

Infant Mortality Statistics from the 1997 Period Linked Birth/Infant Death Data Set

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Abstract

Objectives—This report presents 1997 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 (5.0), followed by white (6.0), American Indian (8.7), and black (13.7) mothers. Infant mortality rates were higher for Puerto Rican mothers (7.9) than for Mexican (5.8), Cuban (5.5), Central and South American (5.5), or non-Hispanic white mothers (6.0). 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 1997, 65 percent of all infant deaths occurred to the 7.5 percent of infants born at low birthweight. The three leading causes of infant death—Congenital anomalies, Disorders relating to short gestation and unspecified low birthweight (low birthweight), and Sudden infant death syndrome (SIDS) taken together accounted for nearly one-half of all infant deaths in the United States in 1997. Cause-specific mortality rates varied considerably by race and Hispanic origin. For black mothers, the infant mortality rate for low birthweight was four times that for white mothers. For American Indian mothers, the SIDS rate was 2.4 times that for white mothers. For Hispanic mothers, the SIDS rate was one-third lower than that for non-Hispanic white mothers.

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

Introduction

This report presents infant mortality data from the 1997 period linked file. In the linked file the information from the death certificate is linked to information from the birth certificate for each infant under

1 year of age who died in the 50 States, the District of Columbia, Puerto Rico, the Virgin Islands, or Guam during 1997. 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 on the linked file and other vital statistics public-use data tapes (1). Infant mortality and natality data for these areas are 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.

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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 1997. 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 1997, 97.9 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. Beginning with 1995 data, linked files are produced first using a period format and then subsequently using a birth cohort format. Thus, the 1997 *period* linked file contains a numerator file that consists of all infant deaths occurring in 1997 that have been linked to their corresponding birth certificates, whether the birth occurred in 1997 or in 1996. The denominator file is the 1997 natality file, which contains all U.S. births occurring in 1997. In contrast, the 1997 *birth cohort* linked file will contain a numerator file that consists of all infant deaths to babies *born* in 1997 whether the death occurred in 1997 or 1998. As with the period file, the denominator file is the 1997 natality file, which contains all births occurring in 1997.

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 2.1 percent (in 1997) 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 by State (from 91–100 percent, with all but five registration areas—California, the District of Columbia, New Mexico, Ohio, and Oklahoma—at 95 percent or higher). The percent linked also varied by age at death, from 97.4 percent for infants who died within the first 7 days of life, to 98.3 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 1997 linked file includes 27,389 unweighted infant death records. An additional 599 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 27,988 linked plus unlinked records. Since the data included in this report are tabulated by place of residence of the mother, 20 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 27,968 infant deaths.

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

The overall infant mortality rate of 7.2 is the same from the 1997 period linked file and from the 1997 vital statistics mortality file. However, the number of infant deaths differs slightly (2). Differences in numbers of infant deaths between the two data sources 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 this purpose 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 (2,4). 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. In 1990, 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 1997), there are notable differences in infant mortality trends between Hispanic and non-Hispanic white women. Therefore, race-specific data for non-Hispanic mothers are presented for comparison in tables showing data for Hispanic mothers. Race and ethnic differentials in infant mortality rates 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 maternal age, 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 1997, the overall infant mortality rate from the linked file was 7.2 infant deaths per 1,000 live births, compared with 7.3 in 1996 (8). Infant mortality rates varied considerably by race of mother ([table A](#)). Mortality rates were lowest for infants born to Chinese (3.1), Japanese (5.3), Filipino (5.8), and White (6.0) mothers. Rates were considerably higher for American Indian (8.7), Hawaiian (9.0), and black (13.7) 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 twice that for infants of white mothers. For infants of Hawaiian mothers, the neonatal mortality rate was 1.6 times that for white mothers. There were not sufficient numbers of postneonatal deaths to compute an accurate postneonatal mortality rate for Hawaiian

mothers. For infants of black mothers, both neonatal and postneonatal mortality rates are more than twice those for infants of white mothers.

Among the more detailed Asian groups enumerated in the eight-State reporting area, the infant mortality rate was 3.1 for Korean mothers, 4.8 for Asian Indian mothers, and 4.9 for Vietnamese mothers ([table B](#)). 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 5.5 for Cuban and Central and South American mothers to 7.9 for Puerto Rican mothers ([table C](#)). The infant mortality rate for Puerto Rican mothers was the highest of any of the Hispanic origin groups, 36 percent higher than the rate for Mexican mothers, and 44 percent higher than the rate for Cuban and Central and South American mothers. The higher rate for infants of Puerto Rican mothers was primarily due to a neonatal mortality rate which was 38–42 percent higher than that for Mexican or Central and South American mothers.

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—In 1997 the infant mortality rate for all races combined was 7.9 for male infants, 18 percent higher than the rate of 6.5 for female infants. Similar to previous years, 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, Asian and Pacific Islander, Puerto Rican, Cuban, and Central and South American mothers.

Multiple births—For all races combined, the infant mortality rate for plural births was about five times the rate of 6.4 for single births. Infant mortality rates for plural births were significantly higher than rates for single births for all race and Hispanic-origin groups. From 1996–97, infant mortality rates for plural births increased for most race and Hispanic-origin groups (except for infants of black, American Indian, and non-Hispanic white mothers), although the differences were not statistically significant. This increase is primarily due to an increase in the number of higher order multiple births (the number of triplet, quadruplet, and quintuplet and other higher order multiple births), since the risk of infant death increases with the increasing number of infants in the pregnancy (9). Higher order multiple birth rates have more than doubled from 1991–97 (from 81.4 per 100,000 live births in 1991 to 173.6 per 100,000 live births in 1997) (3). In 1997, the infant mortality rate for triplet and higher order births (69.0) was more than double the rate for twin births (31.5), and 10 times the rate for single births (6.4).

Factors associated with the rapid increase in multiple births include an increase in births to older women (older women are more likely to have a multiple birth even without the use of fertility therapy), and the more widespread use of fertility-enhancing therapies (fertility drugs and techniques such as in vitro fertilization) (9–11).

Multiple pregnancy can lead to an accentuation of maternal risks and complications associated with pregnancy (12–14). Multiple births are much more likely to be born preterm and at low birthweight, and thus are at higher risk for infant death (9,12–14).

Birthweight and period of gestation—Birthweight and period of gestation are the two most important predictors of an infant's

Table A. Infant, neonatal, and postneonatal deaths and mortality rates by specified race or national origin of mother: United States, 1997 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	3,880,894	27,968	18,507	9,461	7.2	4.8	2.4
White	3,072,640	18,578	12,250	6,328	6.0	4.0	2.1
Black	599,913	8,210	5,536	2,673	13.7	9.2	4.5
American Indian ¹	38,572	335	173	162	8.7	4.5	4.2
Asian or Pacific Islander	169,769	845	548	298	5.0	3.2	1.8
Chinese	28,434	87	59	28	3.1	2.1	1.0
Japanese	8,890	47	27	20	5.3	3.0	2.2
Hawaiian	5,687	51	36	15	9.0	6.3	*
Filipino	31,501	183	112	72	5.8	3.6	2.3
Other Asian or Pacific Islander	95,257	477	314	163	5.0	3.3	1.7

* Figure does not meet standard of reliability or precision.

¹ Includes Aleuts and Eskimos.**Table B. Infant, neonatal, and postneonatal deaths and mortality rates by race or national origin of mother: Total of 8 States, 1997 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	1,570,216	10,126	6,627	3,500	6.4	4.2	2.2
Total Asian or Pacific Islander	118,921	583	373	209	4.9	3.1	1.8
Chinese	22,233	59	38	22	2.7	1.7	1.0
Japanese	6,901	35	19	16	5.1	*	*
Filipino	25,499	146	85	60	5.7	3.3	2.4
Vietnamese	12,685	62	44	18	4.9	3.5	*
Asian Indian	17,550	84	67	17	4.8	3.8	*
Korean	8,282	26	12	13	3.1	*	*
Hawaiian	5,186	45	32	13	8.7	6.2	*
Samoa	1,602	9	3	6	*	*	*
Guamanian	533	2	1	1	*	*	*
Remaining Asian or Pacific Islander	18,450	114	72	42	6.2	3.9	2.3
White	1,247,464	6,999	4,589	2,410	5.6	3.7	1.9
Black	195,607	2,483	1,633	849	12.7	8.3	4.3
American Indian ¹	8,224	62	31	31	7.5	3.8	3.8

* Figure does not meet standard of reliability or precision.

