,984	2,466	117	173
25-29 years	6,772	4,651	1,835	71	215
30-34 years	5,299	3,701	1,339	54	205
35-39 years	2,696	1,878	657	26	135
40-49 years	641	436	143	4	58
Educational attainment of mother:					
0-8 years	1,767	1,381	298	21	66
9-11 years	6,287	3,820	2,239	134	94
12 years	9,971	6,391	3,163	143	274
13-15 years	5,190	3,388	1,599	60	142
16 years and over	3,809	2,970	603	8	228
Not stated	1,395	824	505	10	57
Live-birth order:					
1	11,225	7,578	3,154	141	352
2	8,269	5,715	2,204	94	255
3	4,538	2,986	1,371	52	128
4	2,135	1,297	745	36	58
5 or more	1,916	983	821	50	63
Not stated	336	215	112	4	5
Marital status:					
Married	15,191	12,220	2,164	125	681
Unmarried	13,228	6,554	6,242	252	181

See footnotes at end of table.

Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and specified race of mother: United States, 1996 linked file—Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian ¹	Asian/Pacific Islander
Infant deaths					
Mother's place of birth:					
Born in the 50 States and D.C.	23,652	15,577	7,564	364	147
Born elsewhere	4,102	2,835	554	10	703
Not stated	665	362	289	3	11
Maternal smoking during pregnancy: ²					
Smoker	4,642	3,383	1,140	89	30
Nonsmoker	18,140	11,279	6,152	211	498
Not stated	760	455	260	26	19

* Figure does not meet standard of reliability or precision.

¹ Includes Aleuts and Eskimos.

² Excludes data for California, Indiana, New York State (but includes New York City), and South Dakota, which do not report tobacco use on the birth certificate.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Not stated responses were included in totals but not distributed among groups for rate computations.

