

Infant Mortality Statistics From the 2013 Period Linked Birth/Infant Death Data Set

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Abstract

Objectives—This report presents 2013 period infant mortality statistics from the linked birth/infant death data set (linked file) by maternal and infant characteristics. The linked file differs from the mortality file, which is based entirely on death certificate data.

Methods—Descriptive tabulations of data are presented and interpreted.

Results—The U.S. infant mortality rate was 5.96 infant deaths per 1,000 live births in 2013, similar to the rate of 5.98 in 2012. The number of infant deaths was 23,446 in 2013, a decline of 208 infant deaths from 2012. From 2012 to 2013, infant mortality rates were stable for most race and Hispanic origin groups; declines were reported for two Hispanic subgroups: Cuban and Puerto Rican. Since 2005, the most recent high, the U.S. infant mortality rate

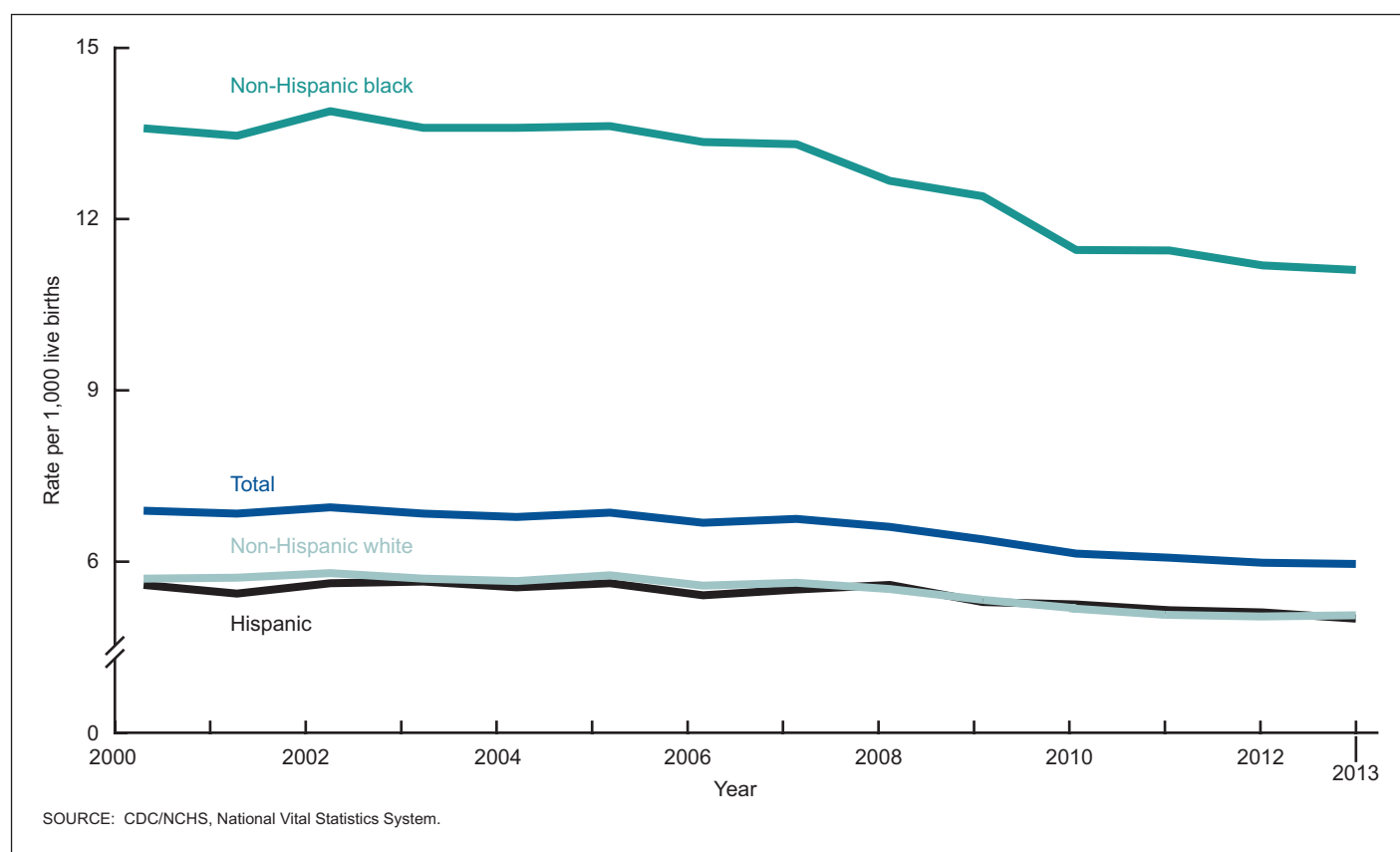


Figure 1. Infant mortality rates, by race and Hispanic origin of mother: United States, 2000–2013

has declined 13% (from 6.86), with declines in both neonatal and postneonatal mortality overall and for most groups. In 2013, infants born at 37–38 weeks of gestation (early term) had mortality rates that were 63% higher than for full-term (39–40 week) infants. For multiple births, the infant mortality rate was 25.84, 5 times the rate of 5.25 for singleton births. In 2013, 36% of infant deaths were due to preterm-related causes of death, and an additional 15% were due to causes grouped into the sudden unexpected infant death category.