¹ Includes 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, 1997 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	3,880,894	27,968	18,507	9,461	7.2	4.8	2.4
Total Hispanic	709,767	4,226	2,806	1,421	6.0	4.0	2.0
Mexican	499,024	2,908	1,908	1,000	5.8	3.8	2.0
Puerto Rican	55,450	436	299	138	7.9	5.4	2.5
Cuban	12,887	71	52	19	5.5	4.0	...
Central and South American	97,405	531	381	150	5.5	3.9	1.5
Other and unknown Hispanic	45,001	280	166	114	6.2	3.7	2.5
Non-Hispanic total ²	3,115,174	23,141	15,225	7,916	7.4	4.9	2.5
Non-Hispanic white	2,333,363	14,046	9,181	4,865	6.0	3.9	2.1
Non-Hispanic black	581,431	7,978	5,358	2,620	13.7	9.2	4.5
Not stated	55,953	600	477	124	...	...	...

... Category not applicable.

¹ Origin of mother not stated included in "All origins" but not distributed among origins.² Includes races other than white or black.

subsequent health and survival. In 1997, 65 percent of all infant deaths occurred to the 7.5 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 both short term and long term disability than those born at term (37–41 weeks of gestation) or with birthweights of 2,500 grams or more (15–17). 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 18 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 252.8, over 90 times the rate of 2.7 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 16.7, about six times the rate for infants with birthweights of 2,500 grams or more. Similarly, the infant mortality rate for very preterm infants (those born at less than 32 weeks of gestation) was 184.6, 66 times the rate of 2.8 for infants born at term (37–41 weeks of gestation). The infant mortality rate for moderately preterm infants (those born at 32–36 weeks of gestation) was 9.9, almost four times the rate for term births.

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 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 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 1996–97, infant mortality rates declined most rapidly for infants with birthweights of 1,250–1,499 grams, 2,000–2,499 grams, and 5000 grams or more at birth, although the differences were not statistically significant.

Prenatal care—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 (18–20). 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 (21–23). In general, infant mortality was higher for women who began prenatal care after the first trimester of pregnancy or not at all than for those who began care in the first trimester. For all race and Hispanic-origin groups combined, infants of mothers who began prenatal care after the first trimester of pregnancy or not at all had an infant mortality rate, which was 49 percent higher than those who began care in the first trimester (9.4 and 6.3, respectively). For each race and Hispanic-origin group, infant mortality rates were higher for mothers who began prenatal care after the first trimester or not at all, although differences were not statistically significant for mothers of Hispanic-origin (Mexican, Puerto Rican, and Central and South American mothers).

Similar to 1995–96, the infant mortality rate for mothers who began prenatal care in the first trimester continued to decline from 1996 to 1997. The rate in 1997 (6.3) was 3 percent lower than the rate in 1996 (6.5) and 4.5 percent lower than in 1995 (6.6). Reasons for the decrease in infant mortality rates among mothers who begin care in the first trimester may include earlier detection of adverse pregnancy conditions, improvements in the delivery of care, and greater utilization of health behavior services.

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 and over. The percent of births to teenage mothers was lowest for Chinese mothers (1 percent) and highest for black and Puerto Rican mothers (22 percent) (tables 3 and 4).

For the total population, white, and non-Hispanic white mothers, infant mortality rates were higher for teenage mothers than for mothers 40–54 years of age. For black, Asian and Pacific Islander, total Hispanic, and Mexican mothers, infant mortality rates were higher for mothers 40–54 years of age than for teenagers, although the difference was not statistically significant for black and Asian and Pacific Islander mothers. For American Indian, Puerto Rican, and Cuban mothers, there were not enough infant deaths for mothers 40–54 years of age to be able to compute reliable rates.

Infant mortality rates were higher for infants of teenaged mothers than for infants of mothers 25–29 years of age for all race and Hispanic origin groups, although differences were only statistically significant for infants of white, Mexican, and Asian and Pacific Islander mothers. For Cuban mothers there were not enough infant deaths to teenage mothers to be able to compute reliable rates. Infant mortality rates were higher for women 40–54 years of age than for women 25–29 years of age for all race and Hispanic origin groups that rates could be computed for, although differences were only statistically significant for white and Mexican 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 (24–28).

Maternal education—The percent of births to mothers who had completed high school or more ranged from a low of 44 percent for Mexican mothers to a high of 98 percent for Japanese mothers (tables 3 and 4). Infant mortality rates generally decreased with increasing educational level. This pattern may reflect in part socioeconomic differences because women with more education tend to have higher family income levels (29).

Among infants of black, American Indian, Central and South American, and non-Hispanic white mothers, infant mortality rates declined steadily with increasing educational level with the highest mortality rates occurring among infants of mothers with 0–8 years of education. In contrast, for Asian and Pacific Islander, total Hispanic, Mexican, and Puerto Rican mothers (and by extension for total white and the total population), 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 only statistically significant for white mothers. This may be due in part to the very different population composition of 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