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, 1996 linked file

Characteristics	All origins ¹	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total ²	White	Black	
Infant mortality rates per 1,000 live births in specified group											
Total	7.3	6.1	5.8	8.6	5.1	5.0	7.7	7.5	6.0	14.2	...
Age at death:											
Total neonatal	4.8	4.0	3.8	5.6	3.6	3.4	5.3	4.9	3.9	9.4	...
Early neonatal (< 7 days)	3.8	3.1	2.9	4.3	3.0	2.6	4.3	4.0	3.1	7.7	...
Late neonatal (7-27 days)	0.9	0.9	0.8	1.3	*	0.8	1.0	0.9	0.8	1.7	...
Postneonatal	2.5	2.1	2.1	3.0	*	1.6	2.5	2.6	2.1	4.8	...
Sex:											
Male	8.0	6.7	6.4	9.8	6.1	5.3	8.4	8.3	6.7	15.5	...
Female	6.6	5.4	5.2	7.4	3.9	4.7	7.1	6.8	5.4	12.9	...
Plurality:											
Single births	6.6	5.6	5.5	8.3	4.2	4.5	7.2	6.7	5.3	12.9	...
Plural births	33.5	27.6	27.2	22.5	*	28.7	30.7	34.0	29.3	55.1	...
Birthweight:											
Less than 1,500 grams	259.3	252.1	253.6	271.1	258.8	208.7	284.5	258.6	245.9	279.2	...
1,500-2,499 grams	17.4	17.4	19.3	12.3	*	15.7	14.3	17.5	17.4	17.7	...
2,500 grams or more	2.8	2.4	2.4	3.1	*	1.9	2.7	2.8	2.6	4.2	...
Period of gestation:											
Less than 28 weeks	418.8	393.8	379.4	464.7	455.7	359.1	439.9	420.6	431.3	410.0	...
28-36 weeks	14.9	12.9	13.5	14.1	*	9.1	14.8	15.3	15.0	16.3	...
37-41 weeks	2.9	2.5	2.5	3.1	*	1.9	2.6	3.0	2.7	4.6	...
42 weeks or more	3.4	3.3	3.3	*	*	3.7	*	3.4	3.0	5.4	...
Trimester of pregnancy prenatal care began:											
First trimester	6.5	5.6	5.4	8.0	4.9	4.6	6.9	6.6	5.5	13.0	...
After first trimester or no care	9.3	6.4	6.3	8.4	*	4.9	8.1	10.4	8.4	14.9	...
Second trimester	7.7	5.6	5.6	7.5	*	4.4	6.8	8.5	7.4	11.3	...
Third trimester	6.7	5.0	5.2	*	*	*	*	7.4	6.7	9.0	...
No prenatal care	35.2	19.0	17.3	31.4	*	19.9	27.3	40.2	30.4	49.8	...
Age of mother:											
Under 20 years	10.5	7.5	7.3	10.2	*	5.8	7.8	11.5	9.7	14.6	...
20-24 years	8.2	5.8	5.5	7.5	*	4.8	9.8	8.8	7.2	13.8	...
25-29 years	6.3	5.2	5.0	7.4	*	4.5	6.8	6.5	5.3	13.8	...
30-34 years	5.9	5.7	5.6	8.9	6.2	4.7	6.1	5.9	4.7	14.3	...
35-39 years	6.7	6.9	7.1	12.1	*	5.5	6.2	6.7	5.4	15.2	...
40-49 years	8.6	9.6	9.5	*	*	10.5	*	8.3	6.6	16.8	...
Educational attainment of mother:											
0-8 years	7.6	5.7	5.6	9.3	*	4.8	8.4	11.7	11.0	16.4	...
9-11 years	10.0	6.5	6.1	10.0	*	5.2	7.8	11.7	9.8	15.5	...
12 years	7.8	6.0	5.7	7.8	7.0	5.3	7.4	8.1	6.6	13.8	...
13-15 years	6.1	5.1	5.0	6.4	*	4.0	6.4	6.2	5.0	12.3	...
16 years and over	4.5	5.1	5.4	7.7	*	3.8	5.1	4.5	4.0	10.5	...
Live-birth order:											
1	7.1	6.0	5.7	9.1	*	5.0	7.9	7.3	5.9	13.8	...
2	6.6	5.6	5.6	6.6	5.4	4.7	7.0	6.8	5.6	12.9	...
3	7.3	5.7	5.6	7.8	*	4.5	6.6	7.6	6.1	13.8	...
4	8.9	6.9	6.5	10.9	*	5.3	8.8	9.5	7.2	16.0	...
5 or more	11.8	8.3	7.7	13.9	*	8.4	*	13.0	9.4	19.8	...
Marital status:											
Married	5.8	5.4	5.4	6.9	5.2	4.4	6.5	5.8	5.3	12.1	...
Unmarried	10.5	7.0	6.6	9.7	*	5.8	9.3	11.5	8.9	15.1	...
Mother's place of birth:											
Born in the 50 States and D.C.	7.5	7.1	6.9	8.4	4.3	6.0	7.4	7.6	6.0	14.3	...
Born elsewhere	5.5	5.3	5.1	8.8	5.5	4.9	6.2	5.8	5.1	9.6	...
Maternal smoking during pregnancy: ³											
Smoker	11.1	12.2	13.1	13.4	*	*	9.9	11.0	9.4	21.4	...
Nonsmoker	6.8	5.9	5.7	7.7	4.9	5.3	7.5	7.0	5.4	13.1	...

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, 1996 linked file--Con.