Keywords: infant health, birthweight, gestational age, maternal characteristics

Introduction

This report presents infant mortality data from the 2013 period linked file. In the linked file, information from the death certificate is linked to information from the birth certificate for each infant under age 1 year who died in the 50 states, the District of Columbia (D.C.), Puerto Rico, or Guam during 2013 (1). For 2013, linked birth-infant death data are not available for American Samoa, the Commonwealth of the Northern Marianas, and the Virgin Islands. 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 (2,3). This report presents infant mortality data by race and Hispanic origin of the mother, birthweight, period of gestation, sex of infant, plurality, maternal age, live-birth order, mother's marital status, mother's place of birth, age at death, and underlying cause of death (Tables 1–7, A–D, and Figures 1–5).

Data based exclusively on the vital statistics mortality file provide further information on trends in infant mortality and on causes of infant death (4). The linked file is used to analyze and calculate infant mortality rates by race and ethnicity that are more accurately measured from the birth certificate. Some rates calculated from the mortality file differ from those published using the linked file. A more detailed discussion of these differences is presented in the [Technical Notes](#).

Methods

Data shown in this report are based on birth and infant death certificates registered in all states, D.C., Puerto Rico, and Guam. As part of the Vital Statistics Cooperative Program (VSCP), each state provides matching birth and death certificate numbers for each infant under age 1 year who died in the state during 2013 to the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). 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 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 2013, 99.0% of all infant death records were successfully linked to

their corresponding birth records. These records were weighted to adjust for the 1.0% of infant death records that were not linked to their corresponding birth certificates (see [Technical Notes](#)).

Information on births by age, race, or marital status of mother is imputed if it is not reported on the birth certificate. These items were not reported for less than 2% of U.S. births in 2013 (2,3).

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

Cause-of-death statistics in this publication are classified in accordance with the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* (ICD-10) (5) (see [Technical Notes](#)).

Data by maternal and infant characteristics

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

Race and Hispanic origin data—Infant mortality rates are presented here by race and detailed Hispanic origin of mother. The linked file is particularly useful for computing accurate infant mortality rates for this purpose because the race and Hispanic origin of the mother from the birth certificate are used in both the numerator and denominator of the infant mortality rate. In contrast, for the vital statistics mortality file, race information for the denominator is the race of the mother as reported on the birth certificate, whereas the race information for the numerator is the race of the decedent as reported on the death certificate (2–4). Race information from the birth certificate reported by the mother is considered to be more reliable than that from the death certificate where the race and ethnicity of the deceased infant are reported by the funeral director based on information provided by an informant or by observation. These different reporting methods can lead to differences in race- and ethnicity-specific infant mortality rates between the two data files (4,6).

The 2003 revision of the U.S. Standard Certificate of Live Birth allows the reporting of more than one race (multiple races) for each parent (2,3,7,8). Forty-four states and D.C. reported multiple race data on their birth certificates for either part or all of 2013, and 33 states reported in 2012. To provide uniformity and comparability of the data, multiple race is imputed to a single race (see [Technical Notes](#)).

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

Results and Discussion

Trends in infant mortality

The overall 2013 infant mortality rate from the linked file was 5.96 infant deaths per 1,000 live births, nearly the same as the rate of 5.98 in 2012 ([Tables A and B](#)). The infant mortality rate plateaued from 2000 to 2005, fluctuated for 2 years, and then declined from 2007 to 2012 ([Table B and Figure 1](#)); the 2013 infant mortality rate is 13% lower than the 2005 high (6.86).

From 2012 to 2013, the infant mortality rates were stable for most groups but declined significantly for two Hispanic subgroups: 14% for Puerto Rican women (6.86 to 5.93) and 40% for Cuban women (5.00 to 3.02) (in 2013 there were 57 infant deaths to Cuban women) ([Table B](#)). Several groups had significant declines from 2005 (the most recent U.S. high) to 2013: Puerto Rican (29%), non-Hispanic black (18%), API (17%), non-Hispanic white (12%), and Mexican women (11%) ([Table B and Figure 2](#)).

Infant mortality by race and Hispanic origin of mother

Infant mortality rates vary considerably by race and Hispanic origin of mother. In 2013, the highest rate, 11.11 per 1,000 live births, was for infants of non-Hispanic black mothers. Infants of Cuban mothers had the lowest rate at 3.02. Rates were higher for infants of non-Hispanic black, AIAN (7.61), and Puerto Rican (5.93)

mothers compared with non-Hispanic white mothers (5.06). Rates were below the non-Hispanic white rate for infants of API (4.07), Central and South American (4.30), and Cuban (3.02) mothers ([Tables A and B](#)). These differences are explained in part by the differences in cause-specific infant mortality rates among race and Hispanic origin groups (9,10).

The disparity in the infant mortality rate between non-Hispanic black and non-Hispanic white women has more than doubled over the past decade. From 2005 (the most recent U.S. high) to 2013, the infant mortality rate declined for both groups. The ratio in the infant mortality rate was 2.4 from 2000 to 2007, 2.3 in 2008 and 2009, and has fluctuated between 2.2 and 2.3 from 2010 to 2013 ([Table B](#)).

Age at death

Neither neonatal (under 28 days) nor postneonatal (28 days to under age 1 year) mortality rates changed significantly for the United States from 2012 to 2013 ([Table B](#)). The neonatal mortality rate was 4.04 in 2013 and 4.02 in 2012 for deaths under 28 days of age per 1,000 births. The postneonatal mortality rate was 1.92 in 2013 and 1.96 in 2012 for deaths from 28 days to under age 1 year per 1,000 live births.