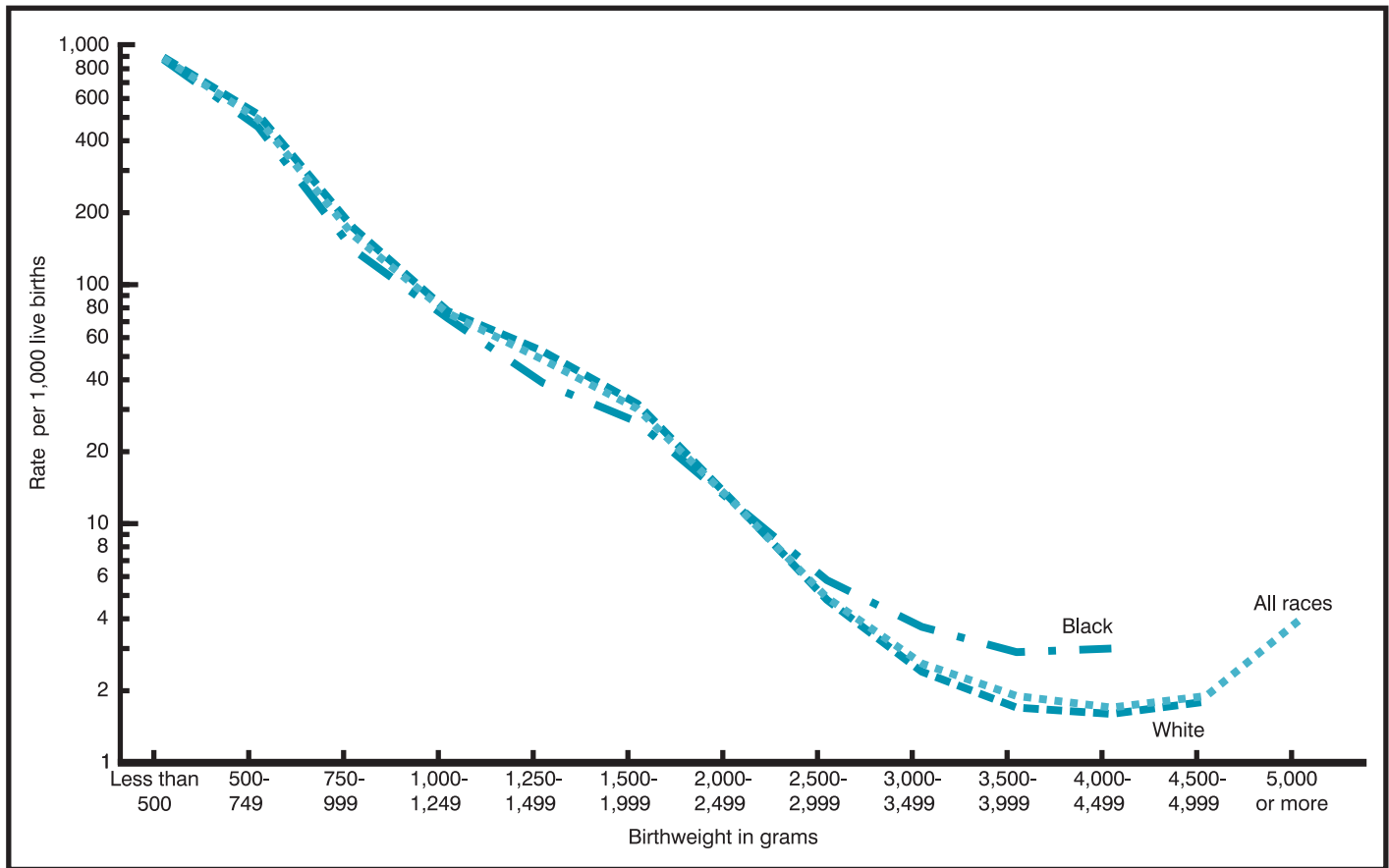


Figure 1. Infant mortality rates by birthweight: United States, 1997 linked file

of Columbia have lower infant mortality rates than infants of women born in the 50 States and the District of Columbia (see the section on Nativity) (30).

Live birth order—Overall, infant mortality rates were slightly higher for first births than for second births, and thereafter increased with increasing birth order. Compared with the infant mortality rate for second births (6.5), the rate for first births was 9 percent higher (7.1), the rate for fourth births (8.6) was 32 percent higher, and the rate for fifth and higher order births (11.2) was 72 percent higher. The proportion of women with fourth and higher order births ranged from a low of 2 percent for Chinese mothers to a high of 20 percent for American Indian mothers.

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 (31–33). For all races combined, there was a decrease in infant mortality rates for married mothers in 1997. The infant mortality rate for married mothers was 5.6 in 1997 compared with 5.8 in 1996. The rate for unmarried mothers in 1997 (10.5) did not change and was 1.9 times the rate for married mothers. For each race and Hispanic-origin group studied, infant mortality rates were higher for unmarried mothers than for married mothers, although differences were not significant for American Indian and Puerto Rican mothers.

The percent of births to unmarried women ranged from a low of 7 percent for Chinese mothers to a high of 69 percent for black mothers.

Nativity—For all races combined, the infant mortality rate for mothers born in the 50 States and the District of Columbia (7.4) was nearly one-third (32 percent) higher than the rate for those born outside of the 50 States and the District of Columbia (5.6). For each race and Hispanic origin group, infant mortality rates were higher for mothers born in the 50 States and the District of Columbia than for those born elsewhere, although the differences were not statistically significant for Puerto Rican, Cuban, and Central and South American mothers. The infant mortality rate for American Indian mothers born outside the 50 States and the District of Columbia could not be computed because of insufficient numbers. The percent of births to mothers born in the 50 States and the District of Columbia ranged from a low of 9–10 percent for Central and South American and Chinese mothers to a high of 97–98 percent for American Indian and Hawaiian mothers.

A variety of different hypotheses has been advanced to account for the lower infant mortality rate among mothers born outside the 50 States and the District of Columbia, including possible differences in the level of familial integration and social support for new mothers (34–36). Also, women born outside the 50 States and the District of Columbia have been shown to have different characteristics than women born within the 50 States and the District of Columbia with regard to socioeconomic and educational status, and risk behaviors such as smoking and alcohol use (36–37).

Maternal smoking—The infant mortality rate for smokers was 10.8 in 1997, nearly 60 percent higher than the rate for nonsmokers (6.8). 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, the infant mortality rate for smokers was higher than for nonsmokers, although the difference was not statistically significant for Puerto Rican mothers. Reliable rates for smokers could not be calculated for Cuban and Central and South American mothers due to an insufficient number of infant deaths.

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 (38–41).

Leading causes of infant death

Infant mortality rates for the five leading causes of infant death are presented in [table 6](#) by race of mother and in [table 7](#) for selected Hispanic origin groups and for non-Hispanic white mothers. The three leading causes of infant death—Congenital anomalies, Disorders relating to short gestation and unspecified low birthweight (low birthweight), and Sudden infant death syndrome (SIDS) taken together accounted for nearly one-half (47 percent) of all infant deaths in the United States in 1997.

Rankings of leading causes of infant death varied by race and Hispanic origin of the mother. For all races combined, white, Hispanic total, Mexican, and Central and South American mothers, Congenital anomalies was the leading cause of infant death in 1997, followed by low birthweight, 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, Congenital anomalies was the leading cause of death, followed by SIDS and low birthweight. For infants of Puerto Rican mothers, the order of the first three causes of infant death was the same as for the total population, but maternal complications was ranked fourth, and RDS fifth. For non-Hispanic white mothers, Congenital anomalies was the leading cause of infant death, followed by SIDS, low birthweight, maternal complications, and RDS.

Mortality rates were higher for black than for white mothers for all of the five leading causes of infant death. 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 284.0 for infants of black mothers, over four times the rate of 68.3 for infants of white mothers. For SIDS, RDS, and maternal complications, rates were 2.2–2.9 times higher for infants of black than for infants of white mothers.

For infants of American Indian mothers, the SIDS rate was 155.6, 2.4 times that for infants of white 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. For infants of Asian and Pacific Islander mothers cause-specific mortality rates were significantly lower than those for white mothers for low birthweight and maternal complications.

For Mexican mothers, the infant mortality rate for Congenital anomalies was 177.1, 17 percent higher than the rate of 151.5 for non-Hispanic white mothers. The SIDS rate of 46.9 was one-third lower

than the rate of 70.7 for non-Hispanic white mothers. The rate for maternal complications was also nearly one-third lower for Mexican than for non-Hispanic white mothers.

For Puerto Rican mothers, the most notable finding was the much higher infant mortality rate for low birthweight. The rate of 108.2 was 65 percent higher than the rate of 65.5 for non-Hispanic white mothers. For Central and South American mothers, the most notable finding was the much lower SIDS rate. The SIDS rate of 40.0 was 43 percent below the rate for non-Hispanic white mothers.

An examination of cause-specific differences in infant mortality rates between race and Hispanic origin groups can help the researcher to understand overall differences in infant mortality rates between these groups. For example, more than one-third (34 percent) of the elevated infant mortality rate for American Indian mothers when compared with white mothers can be accounted for by their higher SIDS rates. In other words, if American Indian SIDS mortality could be made equal to white SIDS mortality, the difference in the infant mortality rate between American Indian and white mothers would be reduced by one-third.

For black mothers, more than one-fourth (28 percent) of their elevated infant mortality rate, when compared with white mothers, can be accounted for by their higher infant mortality rate due to low birthweight and a further 10 percent can be accounted for by differences in SIDS. If black infant mortality rates for low birthweight and SIDS could be reduced to white levels, the difference in the infant mortality rate between black and white mothers would be reduced by 38 percent. In addition to helping to explain differences in infant mortality rates between various groups, comparisons such as these can be helpful in targeting prevention efforts.