Characteristics	All origins ¹	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total ²	White	Black	
Live births											
Total	3,891,494	701,339	489,666	54,863	12,613	97,888	46,309	3,133,484	2,358,989	578,099	56,671
Sex:											
Male	1,990,480	357,728	249,502	27,926	6,443	50,044	23,813	1,603,633	1,209,852	292,950	29,119
Female	1,901,014	343,611	240,164	26,937	6,170	47,844	22,496	1,529,851	1,149,137	285,149	27,552
Plurality:											
Single births	3,784,805	687,916	480,812	53,575	12,289	95,940	45,300	3,042,007	2,288,581	560,801	54,882
Plural births	106,689	13,423	8,854	1,288	324	1,948	1,009	91,477	70,408	17,298	1,789
Birthweight:											
Less than 1,500 grams	54,151	7,920	4,980	948	170	1,126	696	45,403	25,723	17,663	828
1,500-2,499 grams	234,030	36,206	23,771	4,135	647	4,785	2,868	194,607	124,609	58,339	3,217
2,500 grams or more	3,601,121	656,986	460,806	49,754	11,794	91,948	42,684	2,892,238	2,207,908	501,777	51,897
Not stated	2,192	227	109	26	2	29	61	1,236	749	320	729
Period of gestation:											
Less than 28 weeks	27,456	3,944	2,475	467	79	557	366	23,036	11,747	10,390	476
28-36 weeks	395,651	70,906	47,933	6,677	1,217	9,961	5,118	319,840	210,845	89,981	4,905
37-41 weeks	3,093,025	549,392	383,147	42,383	10,328	77,621	35,913	2,498,996	1,915,914	425,729	44,637
42 weeks or more	334,713	62,824	44,600	4,775	935	8,341	4,173	267,177	205,431	46,962	4,712
Not stated	40,649	14,273	11,511	561	54	1,408	739	24,435	15,052	5,037	1,941
Trimester of pregnancy prenatal care began:											
First trimester	3,102,972	490,207	337,714	38,931	11,119	69,556	32,887	2,570,708	2,024,891	395,966	42,057
After first trimester or no care	687,704	188,744	140,051	13,003	1,341	23,174	11,175	490,973	292,752	158,017	7,987
Second trimester	536,402	143,590	105,715	10,043	1,147	18,107	8,578	386,843	238,182	117,412	5,969
Third trimester	106,759	33,263	25,045	2,227	150	4,012	1,829	72,177	40,713	24,350	1,319
No prenatal care	44,543	11,891	9,291	733	44	1,055	768	31,953	13,857	16,255	699
Not stated	100,818	22,388	11,901	2,929	153	5,158	2,247	71,803	41,346	24,116	6,627
Age of mother:											
Under 20 years	502,725	121,934	88,765	12,700	963	10,316	9,190	375,807	227,729	132,700	4,984
20-24 years	945,210	214,173	157,857	16,592	2,476	23,943	13,305	720,228	508,056	174,958	10,809
25-29 years	1,071,287	185,478	129,621	13,075	3,512	27,881	11,389	870,250	683,376	129,002	15,559
30-34 years	897,913	119,690	76,400	8,392	3,888	22,802	8,208	762,064	616,224	91,050	16,159
35-39 years	399,510	49,812	30,600	3,468	1,545	10,661	3,538	342,061	274,431	42,279	7,637
40-49 years	74,849	10,252	6,423	636	229	2,285	679	63,074	49,173	8,110	1,523
Educational attainment of mother:											
0-8 years	233,596	160,642	132,820	3,447	272	20,396	3,707	71,899	42,898	17,217	1,055
9-11 years	626,175	193,525	145,183	17,052	1,548	18,695	11,047	427,109	262,140	141,973	5,541
12 years	1,281,198	200,608	131,858	17,771	3,999	30,702	16,278	1,064,791	783,996	224,097	15,799
13-15 years	847,139	89,762	51,646	10,751	3,352	15,280	8,733	745,555	576,733	127,928	11,822
16 years and over	847,824	44,105	20,191	4,795	3,393	10,776	4,950	789,278	672,417	56,840	14,441
Not stated	55,562	12,697	7,968	1,047	49	2,039	1,594	34,852	20,805	10,044	8,013
Live-birth order:											
1	1,589,512	265,986	181,056	21,887	5,559	38,437	19,047	1,301,780	992,907	223,941	21,746
2	1,251,760	209,983	144,241	16,507	4,454	30,607	14,174	1,024,248	794,021	166,731	17,529
3	624,631	124,529	88,857	9,032	1,856	17,199	7,585	491,760	367,592	97,467	8,342
4	240,074	55,839	41,534	3,868	476	6,788	3,173	181,194	124,926	45,881	3,041
5 or more	162,375	40,124	30,813	2,800	223	4,271	2,017	119,859	69,464	40,330	2,392
Not stated	23,142	4,878	3,165	769	45	586	313	14,643	10,079	3,749	3,621
Marital status:											
Married	2,631,188	415,838	303,870	21,551	9,495	54,749	26,173	2,174,265	1,850,832	173,524	41,085
Unmarried	1,260,306	285,501	185,796	33,312	3,118	43,139	20,136	959,219	508,157	404,575	15,586
Mother's place of birth:											
Born in the 50 States and D.C.	3,138,175	267,083	186,763	33,644	4,651	7,938	34,087	2,819,979	2,239,713	523,048	51,113
Born elsewhere	743,352	432,577	302,124	21,087	7,958	89,791	11,617	306,516	115,822	52,009	4,259
Not stated	9,967	1,679	779	132	4	159	605	6,989	3,454	3,042	1,299
Maternal smoking during pregnancy: ³											
Smoker	418,280	18,478	8,222	5,367	539	1,211	3,139	395,695	333,703	52,566	4,107
Nonsmoker	2,649,899	408,212	257,468	43,439	11,051	64,786	31,468	2,220,401	1,643,152	459,361	21,286
Not stated	48,889	4,884	1,783	1,312	68	918	803	39,857	30,053	7,178	4,148

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, 1996 linked file--Con.