The only decline in neonatal mortality from 2012 to 2013 was for births to Cuban women, down 43%, from 3.97 to 2.28 per 1,000. While all groups had lower postneonatal mortality rates from 2012 to 2013, none of the declines were significant ([Table B](#)).

Non-Hispanic black women had the highest neonatal mortality rate in 2013 at 7.46, 2.2 times that for non-Hispanic white women (3.34). Neonatal mortality rates were also higher for Puerto Rican (4.23) and AIAN (4.11) women than for non-Hispanic white women. Neonatal mortality rates were lower for API (2.99) and Cuban (2.28) women compared with non-Hispanic white women ([Tables A and B](#)).

Infants of non-Hispanic black (3.65) and AIAN (3.50) women had the highest postneonatal mortality rates of any group—more than twice the rate for non-Hispanic white women (1.71) ([Tables A and B](#)). In contrast, postneonatal mortality rates for Mexican (1.40), Central and South American (1.18), and API (1.08) women were lower than for non-Hispanic white women ([Table A](#)).

Table A. Infant, neonatal, and postneonatal deaths and mortality rates, by race and Hispanic origin of mother: United States, 2013 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
Total ¹	3,932,181	23,446	15,893	7,553	5.96	4.04	1.92
Non-Hispanic white	2,129,196	10,766	7,119	3,647	5.06	3.34	1.71
Non-Hispanic black	583,834	6,488	4,355	2,133	11.11	7.46	3.65
American Indian or Alaska Native	45,991	350	189	161	7.61	4.11	3.50
Asian or Pacific Islander	265,673	1,082	794	288	4.07	2.99	1.08
Hispanic	901,033	4,507	3,200	1,308	5.00	3.55	1.45
Mexican	545,202	2,672	1,911	761	4.90	3.51	1.40
Puerto Rican	68,302	405	289	115	5.93	4.23	1.68
Cuban	18,854	57	43	14	3.02	2.28	*
Central and South American	131,305	565	410	155	4.30	3.12	1.18

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

¹Includes other and unknown Hispanic origin and Hispanic origin not stated, not shown separately.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is under 28 days and postneonatal is 28 days to under age 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Infant mortality by state and race and ethnicity

Total infant mortality rates by state for 2005 (the most recent U.S. high) and 2013 and the number of infant deaths for 2013 are presented in [Table C](#). Between 2005 and 2013, rates declined in 24 states, D.C., and Puerto Rico ([Figure 3](#)). These declines ranged from 51% for D.C. (13.67 to 6.68) to 9% for Pennsylvania (7.29 to 6.65). Six states and D.C. had declines greater than 20%. Rates for other states did not change significantly over this time period.

To examine variations across states in more detail and obtain statistically reliable state-specific rates by race and Hispanic origin, 3 years of data were combined ([Table 2](#)). Across the United States, infant mortality rates are generally higher in the South and Midwest and lower elsewhere. For 2011–2013, infant mortality rates ranged from a high of 9.25 for Mississippi to a low of 4.21 for Massachusetts.

Infant mortality rates differ by state among race and Hispanic origin groups. In 2011–2013, rates for infants of non-Hispanic black mothers could be reliably computed (20 or more infant deaths) in

39 states and D.C.; among these states, mortality rates ranged from a high of 14.18 in Kansas to a low of 6.90 in Massachusetts. For infants of non-Hispanic white mothers, West Virginia had the highest infant mortality rate (6.99) and New Jersey had the lowest rate (3.20). Among the 41 states and D.C. where infant mortality rates could be reliably computed for Hispanic mothers, Rhode Island had the highest rate (7.22) and Iowa had the lowest (2.65).

For infants of AIAN mothers, mortality rates for 2011–2013 could be reliably computed for only 15 states, and for infants of API mothers, rates could only be computed for 28 states. For infants of AIAN mothers, mortality rates ranged from 13.23 in North Dakota to 5.87 in New Mexico. Infant mortality rates for infants of API mothers ranged from 7.59 in Oklahoma to 3.32 in Massachusetts.

The data shown in [Table 2](#) and described above show the wide disparities that exist in infant mortality rates across states. The U.S. infant mortality rate ratio for non-Hispanic black relative to non-Hispanic white populations for the 3 years 2011–2013 was 2.2.

Table B. Infant, neonatal, and postneonatal mortality rates, by race and Hispanic origin of mother: United States, 2000, 2005–2013
linked files