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Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and specified race of mother: United States, 1997 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	7.2	6.0	13.7	8.7	5.0
Age at death:					
Total neonatal	4.8	4.0	9.2	4.5	3.2
Early neonatal (< 7 days)	3.8	3.1	7.7	3.4	2.5
Late neonatal (7-27 days)	0.9	0.8	1.6	1.1	0.7
Postneonatal	2.4	2.1	4.5	4.2	1.8
Sex:					
Male	7.9	6.7	14.9	9.9	5.4
Female	6.5	5.4	12.4	7.4	4.5
Plurality:					
Single births	6.4	5.3	12.4	8.1	4.4
Plural births	33.8	29.8	52.5	34.6	34.9
Birthweight:					
Less than 1,500 grams	252.8	245.5	270.1	241.4	218.8
1,500-2,499 grams	16.7	17.0	15.9	25.6	13.7
2,500 grams or more	2.7	2.4	4.1	4.6	1.9
Period of gestation:					
Less than 32 weeks	184.6	179.3	197.9	145.9	162.0
32-36 weeks	9.9	9.5	11.4	12.1	8.2
37-41 weeks	2.8	2.6	4.2	4.8	2.0
42 weeks or more	3.5	3.2	5.0	6.2	2.2
Trimester of pregnancy prenatal care began:					
First trimester	6.3	5.5	12.3	7.5	4.4
After first trimester or no care	9.4	7.8	14.7	10.0	6.3
Second trimester	7.6	6.6	11.1	8.9	5.7
Third trimester	6.6	5.9	8.8	*	*
No prenatal care	35.6	28.0	50.3	28.0	22.5
Age of mother:					
Under 20 years	10.4	9.0	14.2	10.4	9.4
20-24 years	8.0	6.7	13.4	8.1	6.0
25-29 years	6.2	5.2	13.2	7.5	4.4
30-34 years	5.8	5.0	13.6	9.8	3.6
35-39 years	6.8	5.9	14.4	8.5	5.3
40-54 years	8.7	7.7	15.6	*	9.7
Educational attainment of mother:					
0-8 years	7.6	6.9	16.2	13.0	4.9
9-11 years	9.8	8.4	14.4	9.5	6.4
12 years	7.6	6.4	13.4	8.7	5.9
13-15 years	6.0	4.9	11.7	6.6	4.5
16 years and over	4.6	4.2	10.6	7.7	3.7
Live-birth order:					
1	7.1	6.0	13.6	8.3	4.7
2	6.5	5.5	12.8	7.6	4.4
3	7.0	5.8	12.7	9.4	5.4
4	8.6	7.2	14.4	9.7	6.0
5 or more	11.2	8.7	18.3	9.9	10.5
Marital status:					
Married	5.6	5.2	11.5	7.5	4.5
Unmarried	10.5	8.5	14.6	9.5	7.3
Mother's place of birth:					
Born in the 50 States and D.C.	7.4	6.1	13.7	8.6	6.7
Born elsewhere	5.6	5.3	9.9	*	4.6
Maternal smoking during pregnancy: ²					
Smoker	10.8	9.4	19.9	13.2	11.5
Nonsmoker	6.8	5.5	12.8	7.3	4.8

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, 1997 linked file--Con.

Characteristics	All races	Race of mother				
		White	Black	American Indian ¹	Asian/ Pacific Islander	
			Live births			
Total	3,880,894	3,072,640	599,913	38,572	169,769	
Sex:						
Male	1,985,596	1,573,622	304,530	19,627	87,817	
Female	1,895,298	1,499,018	295,383	18,945	81,952	
Plurality:						
Single births	3,770,020	2,984,532	581,394	37,763	166,331	
Plural births	110,874	88,108	18,519	809	3,438	
Birthweight:						
Less than 1,500 grams	55,659	34,962	18,432	464	1,801	
1,500-2,499 grams	236,410	164,019	59,775	2,147	10,469	
2,500 grams or more	3,587,099	2,872,582	521,347	35,933	157,237	
Not stated	1,726	1,077	359	28	262	
Period of gestation:						
Less than 32 weeks	74,403	46,530	24,776	788	2,309	
32-36 weeks	362,197	264,313	79,376	3,876	14,632	
37-41 weeks	3,103,295	2,489,555	445,747	29,727	138,266	
42 weeks or more	302,541	243,494	44,745	3,705	10,597	
Not stated	38,458	28,748	5,269	476	3,965	
Trimester of pregnancy prenatal care began:						
First trimester	3,119,693	2,545,590	414,251	25,452	134,400	
After first trimester or no care	660,509	460,349	158,935	11,937	29,288	
Second trimester	512,228	363,139	117,343	8,719	23,027	
Third trimester	102,041	69,505	25,356	2,431	4,749	
No prenatal care	46,240	27,705	16,236	787	1,512	
Not stated	100,692	66,701	26,727	1,183	6,081	
Age of mother:						
Under 20 years	493,341	343,293	133,251	8,012	8,785	
20-24 years	942,048	720,546	182,600	12,316	26,586	
25-29 years	1,069,436	871,636	135,529	9,168	53,103	
30-34 years	886,798	735,571	94,123	5,812	51,292	
35-39 years	409,710	337,423	45,069	2,694	24,524	
40-54 years	79,561	64,171	9,341	570	5,479	
Educational attainment of mother:						
0-8 years	224,911	196,441	17,272	1,616	9,582	
9-11 years	620,586	451,023	145,147	10,786	13,630	
12 years	1,257,946	969,727	229,003	15,209	44,007	
13-15 years	848,379	670,870	134,490	7,611	35,408	
16 years and over	872,733	745,496	61,868	2,589	62,780	
Not stated	56,339	39,083	12,133	761	4,362	
Live-birth order:						
1	1,573,768	1,252,047	230,724	13,696	77,301	
2	1,254,354	1,012,916	174,612	10,596	56,230	
3	628,579	498,451	101,843	6,579	21,706	
4	241,418	182,633	47,865	3,616	7,304	
5 or more	162,167	110,873	41,244	3,846	6,204	
Not stated	20,608	15,720	3,625	239	1,024	
Marital status:						
Married	2,623,450	2,279,438	184,859	15,932	143,221	
Unmarried	1,257,444	793,202	415,054	22,640	26,548	
Mother's place of birth:						
Born in the 50 States and D.C.	3,124,817	2,528,268	533,038	37,162	26,349	
Born elsewhere	746,928	538,829	63,691	1,324	143,084	
Not stated	9,149	5,543	3,184	86	336	
Maternal smoking during pregnancy: ²						
Smoker	406,484	344,666	51,891	6,609	3,318	
Nonsmoker	2,671,200	2,063,713	480,773	25,176	101,538	
Not stated	46,426	36,608	6,493	1,240	2,085	

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, 1997 linked file--Con.

Characteristics	All races	Race of mother			
		White	Black	American Indian ¹	Asian/ Pacific Islander
		Infant deaths			
Total	27,968	18,578	8,210	335	845
Age at death:					
Total neonatal	18,507	12,250	5,536	173	548
Early neonatal (< 7 days)	14,827	9,673	4,596	130	428
Late neonatal (7-27 days)	3,680	2,576	940	44	120
Postneonatal	9,461	6,328	2,673	162	298
Sex:					
Male	15,729	10,519	4,543	194	473
Female	12,239	8,059	3,667	141	372
Plurality:					
Single births	24,225	15,956	7,236	307	726
Plural births	3,743	2,622	973	28	120
Birthweight:					
Less than 1,500 grams	14,068	8,584	4,978	112	394
1,500-2,499 grams	3,944	2,794	952	55	143
2,500 grams or more	9,615	7,020	2,130	167	298
Not stated	341	180	150	1	10
Period of gestation:					
Less than 32 weeks	13,736	8,344	4,903	115	374
32-36 weeks	3,583	2,508	908	47	120
37-41 weeks	8,672	6,381	1,866	142	283
42 weeks or more	1,046	779	223	23	23
Not stated	930	565	310	9	46
Trimester of pregnancy prenatal care began:					
First trimester	19,762	13,886	5,096	191	589
After first trimester or no care	6,221	3,574	2,344	119	184
Second trimester	3,904	2,392	1,304	78	131
Third trimester	670	408	224	19	19
No prenatal care	1,647	775	816	22	34
Not stated	1,985	1,118	769	25	73
Age of mother:					
Under 20 years	5,149	3,085	1,898	83	83
20-24 years	7,559	4,856	2,444	100	159
25-29 years	6,598	4,501	1,794	69	234
30-34 years	5,174	3,647	1,282	57	187
35-39 years	2,793	1,993	647	23	130
40-54 years	695	495	146	2	53
Educational attainment of mother:					
0-8 years	1,699	1,352	280	21	47
9-11 years	6,096	3,811	2,095	103	87
12 years	9,621	6,168	3,060	133	260
13-15 years	5,052	3,272	1,568	50	161
16 years and over	4,003	3,095	655	20	233
Not stated	1,497	880	552	8	56
Live-birth order:					
1	11,149	7,542	3,129	114	364
2	8,177	5,616	2,232	81	249
3	4,370	2,891	1,298	62	118
4	2,079	1,313	687	35	44
5 or more	1,821	965	753	38	65
Not stated	372	250	111	5	5
Marital status:					
Married	14,771	11,866	2,134	120	651
Unmarried	13,197	6,712	6,076	215	194

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, 1997 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.	23,096	15,321	7,277	321	177
Born elsewhere	4,179	2,878	633	10	659
Not stated	693	379	300	3	10
Maternal smoking during pregnancy: ²					
Smoker	4,392	3,237	1,031	87	38
Nonsmoker	18,118	11,296	6,153	183	487
Not stated	711	466	212	17	16

* 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.