Characteristics	All origins ¹	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total ²	White	Black	
Infant deaths											
Total	28,419	4,246	2,861	472	64	491	358	23,631	14,249	8,209	541
Age at death:											
Total neonatal	18,556	2,771	1,842	306	46	333	244	15,345	9,227	5,424	439
Early neonatal (< 7 days)	14,947	2,163	1,437	234	38	254	200	12,412	7,409	4,438	372
Late neonatal (7-27 days)	3,609	608	405	72	8	79	44	2,934	1,819	986	67
Postneonatal	9,863	1,474	1,019	165	18	158	114	8,286	5,022	2,785	103
Sex:											
Male	15,957	2,382	1,603	274	39	267	199	13,284	8,081	4,543	292
Female	12,461	1,865	1,259	198	24	225	159	10,348	6,168	3,667	249
Plurality:											
Single births	24,847	3,876	2,621	442	51	435	327	20,518	12,187	7,257	453
Plural births	3,572	370	241	29	13	56	31	3,114	2,062	953	88
Birthweight:											
Less than 1,500 grams	14,043	1,997	1,263	257	44	235	198	11,740	6,325	4,932	306
1,500-2,499 grams	4,083	630	459	51	4	75	41	3,396	2,163	1,034	57
2,500 grams or more	9,963	1,582	1,122	155	16	175	114	8,226	5,632	2,122	155
Not stated	331	37	18	8	-	7	4	271	130	122	23
Period of gestation:											
Less than 28 weeks	11,498	1,553	939	217	36	200	161	9,688	5,067	4,260	255
28-36 weeks	5,888	918	647	94	10	91	76	4,880	3,158	1,469	90
37-41 weeks	9,016	1,359	971	131	12	151	94	7,530	5,116	1,974	127
42 weeks or more	1,148	209	145	17	3	31	13	921	617	252	18
Not stated	870	206	159	13	2	18	14	613	291	255	51
Trimester of pregnancy prenatal care began:											
First trimester	20,017	2,738	1,822	312	55	322	227	17,010	11,078	5,143	270
After first trimester or no care	6,426	1,204	884	109	6	114	91	5,095	2,451	2,350	127
Second trimester	4,144	810	593	75	5	79	58	3,276	1,758	1,322	58
Third trimester	714	166	130	10	1	14	11	534	272	219	13
No prenatal care	1,568	226	161	23	-	21	21	1,285	421	809	55
Not stated	1,975	303	155	51	3	55	39	1,528	720	717	145
Age of mother:											
Under 20 years	5,271	909	645	129	3	60	72	4,306	2,209	1,936	55
20-24 years	7,739	1,251	867	124	15	114	131	6,355	3,668	2,416	133
25-29 years	6,772	956	642	97	14	126	77	5,677	3,628	1,774	138
30-34 years	5,299	685	428	75	24	108	50	4,480	2,927	1,305	133
35-39 years	2,696	346	217	42	6	59	22	2,288	1,490	642	63
40-49 years	641	98	61	5	1	24	7	522	325	136	20
Educational attainment of mother:											
0-8 years	1,767	909	748	32	1	97	31	841	473	282	18
9-11 years	6,287	1,254	890	171	9	98	86	4,982	2,570	2,200	50
12 years	9,971	1,203	754	138	28	163	120	8,632	5,142	3,101	134
13-15 years	5,190	457	259	69	12	61	56	4,657	2,887	1,573	75
16 years and over	3,809	224	109	37	12	41	25	3,531	2,705	595	55
Not stated	1,395	198	102	25	1	31	39	987	471	459	208
Live-birth order:											
1	11,225	1,583	1,023	199	19	191	151	9,447	5,888	3,092	195
2	8,269	1,179	802	109	24	145	99	6,951	4,461	2,158	138
3	4,538	708	496	70	14	78	50	3,759	2,241	1,341	70
4	2,135	383	272	42	5	36	28	1,718	898	732	35
5 or more	1,916	333	238	39	1	36	19	1,557	654	799	25
Not stated	336	59	30	13	-	5	11	197	107	87	78
Marital status:											
Married	15,191	2,237	1,628	149	49	241	170	12,635	9,751	2,104	319
Unmarried	13,228	2,009	1,233	323	15	250	188	10,997	4,498	6,106	222

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, 1996 linked file--Con.