Race and Hispanic origin of mother	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percent change 2005 to 2013	Percent change 2012 to 2013
Infant mortality rate												
All races	6.89	6.86	6.68	6.75	6.61	6.39	6.14	6.07	5.98	5.96	†–13.1	–0.3
Non-Hispanic white	5.70	5.76	5.58	5.63	5.52	5.33	5.18	5.07	5.04	5.06	†–12.2	0.4
Non-Hispanic black	13.59	13.63	13.35	13.31	12.67	12.40	11.46	11.45	11.19	11.11	†–18.5	–0.7
American Indian or Alaska Native	8.30	8.06	8.28	9.22	8.42	8.47	8.28	8.21	8.40	7.61	–5.6	–9.4
Asian or Pacific Islander	4.87	4.89	4.55	4.78	4.51	4.40	4.27	4.36	4.06	4.07	†–16.8	0.2
Hispanic	5.59	5.62	5.41	5.51	5.59	5.29	5.25	5.15	5.11	5.00	†–11.0	–2.2
Mexican	5.43	5.53	5.34	5.42	5.58	5.12	5.12	4.99	5.02	4.90	†–11.4	–2.4
Puerto Rican	8.21	8.30	8.01	7.71	7.29	7.18	7.10	7.85	6.86	5.93	†–28.6	†–13.6
Cuban	4.54	4.42	5.08	5.18	4.90	5.77	3.79	4.32	5.00	3.02	–31.7	†–39.6
Central and South American	4.64	4.68	4.52	4.57	4.76	4.47	4.43	4.35	4.14	4.30	–8.1	3.9
Neonatal mortality rate												
All races	4.62	4.54	4.46	4.42	4.29	4.18	4.05	4.06	4.02	4.04	†–11.0	0.5
Non-Hispanic white	3.78	3.71	3.64	3.61	3.50	3.40	3.35	3.31	3.31	3.34	†–10.0	0.9
Non-Hispanic black	9.19	9.13	8.95	8.74	8.28	8.13	7.45	7.62	7.46	7.46	†–18.3	0.0
American Indian or Alaska Native	4.39	4.04	4.30	4.55	4.18	4.38	4.28	4.70	4.86	4.11	1.7	–15.4
Asian or Pacific Islander	3.43	3.37	3.18	3.38	3.08	3.11	3.01	3.10	2.88	2.99	†–11.3	3.8
Hispanic	3.77	3.86	3.74	3.72	3.76	3.56	3.59	3.63	3.58	3.55	†–8.0	–0.8
Mexican	3.61	3.78	3.73	3.68	3.78	3.44	3.53	3.51	3.56	3.51	†–7.1	–1.4
Puerto Rican	5.80	5.95	5.44	5.14	4.98	4.76	4.82	5.28	4.85	4.23	†–28.9	–12.8
Cuban	3.20	3.05	3.60	3.65	3.23	3.61	2.84	3.44	3.97	2.28	–25.2	†–42.6
Central and South American	3.26	3.23	3.12	3.14	3.19	3.17	3.00	3.23	2.85	3.12	–3.4	9.5
Postneonatal mortality rate												
All races	2.27	2.32	2.22	2.33	2.32	2.21	2.10	2.01	1.96	1.92	†–17.2	–2.0
Non-Hispanic white	1.92	2.05	1.94	2.02	2.02	1.93	1.82	1.76	1.73	1.71	†–16.6	–1.2
Non-Hispanic black	4.40	4.50	4.40	4.57	4.39	4.27	4.01	3.83	3.73	3.65	†–18.9	–2.1
American Indian or Alaska Native	3.94	4.02	3.98	4.67	4.24	4.09	4.00	3.51	3.51	3.50	–12.9	–0.3
Asian or Pacific Islander	1.44	1.51	1.37	1.40	1.43	1.29	1.25	1.26	1.17	1.08	†–28.5	–7.7
Hispanic	1.82	1.76	1.67	1.79	1.83	1.73	1.66	1.52	1.53	1.45	†–17.6	–5.2
Mexican	1.82	1.75	1.61	1.75	1.80	1.67	1.58	1.48	1.46	1.40	†–20.0	–4.1
Puerto Rican	2.41	2.37	2.57	2.57	2.30	2.42	2.28	2.55	1.99	1.68	†–29.1	–15.6
Cuban	*	1.37	1.42	1.53	1.62	2.10	*	*	*	*	*	*
Central and South American	1.38	1.46	1.41	1.43	1.57	1.30	1.42	1.12	1.29	1.18	†–19.2	–8.5

† Significant at $p < 0.05$.

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

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3. Neonatal is under 28 days and postneonatal is 28 days to under age 1 year.