NOTE: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Not stated responses were included in totals but not distributed among 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, 1997 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	7.2	6.0	5.8	7.9	5.5	5.5	6.2	7.4	6.0	13.7	...
Age at death:											
Total neonatal	4.8	4.0	3.8	5.4	4.0	3.9	3.7	4.9	3.9	9.2	...
Early neonatal (< 7 days)	3.8	3.1	2.9	4.5	2.8	3.1	3.0	3.9	3.1	7.6	...
Late neonatal (7-27 days)	0.9	0.9	0.9	0.9	*	0.8	0.7	1.0	0.8	1.6	...
Postneonatal	2.4	2.0	2.0	2.5	*	1.5	2.5	2.5	2.1	4.5	...
Sex:											
Male	7.9	6.4	6.3	8.7	5.8	5.6	6.9	8.2	6.7	15.0	...
Female	6.5	5.5	5.4	7.0	5.2	5.3	5.5	6.6	5.3	12.4	...
Plurality:											
Single births	6.4	5.4	5.3	7.1	4.5	4.9	6.1	6.6	5.3	12.5	...
Plural births	33.8	31.1	31.7	39.3	*	30.9	*	33.7	29.0	52.5	...
Birthweight:											
Less than 1,500 grams	252.8	250.2	255.4	242.0	227.3	266.7	195.4	250.8	240.7	268.9	...
1,500-2,499 grams	16.7	16.9	18.5	12.7	*	11.5	17.6	16.6	17.0	15.8	...
2,500 grams or more	2.7	2.3	2.4	2.6	*	1.8	2.6	2.8	2.5	4.1	...
Period of gestation:											
Less than 32 weeks	184.6	163.1	161.1	179.0	191.1	170.5	132.9	186.4	181.6	196.9	...
32-36 weeks	9.9	8.4	8.7	8.8	*	5.9	9.4	10.2	9.8	11.4	...
37-41 weeks	2.8	2.4	2.5	2.5	*	2.0	2.9	2.9	2.6	4.2	...
42 weeks or more	3.5	3.2	3.3	*	*	3.2	*	3.5	3.2	5.0	...
Trimester of pregnancy prenatal care began:											
First trimester	6.3	5.6	5.5	7.0	4.9	5.2	5.7	6.5	5.4	12.4	...
After first trimester or no care	9.4	6.2	6.1	8.3	*	5.2	6.5	10.5	8.6	14.8	...
Second trimester	7.6	5.2	5.2	6.8	*	4.8	5.1	8.5	7.3	11.2	...
Third trimester	6.6	4.8	5.1	*	*	*	*	7.3	6.6	8.9	...
No prenatal care	35.6	21.6	19.4	35.4	*	23.5	*	39.5	31.0	50.2	...
Age of mother:											
Under 20 years	10.4	7.3	7.2	7.8	*	6.5	8.5	11.4	9.8	14.3	...
20-24 years	8.0	5.7	5.5	8.8	*	4.8	5.9	8.6	7.1	13.5	...
25-29 years	6.2	5.2	4.8	7.3	*	5.8	5.8	6.3	5.1	13.3	...
30-34 years	5.8	5.5	5.7	6.1	*	4.8	5.6	5.8	4.8	13.6	...
35-39 years	6.8	7.0	7.4	8.8	*	5.7	5.8	6.7	5.7	14.2	...
40-54 years	8.7	10.1	11.2	*	*	8.7	*	8.5	7.2	15.4	...
Educational attainment of mother:											
0-8 years	7.6	5.8	5.5	7.5	*	7.5	6.0	11.4	10.7	16.9	...
9-11 years	9.8	6.4	6.3	8.4	*	5.2	6.8	11.4	9.9	14.6	...
12 years	7.6	5.8	5.6	8.2	5.8	5.2	6.0	8.0	6.5	13.4	...
13-15 years	6.0	5.1	5.2	6.3	*	4.2	5.0	6.1	4.9	11.7	...
16 years and over	4.6	4.4	4.6	6.0	*	4.2	4.3	4.6	4.1	10.7	...
Live-birth order:											
1	7.1	6.1	6.0	7.5	5.7	5.4	6.8	7.2	5.9	13.6	...
2	6.5	5.4	5.3	7.0	4.3	5.1	5.8	6.7	5.5	12.9	...
3	7.0	5.2	5.2	7.8	*	4.3	4.9	7.3	6.0	12.7	...
4	8.6	6.2	5.5	11.7	*	6.5	7.6	9.3	7.6	14.3	...
5 or more	11.2	8.6	8.7	7.5	*	10.8	*	12.0	8.7	18.2	...
Marital status:											
Married	5.6	5.3	5.3	6.8	4.4	4.7	5.3	5.6	5.1	11.6	...
Unmarried	10.5	6.9	6.6	8.6	8.9	6.5	7.4	11.5	9.2	14.7	...
Mother's place of birth:											
Born in the 50 States and D.C.	7.4	6.7	6.7	7.7	5.2	6.3	6.5	7.4	6.0	13.7	...
Born elsewhere	5.6	5.3	5.2	8.0	5.7	5.4	4.1	5.9	5.4	10.3	...
Maternal smoking during pregnancy: ³											
Smoker	10.8	9.1	9.5	11.0	*	*	*	10.8	9.4	19.8	...
Nonsmoker	6.8	6.0	5.9	7.5	5.6	5.2	6.1	6.9	5.3	12.9	...