Characteristics	All origins ¹	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total ²	White	Black	
Infant deaths											
Mother's place of birth:											
Born in the 50 States and D.C.	23,652	1,887	1,285	282	20	48	252	21,365	13,444	7,459	399
Born elsewhere	4,102	2,289	1,549	185	44	439	72	1,791	592	497	23
Not stated	665	69	27	4	-	4	34	476	213	254	119
Maternal smoking during pregnancy: ³											
Smoker	4,642	226	108	72	4	11	31	4,365	3,126	1,127	51
Nonsmoker	18,140	2,424	1,457	335	54	342	236	15,543	8,835	6,033	173
Not stated	760	74	33	26	-	6	9	587	320	233	99

* Figure does not meet standard of reliability or precision. - Quantity zero. ...Category not applicable.

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

² Includes races other than black or white.

³ Excludes data for California, Indiana, New York State (but includes New York City), and South Dakota, which do not report tobacco use on the birth certificate.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Not stated responses were included in totals but not distributed among groups for rate computations.

Table 3. Percent of live births with selected maternal and infant characteristics by specified race of mother: United States, 1996 linked file

Characteristic	All races	White	Black	American Indian ¹	Asian or Pacific Islander					
					Total	Chinese	Japanese	Hawaiian	Filipino	Other
Birthweight:										
Less than 1,500 grams	1.4	1.1	3.0	1.2	1.0	0.6	0.8	1.0	1.2	1.0
Less than 2,500 grams	7.4	6.3	13.0	6.5	7.1	5.0	7.3	6.8	7.9	7.4
Preterm births ²	11.0	9.8	17.4	11.9	10.0	7.4	8.2	11.5	11.5	10.4
Prenatal care beginning in the first trimester	81.9	84.0	71.4	67.7	81.2	86.8	89.3	78.5	82.5	78.4
Births to mothers under 20 years	12.9	11.3	22.8	20.9	5.3	0.9	2.5	18.4	6.1	5.8
Fourth and higher order births	10.4	9.5	15.0	19.7	8.4	2.5	3.8	13.8	7.2	10.7
Births to unmarried mothers	32.4	25.7	69.8	58.0	16.7	9.2	11.4	49.9	19.4	16.5
Mothers completing 12 or more years of school ...	77.6	78.4	71.8	67.0	85.0	87.2	97.3	83.1	92.6	80.6
Mothers born in the 50 States and D.C.	80.8	82.4	89.8	96.6	15.5	9.5	45.7	98.3	17.1	8.6
Mother smoked during pregnancy ³	13.6	14.7	10.2	21.3	3.3	0.7	4.8	15.3	3.5	2.7

¹ Includes births to Aleuts and Eskimos.

² Born prior to 37 completed weeks of gestation.

³ Excludes data for California, Indiana, New York State (but includes New York City), and South Dakota, which do not report tobacco use on the birth certificate.

Table 4. Percent of live births with selected maternal and infant characteristics by Hispanic origin of mother and race of mother for mothers of non-Hispanic origin: United States, 1996 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	1.4	1.1	1.0	1.7	1.3	1.1	1.5	1.4	1.1	3.0
Less than 2,500 grams	7.4	6.3	5.9	9.2	6.5	6.0	7.7	7.6	6.4	13.1
Preterm births ³	11.0	10.9	10.5	13.2	10.3	10.9	12.0	11.0	9.5	17.5
Prenatal care beginning in the first trimester	81.9	72.2	70.7	75.0	89.2	75.0	74.6	84.0	87.4	71.5
Births to mothers under 20 years	12.9	17.4	18.1	23.1	7.6	10.5	19.8	12.0	9.7	23.0
Fourth and higher order births	10.4	13.8	14.9	12.3	5.6	11.4	11.3	9.7	8.3	15.0
Births to unmarried mothers	32.4	40.7	37.9	60.7	24.7	44.1	43.5	30.6	21.5	70.0
Mothers completing 12 or more years of school ...	77.6	48.6	42.3	61.9	85.5	59.2	67.0	83.9	87.0	72.0
Mothers born in the 50 States and D.C.	80.8	38.2	38.2	61.5	36.9	8.1	74.6	90.2	95.1	91.0
Mother smoked during pregnancy ⁴	13.6	4.3	3.1	11.0	4.7	1.8	9.1	15.1	16.9	10.3

¹ Includes origin not stated.

² Includes races other than black or white.