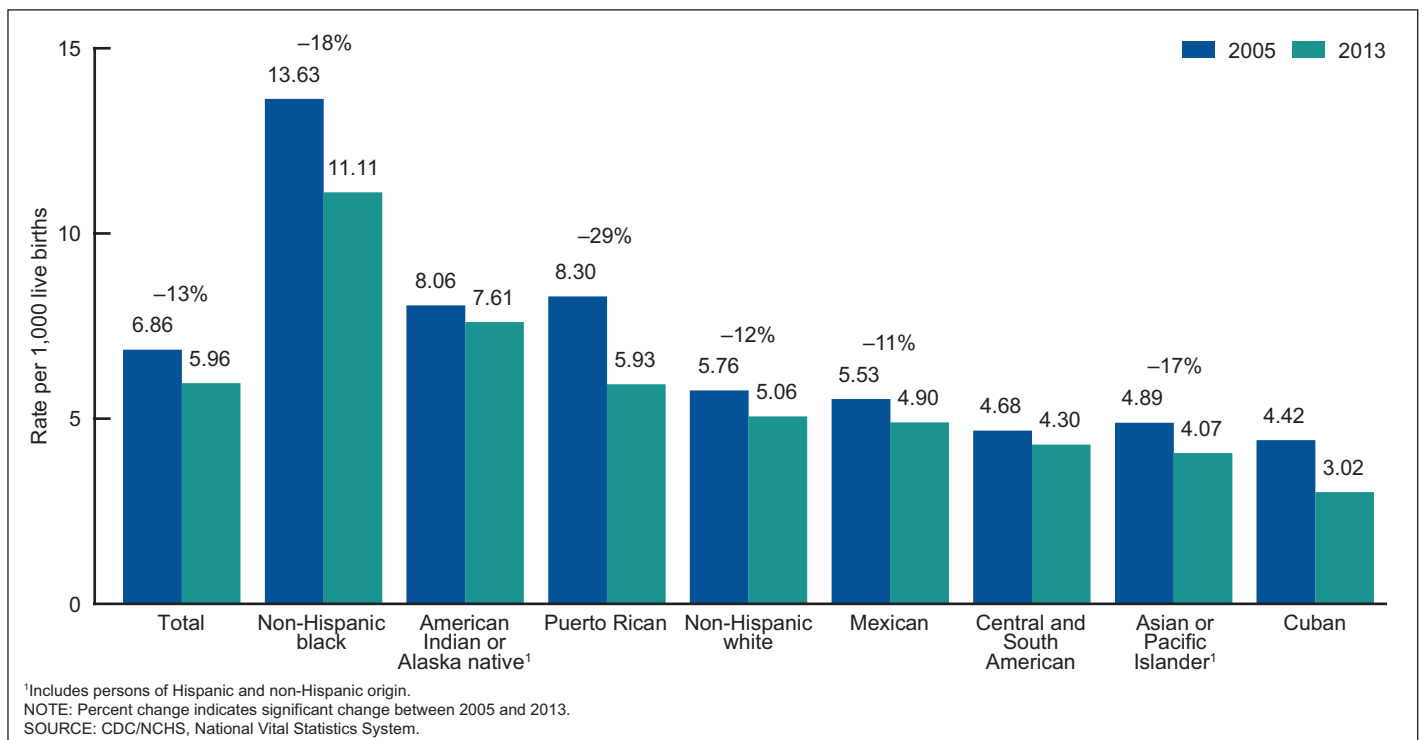


Figure 2. Infant mortality rates, by race and Hispanic origin of mother: United States, 2005 and 2013

Large ratios can occur for two reasons: the infant mortality rate for non-Hispanic black women can be comparatively high, or the rate for non-Hispanic white women can be relatively low. The reverse can be true when the rate ratio is low. State variation is a function of state variation in risk factors and variation in risk factor-specific rates. Several states that lack a calculable infant mortality rate for infants born to non-Hispanic black women due to fewer than 20 infant deaths do not have a rate ratio shown here (11 states and D.C.).

Areas with the highest rate ratios of 2.7 or greater for 2011–2013 were New Jersey (3.2), Connecticut (2.8), Wisconsin (2.8), Illinois (2.7), Maryland (2.7), and Utah (2.7). Ten areas had ratios less than 2.0 and greater than 1.0, and none had a ratio less than 1.0. Kentucky (1.5) had the lowest rate ratio (Table 2).

Sex of infant

In the United States in 2013, the overall infant mortality rate for male infants was 6.51 per 1,000 births, 21% higher than the rate for female infants (5.39). In most countries, infant mortality rates are higher for male infants (11). Infant mortality rates were higher for male infants in each race and Hispanic origin group, although the difference was not significant for infants of AIAN, Cuban, and Puerto Rican mothers (Table 1).

Multiple births

For multiple births, the infant mortality rate in 2013 was 25.84 per 1,000 live births, almost 5 times the rate of 5.25 for singleton births (Table 1). These rates were not significantly different from those in 2012 (25.24 and 5.30, respectively). Infant mortality rates

for multiple births were higher than the rates for single births for all race and Hispanic origin groups for which rates could be reliably computed.

The risk of infant death increases with the increasing number of infants in the pregnancy. In 2013, the infant mortality rate for twins (24.37) was more than 4 times the rate for single births (5.25). The infant mortality rate for triplets (61.08) was nearly 12 times, and the rate for quadruplets (137.04) was 26 times the rate for single births. An infant mortality rate could not be computed for quintuplet and higher-order births due to the small number of events in that category (data not shown).

Multiple pregnancy can lead to an increase in maternal risks and complications associated with pregnancy (2,12–14). For example, multiple births are much more likely to be born preterm and low birthweight than singleton births (2,12–14). The higher risk profile of multiple births has a substantial impact on overall infant mortality (13). For example, in 2013, multiple births accounted for 3% of all live births, but 15% of all infant deaths in the United States (Table 1).

Period of gestation

The gestational age of an infant is perhaps the most important predictor of his or her survival and subsequent health. Infants born too small or too soon have a much greater risk of death and both short-term and long-term disability compared with those born at full term (39–40 weeks of gestation) (15–21), and the percentage of preterm births has been linked to variations in infant mortality rates among countries (22). Because of their much greater risk of death, preterm infants have a large impact on the U.S. infant mortality rate. In 2013, two-thirds (67.0%) of all infant deaths occurred to the 11.4%

Table C. Infant mortality rates, number of infant deaths, and percent change, by state: 2005 and 2013 linked files

[By place of residence]