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, 1997 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	3,880,894	709,767	499,024	55,450	12,887	97,405	45,001	3,115,174	2,333,363	581,431	55,953	
Sex:												
Male	1,985,596	361,868	254,230	28,384	6,580	49,693	22,981	1,595,040	1,196,537	295,134	28,688	
Female	1,895,298	347,899	244,794	27,066	6,307	47,712	22,020	1,520,134	1,136,826	286,297	27,265	
Plurality:												
Single births	3,770,020	695,430	489,525	54,101	12,487	95,301	44,016	3,020,563	2,260,786	563,436	54,027	
Plural births	110,874	14,337	9,499	1,349	400	2,104	985	94,611	72,577	17,995	1,926	
Birthweight:												
Less than 1,500 grams	55,659	8,130	5,156	1,033	176	1,151	614	46,527	26,407	17,961	1,002	
1,500-2,499 grams	236,410	37,489	24,692	4,182	698	4,957	2,960	195,574	125,012	58,455	3,347	
2,500 grams or more	3,587,099	663,973	469,083	50,205	12,012	91,281	41,392	2,871,842	2,181,273	504,709	51,284	
Not stated	1,726	175	93	30	1	16	35	1,231	671	306	320	
Period of gestation:												
Less than 32 weeks	74,403	11,675	7,530	1,408	225	1,654	858	61,577	34,449	24,172	1,151	
32-36 weeks	362,197	66,244	45,354	6,115	1,191	9,119	4,465	291,254	196,143	77,361	4,699	
37-41 weeks	3,103,295	560,079	393,513	43,197	10,495	77,460	35,414	2,498,873	1,905,396	431,630	44,343	
42 weeks or more	302,541	57,582	40,902	4,326	913	7,709	3,732	240,687	183,691	43,296	4,272	
Not stated	38,458	14,187	11,725	404	63	1,463	532	22,783	13,684	4,972	1,488	
Trimester of pregnancy prenatal care began:												
First trimester	3,119,693	506,442	351,737	39,942	11,487	70,583	32,693	2,570,400	2,014,137	401,994	42,851	
After first trimester or no care	660,509	180,884	135,825	12,261	1,218	21,260	10,320	471,755	277,991	154,396	7,870	
Second trimester	512,228	138,218	103,078	9,445	1,027	16,628	8,040	368,063	223,753	113,971	5,947	
Third trimester	102,041	31,283	23,886	1,996	125	3,653	1,623	69,555	38,205	24,502	1,203	
No prenatal care	46,240	11,383	8,861	820	66	979	657	34,137	16,033	15,923	720	
Not stated	100,692	22,441	11,462	3,247	182	5,562	1,988	73,019	41,235	25,041	5,232	
Age of mother:												
Under 20 years	493,341	120,955	88,529	12,343	951	10,224	8,908	367,356	222,097	129,956	5,030	
20-24 years	942,048	216,152	159,304	17,192	2,520	23,992	13,144	715,227	500,928	177,494	10,669	
25-29 years	1,069,436	188,669	133,465	13,337	3,609	27,144	11,114	865,694	674,498	130,942	15,073	
30-34 years	886,798	121,539	78,891	8,357	3,835	22,710	7,746	749,555	603,304	90,637	15,704	
35-39 years	409,710	51,601	32,026	3,515	1,697	10,930	3,433	350,343	280,393	43,434	7,766	
40-54 years	79,561	10,851	6,809	706	275	2,405	656	66,999	52,143	8,968	1,711	
Educational attainment of mother:												
0-8 years	224,911	155,599	129,076	3,349	274	19,262	3,638	68,291	41,659	15,872	1,021	
9-11 years	620,586	194,592	147,123	16,855	1,483	18,477	10,654	420,240	256,605	140,790	5,754	
12 years	1,257,946	205,465	137,369	17,952	4,129	30,403	15,612	1,036,873	757,734	222,692	15,608	
13-15 years	848,379	93,925	54,712	11,340	3,380	15,945	8,548	743,146	570,573	131,000	11,308	
16 years and over	872,733	46,973	21,970	5,026	3,569	11,309	5,099	811,079	686,483	60,248	14,681	
Not stated	56,339	13,213	8,774	928	52	2,009	1,450	35,545	20,309	10,829	7,581	
Live-birth order:												
1	1,573,768	266,392	182,542	21,778	5,633	37,931	18,508	1,286,028	974,855	223,429	21,348	
2	1,254,354	214,352	147,737	17,024	4,621	31,083	13,887	1,022,467	788,759	169,163	17,535	
3	628,579	127,872	92,294	9,180	1,898	17,100	7,400	492,203	366,267	98,781	8,504	
4	241,418	56,782	42,598	3,929	486	6,729	3,040	181,452	124,488	46,602	3,184	
5 or more	162,167	40,123	30,973	2,951	219	4,085	1,895	119,514	69,726	40,228	2,530	
Not stated	20,608	4,246	2,880	588	30	477	271	13,510	9,268	3,228	2,852	
Marital status:												
Married	2,623,450	419,330	304,976	22,515	9,744	56,734	25,361	2,163,526	1,830,743	177,895	40,594	
Unmarried	1,257,444	290,437	194,048	32,935	3,143	40,671	19,640	951,648	502,620	403,536	15,359	
Mother's place of birth:												
Born in the 50 States and D.C.	3,124,817	277,118	195,285	35,038	4,995	8,791	33,009	2,797,591	2,214,861	524,853	50,108	
Born elsewhere	746,928	431,150	303,024	20,318	7,885	88,505	11,418	311,117	115,136	53,834	4,661	
Not stated	9,149	1,499	715	94	7	109	574	6,466	3,366	2,744	1,184	
Maternal smoking during pregnancy: ³												
Smoker	406,484	18,092	7,989	5,459	500	1,172	2,972	383,905	323,821	50,840	4,487	
Nonsmoker	2,671,200	422,425	269,246	44,081	11,352	65,718	32,028	2,225,854	1,638,023	466,061	22,921	
Not stated	46,426	4,888	2,407	1,014	54	679	734	38,280	29,148	6,097	3,258	

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, 1997 linked file--Con.

Characteristics	All origins ¹	Hispanic						Non-Hispanic			Not stated
		Total	Mexican	Puerto Rican	Cuban	Central and South American	Other and unknown Hispanic	Total ²	White	Black	
Infant deaths											
Total	27,968	4,226	2,908	436	71	531	280	23,141	14,046	7,978	600
Age at death:											
Total neonatal	18,507	2,806	1,908	299	52	381	166	15,225	9,181	5,358	477
Early neonatal (< 7 days)	14,827	2,168	1,448	248	36	303	133	12,240	7,271	4,440	417
Late neonatal (7-27 days)	3,680	638	460	51	16	78	33	2,985	1,910	918	59
Postneonatal	9,461	1,421	1,000	138	19	150	114	7,916	4,865	2,620	124
Sex:											
Male	15,729	2,319	1,597	246	38	280	158	13,089	8,034	4,425	321
Female	12,239	1,907	1,311	190	33	251	122	10,052	6,013	3,552	279
Plurality:											
Single births	24,225	3,780	2,607	383	56	466	268	19,953	11,942	7,033	491
Plural births	3,743	446	301	53	15	65	12	3,188	2,104	945	109
Birthweight:											
Less than 1,500 grams	14,068	2,034	1,317	250	40	307	120	11,669	6,357	4,830	365
1,500-2,499 grams	3,944	632	456	53	14	57	52	3,237	2,123	926	76
2,500 grams or more	9,615	1,520	1,105	129	17	163	106	7,966	5,449	2,079	129
Not stated	341	41	29	5	-	4	3	270	117	143	30
Period of gestation:											
Less than 32 weeks	13,736	1,904	1,213	252	43	282	114	11,481	6,257	4,759	351
32-36 weeks	3,583	555	395	54	10	54	42	2,964	1,923	885	64
37-41 weeks	8,672	1,355	975	110	16	153	101	7,195	4,972	1,819	123
42 weeks or more	1,046	187	137	10	2	25	13	849	590	218	10
Not stated	930	227	188	11	-	17	11	651	303	297	52
Trimester of pregnancy prenatal care began:											
First trimester	19,762	2,822	1,931	279	56	369	187	16,620	10,900	4,973	319
After first trimester or no care	6,221	1,116	826	102	10	111	67	4,970	2,392	2,292	136
Second trimester	3,904	721	532	64	5	79	41	3,111	1,641	1,273	72
Third trimester	670	149	122	9	1	9	8	509	254	219	11
No prenatal care	1,647	246	172	29	4	23	18	1,349	497	800	52
Not stated	1,985	289	151	56	5	51	26	1,551	754	713	145
Age of mother:											
Under 20 years	5,149	885	637	96	10	66	76	4,184	2,185	1,853	81
20-24 years	7,559	1,232	877	151	12	115	77	6,179	3,547	2,390	147
25-29 years	6,598	973	635	98	19	157	64	5,473	3,439	1,746	153
30-34 years	5,174	668	446	51	18	110	43	4,376	2,904	1,235	128
35-39 years	2,793	359	237	31	9	62	20	2,357	1,594	615	76
40-54 years	695	110	76	10	2	21	1	569	376	138	15
Educational attainment of mother:											
0-8 years	1,699	904	711	25	2	144	22	776	447	268	18
9-11 years	6,096	1,255	932	142	13	96	72	4,775	2,544	2,053	65
12 years	9,621	1,196	772	148	24	158	94	8,269	4,909	2,986	157
13-15 years	5,052	483	283	71	19	67	43	4,517	2,775	1,538	51
16 years and over	4,003	209	101	30	9	47	22	3,732	2,841	642	62
Not stated	1,497	176	109	19	3	18	27	1,073	529	492	247
Live-birth order:											
1	11,149	1,630	1,103	164	32	205	126	9,281	5,780	3,046	238
2	8,177	1,167	790	120	20	157	80	6,870	4,376	2,180	141
3	4,370	670	476	72	13	73	36	3,614	2,192	1,254	86
4	2,079	352	235	46	4	44	23	1,686	943	668	41
5 or more	1,821	346	268	22	1	44	11	1,439	609	732	36
Not stated	372	60	36	12	-	8	4	251	146	98	60
Marital status:											
Married	14,771	2,217	1,620	153	43	267	134	12,220	9,413	2,061	334
Unmarried	13,197	2,010	1,288	284	28	264	146	10,920	4,633	5,916	267