³ Born prior to 37 completed weeks of gestation.

⁴ Excludes data for California, Indiana, New York State (but includes New York City), and South Dakota, which do not report tobacco use on the birth certificate.

Table 5. Live births, infant, neonatal, and postneonatal deaths and mortality rates by race of mother and birthweight: United States, 1996 linked file, and percent change in birthweight-specific infant mortality, 1995-96 linked file

Race and birthweight	Number				Mortality rate per 1,000 live births			Percent change in infant mortality rate 1995-96
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races ¹	3,891,494	28,419	18,556	9,863	7.3	4.8	2.5	-3.9
Less than 2,500 grams	288,181	18,126	14,682	3,444	62.9	50.9	12.0	-2.6
Less than 1,500 grams	54,151	14,043	12,445	1,598	259.3	229.8	29.5	-3.4
Less than 500 grams	5,813	5,168	5,079	88	889.0	873.7	15.1	-1.6
500-749 grams	10,358	5,307	4,707	600	512.4	454.4	57.9	-3.0
750-999 grams	11,020	1,842	1,421	421	167.2	128.9	38.2	-8.2
1,000-1,249 grams	12,491	964	720	244	77.2	57.6	19.5	-9.7
1,250-1,499 grams	14,469	763	518	245	52.7	35.8	16.9	-3.5
1,500-1,999 grams	56,033	1,696	1,055	641	30.3	18.8	11.4	-8.7
2,000-2,499 grams	177,997	2,387	1,182	1,205	13.4	6.6	6.8	-0.7
2,500 grams or more	3,601,121	9,963	3,564	6,399	2.8	1.0	1.8	-6.7
2,500-2,999 grams	639,450	3,254	1,265	1,988	5.1	2.0	3.1	-5.6
3,000-3,499 grams	1,435,306	3,832	1,268	2,564	2.7	0.9	1.8	-6.9
3,500-3,999 grams	1,127,827	2,152	739	1,413	1.9	0.7	1.3	-5.0
4,000-4,499 grams	336,685	573	222	351	1.7	0.7	1.0	-5.6
4,500-4,999 grams	55,583	113	50	63	2.0	0.9	1.1	-9.1
5,000 grams or more	6,270	39	19	19	6.2	*	*	-26.2
Not stated	2,192	331	310	21	...	...	...	...
White	3,093,057	18,774	12,260	6,513	6.1	4.0	2.1	-3.2
Less than 2,500 grams	196,443	11,297	9,280	2,017	57.5	47.2	10.3	-3.7
Less than 1,500 grams	34,034	8,476	7,601	876	249.0	223.3	25.7	-4.5
Less than 500 grams	3,217	2,870	2,827	44	892.1	878.8	13.7	-2.1
500-749 grams	6,047	3,193	2,897	296	528.0	479.1	48.9	-3.3
750-999 grams	6,929	1,226	984	242	176.9	142.0	34.9	-8.2
1,000-1,249 grams	8,193	650	512	138	79.3	62.5	16.8	-12.8
1,250-1,499 grams	9,648	536	381	156	55.6	39.5	16.2	0.2
1,500-1,999 grams	38,486	1,171	781	390	30.4	20.3	10.1	-8.4
2,000-2,499 grams	123,923	1,650	898	752	13.3	7.2	6.1	-2.9
2,500 grams or more	2,895,116	7,292	2,807	4,486	2.5	1.0	1.5	-7.4
2,500-2,999 grams	459,079	2,268	969	1,299	4.9	2.1	2.8	-7.5
3,000-3,499 grams	1,127,613	2,818	995	1,823	2.5	0.9	1.6	-7.4
3,500-3,999 grams	956,468	1,626	598	1,028	1.7	0.6	1.1	-5.6
4,000-4,499 grams	297,023	459	189	270	1.5	0.6	0.9	-6.3
4,500-4,999 grams	49,516	90	39	51	1.8	0.8	1.0	-10.0
5,000 grams or more	5,417	32	16	15	5.9	*	*	-23.4
Not stated	1,498	184	174	10	...	...	...	...
Black	594,781	8,406	5,562	2,844	14.1	9.4	4.8	-3.4
Less than 2,500 grams	77,556	6,105	4,828	1,277	78.7	62.3	16.5	-0.6
Less than 1,500 grams	18,005	5,049	4,380	669	280.4	243.3	37.2	-1.8
Less than 500 grams	2,403	2,129	2,086	43	886.0	868.1	17.9	-1.0
500-749 grams	3,950	1,919	1,631	288	485.8	412.9	72.9	-2.7
750-999 grams	3,672	535	373	162	145.7	101.6	44.1	-10.6
1,000-1,249 grams	3,783	271	177	94	71.6	46.8	24.8	-3.9
1,250-1,499 grams	4,197	195	112	82	46.5	26.7	19.5	-4.3
1,500-1,999 grams	14,960	440	221	219	29.4	14.8	14.6	-9.3
2,000-2,499 grams	44,591	616	228	388	13.8	5.1	8.7	2.2
2,500 grams or more	516,749	2,177	615	1,562	4.2	1.2	3.0	-6.7
2,500-2,999 grams	138,732	832	247	585	6.0	1.8	4.2	-3.2
3,000-3,499 grams	224,489	822	221	601	3.7	1.0	2.7	-9.8
3,500-3,999 grams	121,602	416	111	305	3.4	0.9	2.5	-2.9
4,000-4,499 grams	27,219	88	28	61	3.2	1.0	2.2	-25.6
4,500-4,999 grams	4,142	14	8	6	*	*	*	*
5,000 grams or more	565	4	1	3	*	*	*	*
Not stated	476	125	119	6	...	...	...	...