State	Infant mortality rate per 1,000 live births		Percent change 2005 to 2013	Number of infant deaths in 2013
	2005	2013		
Total ¹	6.86	5.96	†-13.1	23,446
Alabama	9.53	8.60	-9.7	500
Alaska	5.93	5.77	-2.7	66
Arizona	6.85	5.25	†-23.4	449
Arkansas	7.83	7.85	0.3	297
California	5.32	4.76	†-10.5	2,354
Colorado	6.44	5.12	†-20.5	333
Connecticut	5.85	4.79	†-18.1	173
Delaware	9.02	6.37	-29.4	69
District of Columbia	13.67	6.68	†-51.2	62
Florida	7.24	6.14	†-15.2	1,322
Georgia	8.07	6.98	†-13.5	899
Hawaii	6.58	6.37	-3.2	121
Idaho	5.98	5.63	-5.9	126
Illinois	7.38	5.97	†-19.2	937
Indiana	8.04	7.24	-9.9	602
Iowa	5.44	4.25	†-21.9	166
Kansas	7.37	6.49	-11.9	252
Kentucky	6.73	6.39	-5.1	356
Louisiana	9.85	8.69	†-11.7	549
Maine	6.87	7.12	3.6	91
Maryland	7.30	6.63	-9.1	477
Massachusetts	5.13	4.18	†-18.5	300
Michigan	7.89	7.05	†-10.6	800
Minnesota	5.09	5.09	0.0	352
Mississippi	11.46	9.60	†-16.3	371
Missouri	7.52	6.52	†-13.3	491
Montana	7.25	5.57	-23.2	69
Nebraska	5.66	5.21	-8.0	136
Nevada	5.66	5.31	-6.2	186
New Hampshire	5.27	5.57	5.7	69
New Jersey	5.17	4.50	†-12.9	462
New Mexico	6.17	5.27	-14.6	139
New York	5.82	4.93	†-15.2	1,169
North Carolina	8.81	6.99	†-20.7	832
North Dakota	5.96	6.04	1.4	64
Ohio	8.17	7.33	†-10.3	1,019
Oklahoma	7.95	6.73	†-15.4	359
Oregon	5.99	4.94	†-17.5	223
Pennsylvania	7.29	6.65	†-8.8	937
Rhode Island	6.46	6.48	0.3	70
South Carolina	9.46	6.87	†-27.4	390
South Dakota	6.98	6.45	-7.6	79
Tennessee	8.77	6.80	†-22.5	544
Texas	6.55	5.82	†-11.1	2,255
Utah	4.52	5.18	14.6	264
Vermont	6.49	4.35	-33.0	26
Virginia	7.47	6.18	†-17.3	631
Washington	5.07	4.53	-10.6	392
West Virginia	8.16	7.64	-6.4	159
Wisconsin	6.54	6.26	-4.2	417
Wyoming	6.63	4.84	-27.0	37
Puerto Rico	9.22	7.10	†-23.0	259
Guam	10.59	9.07	-14.4	30

† Significant at $p < 0.05$.¹Excludes data for Puerto Rico and Guam.

of infants who were born preterm (Table D). Infant mortality rates are highest for very preterm (under 32 weeks) infants, and the risk decreases sharply with increasing gestational age (Table 1) (16,20). In 2013, the infant mortality rate for very preterm infants (163.71) was 88 times the rate for full-term infants (1.85). The infant mortality rate for infants born at 32–33 weeks of gestation was 16.02, nearly 9 times the rate for full-term infants.

Although mortality falls with increasing gestational age, even infants born only a few weeks early have a substantially increased risk of death and disability when compared with full-term infants (23–26). In 2013, the infant mortality rate for late preterm infants (34–36 weeks) was 7.23, 4 times the rate for full-term infants. The infant mortality rate for early term (37–38 weeks) infants was 3.01, 63% higher than for full-term infants. There were no significant changes in gestational age-specific infant mortality rates during 2012–2013.

There were large differences in the percentage of preterm births by race and ethnicity, and these differences have an impact on infant mortality rates (9,27). In 2013, the percentage of preterm births ranged from 10.2% of births for non-Hispanic white and API women to 16.3% of births for non-Hispanic black women (Table 3).

Gestational age-specific infant mortality rates also varied by race and ethnicity (Table 1). Compared with non-Hispanic white women, infant mortality rates were significantly higher for non-Hispanic black women for all gestational age categories except for 32–33 weeks of gestation. For AIAN women, infant mortality rates were higher at 39–40 and 37–41 weeks of gestation.

The percentage of preterm births increased by 36%, from 9.4% in 1984 to a high of 12.8% in 2006 (2). However, since 2006, the trend has reversed, and the percentage of preterm births declined to 11.4% in 2013, a decline of 11% (Table D). Declines were most rapid for late preterm (-13%) and early term (-14%) births, followed by early preterm (-7%) births (2). The percentage of births born at full term (39–40 weeks) increased by 13% during this period (Figure 4). Similar to the changes for births, the percentage of infant deaths that were preterm declined from 68.6% in 2005 to 67.0% in 2013, while the percentage of full-term infant deaths increased from 13.3% in 2005 to 15.6% in 2013.

Birthweight

Birthweight is another important predictor of infant health. It is closely associated, but does not exactly correspond with, the period of gestation. Infant mortality rates are highest for the smallest infants and decrease as birthweight increases. In 2013, infant mortality rates were 25 times higher for low birthweight (less than 2,500 grams) infants (50.26 per 1,000) than for infants with birthweights of 2,500 grams or more (2.05) (Table 1). The infant mortality rate for very low birthweight (less than 1,500 grams) infants was 219.56, more than 100 times the rate for infants with birthweights of 2,500 grams or more. Among the smallest infants [less than 500 grams (1 lb. 1 oz. or less) (Table 4), 85% were reported to have died within the first year of life. Reporting of deaths among these very small infants may be incomplete (28). Infant mortality rates were lowest at birthweights of 3,500–4,499 grams.