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, 1997 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.	23,096	1,870	1,305	269	26	55	215	20,806	13,189	7,167	420
Born elsewhere	4,179	2,305	1,576	163	45	474	47	1,831	617	557	44
Not stated	693	53	28	5	-	2	18	503	240	254	137
Maternal smoking during pregnancy: ³											
Smoker	4,392	164	76	60	3	7	18	4,158	3,041	1,005	70
Nonsmoker	18,118	2,519	1,591	330	64	339	195	15,369	8,733	6,000	230
Not stated	711	66	35	13	-	9	9	560	341	192	85

* Figure does not meet standard of reliability or precision.

- Quantity zero.

... Category not applicable.

¹ Origin 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.

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

Table 3. Percent of live births with selected maternal and infant characteristics by specified race of mother: United States, 1997 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	1.1	0.7	0.8	1.4	1.3	1.1	
Less than 2,500 grams	7.5	6.5	13.0	6.8	7.2	5.1	6.8	7.2	8.3	7.5	
Preterm births ²	11.4	10.2	17.5	12.2	10.2	7.4	8.1	11.0	11.9	10.6	
Prenatal care beginning in the first trimester	82.5	84.7	72.3	68.1	82.1	87.4	89.3	78.0	83.3	79.7	
Births to mothers under 20 years	12.7	11.2	22.2	20.8	5.2	0.9	2.2	18.6	5.9	5.7	
Fourth and higher order births	10.5	9.6	14.9	19.5	8.0	2.2	4.1	15.3	7.0	10.0	
Births to unmarried mothers	32.4	25.8	69.2	58.7	15.6	6.5	10.1	49.1	19.5	15.6	
Mothers completing 12 or more years of school ...	77.9	78.7	72.4	67.2	86.0	87.7	97.7	83.2	92.7	82.2	
Mothers born in the 50 States and D.C.	80.7	82.4	89.3	96.6	15.6	9.6	44.0	97.9	17.7	9.1	
Mother smoked during pregnancy ³	13.2	14.3	9.7	20.8	3.2	1.0	4.7	15.8	3.4	2.5	

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, 1997 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	1.8	1.4	1.2	1.3	1.5	1.1	3.1	
Less than 2,500 grams	7.5	6.4	6.0	9.4	6.8	6.3	7.9	7.8	6.5	13.1	
Preterm births ³	11.4	11.2	10.9	13.7	11.0	11.2	12.0	11.4	9.9	17.6	
Prenatal care beginning in the first trimester	82.5	73.7	72.1	76.5	90.4	76.9	76.0	84.5	87.9	72.3	
Births to mothers under 20 years	12.7	17.0	17.7	22.3	7.4	10.5	19.8	11.8	9.5	22.4	
Fourth and higher order births	10.5	13.7	14.8	12.5	5.5	11.2	11.0	9.7	8.4	15.0	
Births to unmarried mothers	32.4	40.9	38.9	59.4	24.4	41.8	43.6	30.5	21.5	69.4	
Mothers completing 12 or more years of school ...	77.9	49.7	43.7	62.9	86.3	60.4	67.2	84.1	87.1	72.5	
Mothers born in the 50 States and D.C.	80.7	39.1	39.2	63.3	38.8	9.0	74.3	90.0	95.1	90.7	
Mother smoked during pregnancy ⁴	13.2	4.1	2.9	11.0	4.2	1.8	8.5	14.7	16.5	9.8	

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, 1997 linked file, and percent change in birthweight-specific infant mortality, 1996-97 linked file

Race and birthweight	Number				Mortality rate per 1,000 live births			Percent change in infant mortality rate 1996-97
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races ¹	3,880,894	27,968	18,507	9,461	7.2	4.8	2.4	-1.4
Less than 2,500 grams	292,069	18,012	14,697	3,315	61.7	50.3	11.4	-1.9
Less than 1,500 grams	55,659	14,068	12,456	1,612	252.8	223.8	29.0	-2.5
Less than 500 grams	5,994	5,298	5,210	88	883.9	869.2	14.7	-0.6
500-749 grams	10,653	5,249	4,661	588	492.7	437.5	55.2	-3.8
750-999 grams	11,341	1,829	1,388	441	161.3	122.4	38.9	-3.5
1,000-1,249 grams	12,735	966	684	282	75.9	53.7	22.1	-1.7
1,250-1,499 grams	14,936	726	513	213	48.6	34.3	14.3	-7.8
1,500-1,999 grams	56,899	1,720	1,071	649	30.2	18.8	11.4	-0.3
2,000-2,499 grams	179,511	2,224	1,170	1,054	12.4	6.5	5.9	-7.5
2,500 grams or more	3,587,099	9,615	3,486	6,129	2.7	1.0	1.7	-3.6
2,500-2,999 grams	642,394	3,158	1,261	1,897	4.9	2.0	3.0	-3.9
3,000-3,499 grams	1,435,825	3,685	1,274	2,411	2.6	0.9	1.7	-3.7
3,500-3,999 grams	1,117,955	2,079	670	1,409	1.9	0.6	1.3	*
4,000-4,499 grams	331,020	564	220	344	1.7	0.7	1.0	*
4,500-4,999 grams	53,963	105	45	60	1.9	0.8	1.1	-5.0
5,000 grams or more	5,942	24	16	8	4.0	*	*	-35.5
Not stated	1,726	341	324	17	...	...	...	...
White	3,072,640	18,578	12,250	6,328	6.0	4.0	2.1	-1.6
Less than 2,500 grams	198,981	11,378	9,350	2,028	57.2	47.0	10.2	-0.5
Less than 1,500 grams	34,962	8,584	7,659	924	245.5	219.1	26.4	-1.4
Less than 500 grams	3,315	2,962	2,909	53	893.5	877.5	16.0	0.2
500-749 grams	6,265	3,228	2,901	328	515.2	463.0	52.4	-2.4
750-999 grams	7,048	1,221	967	254	173.2	137.2	36.0	-2.1
1,000-1,249 grams	8,355	647	494	154	77.4	59.1	18.4	-2.4
1,250-1,499 grams	9,979	526	389	136	52.7	39.0	13.6	-5.2
1,500-1,999 grams	39,047	1,239	813	426	31.7	20.8	10.9	4.3
2,000-2,499 grams	124,972	1,556	878	678	12.5	7.0	5.4	-6.0
2,500 grams or more	2,872,582	7,020	2,731	4,289	2.4	1.0	1.5	-4.0
2,500-2,999 grams	459,862	2,193	952	1,240	4.8	2.1	2.7	-2.0
3,000-3,499 grams	1,123,860	2,652	1,000	1,652	2.4	0.9	1.5	-4.0
3,500-3,999 grams	944,629	1,619	549	1,070	1.7	0.6	1.1	*
4,000-4,499 grams	291,289	455	182	273	1.6	0.6	0.9	6.7
4,500-4,999 grams	47,812	87	39	49	1.8	0.8	1.0	*
5,000 grams or more	5,130	13	9	4	*	*	*	*
Not stated	1,077	180	169	11	...	...	...	...
Black	599,913	8,210	5,536	2,673	13.7	9.2	4.5	-2.8
Less than 2,500 grams	78,207	5,930	4,796	1,134	75.8	61.3	14.5	-3.7
Less than 1,500 grams	18,432	4,978	4,351	627	270.1	236.1	34.0	-3.7
Less than 500 grams	2,484	2,174	2,139	34	875.2	861.1	13.7	-1.2
500-749 grams	3,990	1,823	1,581	242	456.9	396.2	60.7	-5.9
750-999 grams	3,831	538	371	167	140.4	96.8	43.6	-3.6
1,000-1,249 grams	3,831	277	163	114	72.3	42.5	29.8	1.0
1,250-1,499 grams	4,296	167	97	70	38.9	22.6	16.3	-16.3
1,500-1,999 grams	15,163	404	212	192	26.6	14.0	12.7	-9.5
2,000-2,499 grams	44,612	548	233	315	12.3	5.2	7.1	-10.9
2,500 grams or more	521,347	2,130	596	1,534	4.1	1.1	2.9	-2.4
2,500-2,999 grams	139,692	816	254	562	5.8	1.8	4.0	-3.3
3,000-3,499 grams	227,482	850	213	637	3.7	0.9	2.8	*
3,500-3,999 grams	122,133	356	88	268	2.9	0.7	2.2	-14.7
4,000-4,499 grams	27,343	83	28	55	3.0	1.0	2.0	-6.3
4,500-4,999 grams	4,167	14	5	9	*	*	*	*
5,000 grams or more	530	10	6	4	*	*	*	*
Not stated	359	150	144	5	...	...	...	...