* Figure does not meet standard of reliability or precision.

...Category not applicable.

¹ Includes races other than white or black.

NOTE: Infant deaths are weighted so numbers may not exactly add to totals due to rounding.

Table 6. Infant deaths and mortality rates for the five leading causes of infant death by race and Hispanic origin of mother: United States, 1996 linked file

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

Cause of death (<i>Ninth Revision International Classification of Diseases, 1975</i>)	All races ¹			White			Black			American Indian			Asian and Pacific Islander			Hispanic		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes .....	...	28,419	730.3	...	18,774	607.0	...	8,406	1413.3	...	377	995.2	...	862	520.0	...	4,246	605.4
Congenital anomalies (740-759)	1	6,406	164.6	1	4,979	161.0	2	1,130	190.0	2	66	174.2	1	231	139.3	1	1,162	165.7
Disorders related to short gestation and unspecified low birthweight (765)	2	3,886	99.9	2	2,128	68.8	1	1,627	273.5	3	37	97.7	2	93	56.1	2	495	70.6
Sudden infant death syndrome (798.0)	3	3,056	78.5	3	1,990	64.3	3	915	153.8	1	77	203.3	3	73	44.0	3	340	48.5
Respiratory distress syndrome (769)	4	1,364	35.1	4	848	27.4	4	467	78.5	7	10	*	4	39	23.5	4	208	29.7
Newborn affected by maternal complications of pregnancy (761)	5	1,252	32.2	5	783	25.3	5	434	73.0	8	6	*	5	29	17.5	5	145	20.7

* Figure does not meet standard of reliability or precision.

...Category not applicable.

¹ Includes races other than white and black.

NOTES: For American Indians, Accidents and adverse effects was the fourth leading cause of infant death with 22 deaths and a rate of 59.3. Pneumonia and influenza was the fifth leading cause of infant death for American Indians, however, with only 15 deaths, a reliable infant mortality rate could not be computed.

Technical notes

Marital status

National estimates of births to unmarried women are based on two methods of determining marital status. For 1996 data, birth certificates in 45 States and the District of Columbia included a question about the mother's marital status. The mother's marital status is inferred in five states (California, Connecticut, Michigan, Nevada, and New York) by comparing the parents' and child's surnames and other information concerning the father. For these States, a birth is inferred as nonmarital if any of these factors, listed in priority-of-use order, is present: a paternity acknowledgment was received, the father's name is missing, or the father's and mother's current surnames are different. In addition, criteria that are particularly applicable for a given State are also applied as necessary; see Technical notes in *Report of Final Natality Statistics, 1996* for additional details (3).

Period of gestation and birthweight

The 1989 revision of the U.S. Standard Certificate of Live Birth included a new item, "clinical estimate of gestation." This item is being compared with length of gestation computed from the date the last normal menstrual period (LMP) began when the latter appears to be inconsistent with birthweight. This is done for normal weight births of apparently short gestations and very low birthweight births reported to be full term. The clinical estimate was also used if the LMP date was not reported. The period of gestation for 4.6 percent of the births in 1996 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

fewer than 400 births or less than 0.01 percent of all birth records in 1996 (3).