Table D. Infant mortality rates, and percent distribution of live births and infant deaths, by period of gestation: United States, 2000 and 2005–2013 linked files

Period of gestation (weeks)	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Infant mortality rates by gestational age ¹										
All gestational ages.	6.89	6.86	6.68	6.75	6.61	6.39	6.14	6.07	5.98	5.96
Preterm (under 37)	37.88	36.55	35.15	36.05	35.76	34.94	34.22	34.47	34.30	34.76
Early preterm (under 34)	109.75	109.77	105.31	107.13	105.71	103.48	99.97	100.35	99.15	99.50
Under 32	180.95	183.24	175.94	178.36	175.45	172.15	165.57	166.66	163.14	163.71
32–33	17.37	16.69	16.19	16.12	17.58	16.07	15.83	15.91	16.23	16.02
Late preterm (34–36)	7.96	7.30	7.08	7.42	7.40	7.13	7.15	7.07	7.10	7.23
Term (37–41)	2.59	2.43	2.39	2.43	2.44	2.36	2.25	2.22	2.21	2.19
Early term (37–38)	3.38	3.08	3.02	3.09	3.13	3.09	3.03	2.92	3.05	3.01
Full term (39–40)	2.23	2.06	2.00	2.07	2.08	1.99	1.86	1.88	1.84	1.85
Late term (41)	2.28	2.13	2.31	2.08	2.10	1.93	1.92	2.07	1.87	1.80
Postterm (42 or over)	2.91	2.66	2.80	2.62	2.69	2.86	2.70	2.50	2.63	2.39
Percent distribution of infant deaths ²										
All gestational ages.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Preterm (under 37)	65.6	68.6	68.1	68.2	67.2	67.0	66.7	66.5	66.1	66.3
Early preterm (under 34)	55.8	58.8	58.3	58.2	57.3	57.3	56.8	56.9	56.5	56.7
Under 32	52.0	54.9	54.3	54.4	53.1	53.3	52.9	52.9	52.4	52.7
32–33	3.7	3.9	4.0	3.8	4.2	3.9	3.9	4.0	4.0	4.0
Late preterm (34–36)	9.4	9.8	9.8	10.0	9.9	9.7	9.9	9.6	9.6	9.7
Term (37–41)	31.2	29.1	29.5	29.6	30.4	30.5	30.2	30.3	30.5	30.5
Early term (37–38)	12.3	12.9	13.2	13.2	13.3	13.4	13.2	12.4	12.7	12.5
Full term (39–40)	14.6	13.3	13.2	13.7	14.3	14.5	14.4	15.0	15.1	15.4
Late term (41)	3.6	2.7	2.9	2.6	2.7	2.5	2.6	2.8	2.7	2.6
Postterm (42 or over)	3.2	2.3	2.4	2.2	2.3	2.5	2.4	2.3	2.5	2.2
Percent distribution of live births ²										
All gestational ages.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Preterm (under 37)	11.6	12.7	12.8	12.7	12.3	12.2	12.0	11.7	11.5	11.4
Early preterm (under 34)	3.4	3.6	3.6	3.6	3.6	3.5	3.5	3.4	3.4	3.4
Under 32	1.9	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9
32–33	1.5	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.5
Late preterm (34–36)	8.1	9.1	9.1	9.0	8.8	8.7	8.5	8.3	8.1	8.0
Term (37–41)	81.1	81.4	81.5	81.7	82.0	82.3	82.4	82.6	82.8	83.0
Early term (37–38)	24.5	28.3	28.9	28.6	27.8	27.6	26.8	25.8	24.9	24.8
Full term (39–40)	45.1	44.2	44.0	44.7	45.6	46.5	47.4	48.4	49.3	49.8
Late term (41)	10.8	8.6	8.3	8.3	8.4	8.2	8.2	8.3	8.5	8.5
Postterm (42 or over)	7.3	5.8	5.7	5.6	5.7	5.5	5.5	5.6	5.6	5.5

¹Rates are deaths under age 1 year per 1,000 live births in specified group.²Infant deaths and live births with unknown gestational age are subtracted from the total number of events used as denominators for percentage computations.

Because of their much higher mortality rates, infants born at the lowest birthweights have a substantial impact on overall infant mortality rates. For example, infants born weighing less than 1,000 grams accounted for only 0.7% of births, but nearly one-half (47.2 %) of all infant deaths in the United States in 2013 (Table 4). Conversely, 91.9% of infants born in the United States in 2013 weighed 2,500 grams or more, but these infants accounted for less than one-third (31.7%) of infant deaths. The large variations by race and Hispanic origin in the percentage of births at low birthweight (from 6.6% for Mexican women to 13.1% for non-Hispanic black women) mean that some racial and ethnic groups are disproportionately impacted by the high infant mortality rates for low birthweight infants (Table 3).

From 2005 to 2013, infant mortality rates for the total population declined for the broader birthweight categories of less than 2,500 grams, less than 1,500 grams, and 2,500 grams or more, and for detailed birthweight categories of 500–749, 750–999, 1,000–1,249, 1,250–1,499, 1,500–1,999, 2,000–2,499, 2,500–2,999, and 3,000–3,499 grams (Table 4). Changes for other detailed birthweight categories were not statistically significant.

Maternal age

Infant mortality rates varied by maternal age. In 2013, infants of mothers under 20 (8.52) and mothers aged 40–54 (7.77) were more likely to die in the first year of life compared with other ages (Table 1). Among mothers under 20, infant mortality rates were 12. for under 15, 8.51 for 15–17, and 8.46 for 18–19. Infants of mothers aged 30–34 had the lowest infant mortality rate (4.87). There were no significant changes from 2012 (29) to 2013 by age group.