* Figure does not meet standard of reliability or precision.

† Category not applicable.

‡ 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 of mother: United States, 1997 linked file

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

Cause of death (Ninth Revision International Classification of Diseases, 1975)	All races			White			Black			American Indian			Asian and Pacific Islander		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes .....	...	27,968	720.7	...	18,578	604.6	...	8,210	1368.5	...	335	868.5	...	845	497.7
Congenital anomalies (740-759)	1	6,187	159.4	1	4,793	156.0	2	1,100	183.4	1	64	165.9	1	230	135.5
Disorders related to short gestation and unspecified low birthweight (765)	2	3,917	100.9	2	2,099	68.3	1	1,704	284.0	3	26	67.4	2	88	51.8
Sudden infant death syndrome (798.0)	3	2,996	77.2	3	1,991	64.8	3	859	143.2	2	60	155.6	3	87	51.2
Respiratory distress syndrome (769)	4	1,303	33.6	4	797	25.9	4	453	75.5	10	8	*	4	44	25.9
Newborn affected by maternal complications of pregnancy (761)	5	1,234	31.8	5	791	25.7	5	407	67.8	4	13	*	7	23	13.5

* Figure does not meet standard of reliability or precision.

... Category not applicable.

NOTE: For American Indians, Newborn affected by complications of placenta, cord and membranes was the 5th leading cause of infant death, however, with only 12 deaths, a reliable infant mortality rate could not be computed. For Asian and Pacific Islanders, Infections specific to the perinatal period was the 5th leading cause of infant death, with 25 deaths and a rate of 14.5.

Table 7. Infant deaths and mortality rates for the five leading causes of infant death by Hispanic origin of mother and for non-Hispanic White mothers: United States, 1997 linked file

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

Cause of death (Ninth Revision International Classification of Diseases, 1975)	Hispanic ¹			Mexican			Puerto Rican			Central and South American			Non-Hispanic White		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes .....	...	4,226	595.4	...	2,908	582.7	...	436	786.3	...	531	545.1	...	14,046	602.0
Congenital anomalies (740-759)	1	1,194	168.2	1	884	177.1	1	79	142.5	1	147	150.9	1	3,536	151.5
Disorders related to short gestation and unspecified low birthweight (765)	2	504	71.0	2	321	64.3	2	60	108.2	2	82	84.2	3	1,528	65.5
Sudden infant death syndrome (798.0)	3	330	46.5	3	234	46.9	3	33	59.5	3	39	40.0	2	1,649	70.7
Respiratory distress syndrome (769)	4	187	26.3	4	127	25.4	5	19	*	4	29	29.8	5	596	25.5
Newborn affected by maternal complications of pregnancy (761)	5	148	20.9	5	91	18.2	4	20	36.1	5	25	25.7	4	624	26.7

* Figure does not meet standard of reliability or precision.

... Category not applicable.

¹ Includes Cuban and other and unknown Hispanic.

Technical notes

Age of mother

Age of mother is computed in most cases from the mother's and infant's dates of birth as reported on the birth certificate. The mother's age is directly reported by six States (Hawaii, Kentucky, Nevada, North Dakota, Virginia, and Wyoming). From 1964–96, mother's age was edited for ages 10–49 years. Births reported to occur to mothers younger than age 10 or older than age 49 years had age imputed according to the age of mother from the previous record with the same race and total birth order (total of live births and fetal deaths). Beginning in 1997, age of mother is edited for ages 10–54 years. A review and verification of unedited birth data for 1996 showed that the vast majority of births reported as occurring to women aged 50 years and over were to women aged 50–54 years. The number of births and infant deaths to women aged 50–54 years are too small for computing age-specific infant mortality rates. These events have been included with births to women aged 40–49 years for computing age-specific infant mortality rates.

In 1997, age of mother was not reported on 0.02 percent of birth records; for these records age of mother was imputed according to the last record with the same race and total birth order.

Marital status

National estimates of births to unmarried women are based on two methods of determining marital status. For 1994 through 1996, birth certificates in 45 States and the District of Columbia included a question about the mother's marital status. Beginning in 1997, California added a direct question to their birth certificate; thus in 1997, all but four States (Connecticut, Michigan, Nevada, and New York) included a direct question on their birth certificates. Nevada asks for the mother's marital status through the electronic birth registration process but this item is not included on certified or paper copies of the birth certificate.

In the three States that used inferential procedures to compile birth statistics by marital status in 1997, 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 *Births: Final Data for 1997* for additional details (3).

The mother's marital status was not reported in 1997 on 0.05 percent of the birth records in the 46 States and the District of Columbia where this information is obtained by a direct question. Marital status was imputed as "married" for these records.

Period of gestation and birthweight

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

problems for this item persist and many occur more frequently among some subpopulations and among births with shorter gestations (42–43).

The U.S. Standard Certificate of Live Birth contains an item, "clinical estimate of gestation," which is being compared with length of gestation computed from the date the LMP began when the latter appears to be inconsistent with birthweight. This is done for normal weight births of apparently short gestations and very low birthweight births reported to be full term. The clinical estimate was also used if the LMP date was not reported. The period of gestation for 4.96 percent of the births in 1997 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 300 births or less than 0.01 percent of all birth records in 1997 (3).

Not stated birthweight was imputed for 2,302 records or 0.06 percent of the birth records in 1997. 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 (1,726 records in 1997) 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 (3.28 percent before imputation) than for live births (0.10 percent before imputation). The imputation reduced the percent of not stated records to 1.21 percent for infant deaths, and 0.04 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)* (44). 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* (45). 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 [tables 6 and 7](#) is based on the List of 61 Selected Causes of Infant Death and HIV Infection (2). 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 tables of frequencies, 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 (46). As a result, numbers of births, deaths, and infant mortality rates are subject to random variation. The probable range of values may be estimated from the actual figures according to certain statistical assumptions.

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

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

where D is the number of deaths and

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

where B is the number of births.

For example, let us say that for group A the number of infant deaths was 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) =

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

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

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			

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, the *Monthly Vital Statistics Reports* and the *National Vital Statistics Report* through NCHS. Additional unpublished tabulations are available from NCHS or through our Internet site at www.cdc.gov/nchswww.

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