Not stated birthweight was imputed for 2,630 records or 0.07 percent of the birth records in 1996. If birthweight was not stated and the period of gestation was known, birthweight was assigned the value from the previous record with the same period of gestation, race, sex, and plurality. If birthweight and period of gestation were both unknown (2,192 records in 1996) the not stated value for birthweight was retained. This imputation was done to improve the accuracy of birthweight-specific infant mortality rates, since the percent of records with not stated birthweight was higher for infant deaths (3.37 percent before imputation) than for live births (0.12 percent before imputation). The imputation reduced the percent of not stated records to 1.16 percent for infant deaths, and 0.06 percent for births.

Cause-of-death classification

The mortality statistics presented here were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify causes of death by the current *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (ICD)* (38). Cause-of-death data presented in this publication were coded according to the Ninth Revision of the ICD by procedures outlined in annual issues of the *NCHS Instruction Manual* (39). 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 that initiated the sequence of events leading directly to death or as the circumstances of the accident or violence that produced the fatal injury. 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. Generally, more medical information is reported on death certificates than is directly reflected in the underlying cause of death.

The cause-of-death ranking for infants in [table 6](#) is based on the List of 61

Selected Causes of Infant Death and HIV Infection. The group titles Certain conditions originating in the perinatal period and Symptoms, signs, and ill-defined conditions are not ranked from the List of 61 Selected Causes of Infant Death. In addition, 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, Pneumonia and influenza), its component parts are not ranked (in this case, Pneumonia, and Influenza).

Computation of rates

Infant mortality rates are the most commonly used index for measuring the risk of dying during the first year of life. 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. Infant mortality rates use the number of live births in the denominator to approximate the population at risk of dying before the first birthday. For all variables, not stated responses were shown in frequencies tables, but were dropped before rates were computed.

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 (40). As a result, numbers of births, deaths, and infant mortality rates are subject to random variation. The probable range of values may be estimated from the actual figures according to certain statistical assumptions.

In general, distributions of vital events may be assumed to follow the binomial distribution. When the number of events

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

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

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

where D is the number of deaths and

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

where B is the number of births.

For example, let us say that for group A the number of infant deaths was 104 while the number of live births was 27,380 yielding an infant mortality rate of 3.8 infant deaths per 1,000 live births.

The RSE of the deaths =

$$100 \cdot \sqrt{\frac{1}{104}} = 9.81$$

while the RSE of the births =

$$100 \cdot \sqrt{\frac{1}{27,380}} = 0.60$$

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

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

The RSE of the IMR =

$$100 \cdot \sqrt{\frac{1}{104} + \frac{1}{27,380}} = 9.82$$

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

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

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

Thus, for Group A:

$$\text{Lower: } 3.8 - 1.96 \cdot 3.8 \cdot \frac{9.82}{100} = 3.1$$

$$\text{Upper: } 3.8 + 1.96 \cdot 3.8 \cdot \frac{9.82}{100} = 4.5$$

Thus the chances are 95 out of 100 that the true IMR for Group A lies somewhere in the 3.1–4.5 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 I](#).

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

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

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

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

$L(.95, D_{adj})$ and $U(.95, D_{adj})$ refer to the values in [table I](#) corresponding to the value of D_{adj} .

For example, let us say that for Group B the number of infant deaths was 47, the number of live births was 8,901, and the infant mortality rate was 5.3.

$$D_{adj} = \frac{(47 \cdot 8,901)}{(47 + 8,901)} = 47$$

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

$$\text{Lower: } 5.3 \cdot 0.73476 = 3.9$$

$$\text{Upper: } 5.3 \cdot 1.32979 = 7.0$$

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

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

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

Availability of linked file data

Linked file data are available on data tapes from the National Technical Information Service (NTIS) and on CD-ROM from NTIS and the Government Printing Office (GPO). Data are also available in selected issues of the *Vital and Health Statistics*, Series 20 reports, and the *Monthly Vital Statistics Reports* and supplements through NCHS. Additional unpublished tabulations are available from NCHS or through our Internet site at www.cdc.gov/nchswww/.

Table I. Lower and upper 95 percent confidence limit factors for a death rate based on a Poisson variable of 1–99 deaths

Number of deaths	L(0.95, D_{adj})	U(0.95, D_{adj})	Number of deaths	L(0.95, D_{adj})	U(0.95, D_{adj})
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 1
 Methods 2
 Results and discussion 3
 References 7
 Detailed tables 9
 Technical notes 21

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