The relationship between maternal age and infant mortality is complex. Both younger and older mothers are more likely to have adverse birth outcomes, such as early gestational age and low birthweight (2), which may increase the risk of infant mortality. In addition, multiple births (2) and chronic conditions (30) are more common with advanced maternal age.

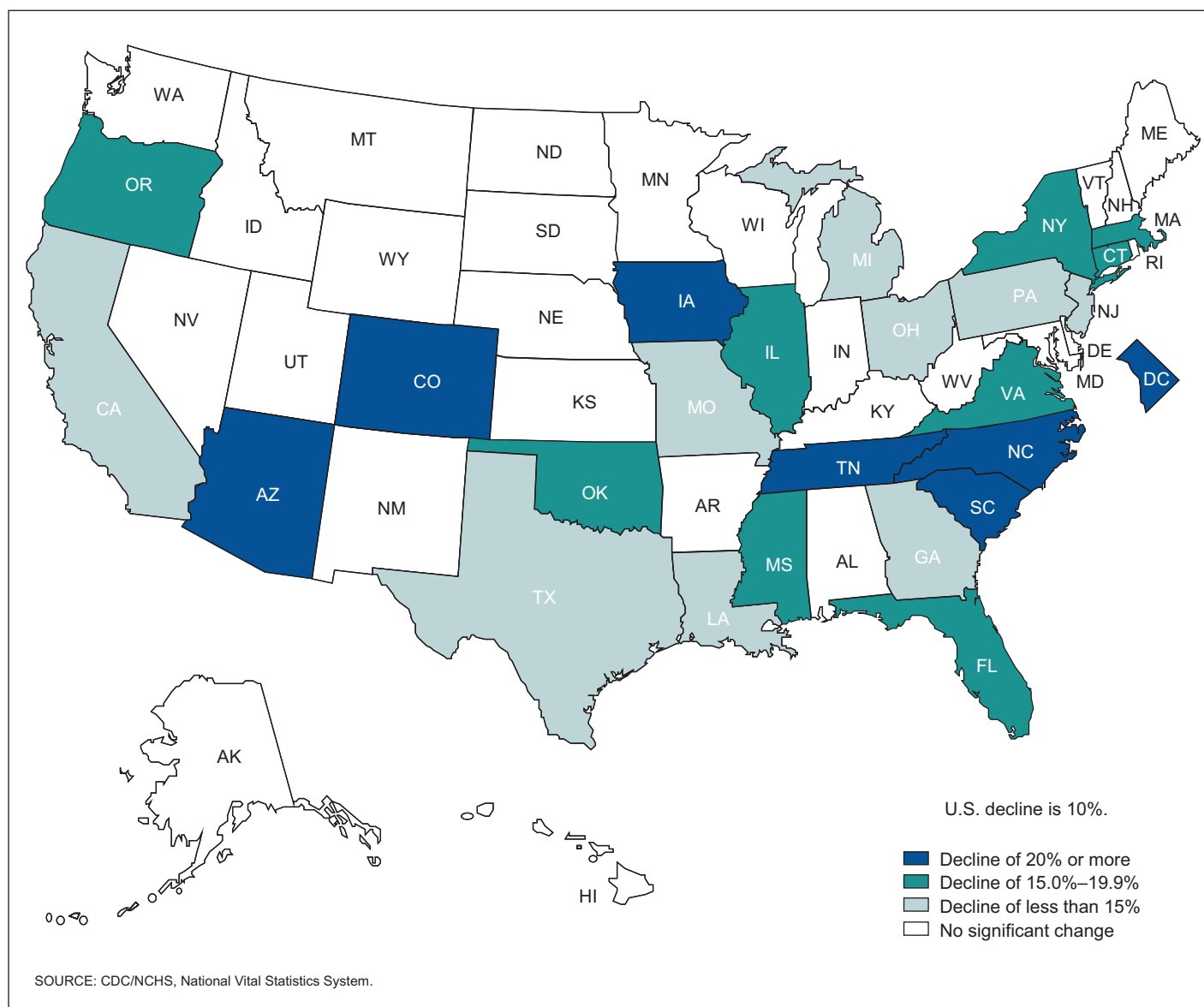


Figure 3. Percent change in infant mortality rate, by state: United States, 2005–2013

Live-birth order

In 2013, as in previous years, infant mortality rates were higher for first births than for second births, and then generally increased as birth order increased ([Table 1](#)). In 2013, the infant mortality rate for first births (6.02) was 17% higher than for second births (5.14). Birth order and maternal age have been examined together and have been shown to affect adverse pregnancy and birth outcomes (31,32).

Marital status

In 2013, the mortality rate for infants of unmarried mothers was 7.96 per 1,000, 73% higher than the rate for infants of married mothers (4.60) ([Table 1](#)). Infants of unmarried mothers had higher rates of mortality compared with married mothers across all race and Hispanic origin groups except Central and South American and Cuban populations.

Marital status may be a marker for the presence or absence of financial, social, and emotional resources (33). Infants of mothers who are not married have been shown to be at higher risk of poor outcomes (34).

Nativity

In 2013, the infant mortality rate for mothers born in the 50 states and D.C. (6.28 per 1,000) was 39% higher than the rate for mothers born elsewhere (4.51) ([Table 1](#)). Among race and Hispanic origin groups, mothers born in the 50 states and D.C. had higher infant mortality rates than mothers born elsewhere for non-Hispanic white (31% higher), non-Hispanic black (66% higher), API (32% higher), and Hispanic populations (19% higher).

A number of hypotheses have been suggested to account for the lower infant mortality rate among infants of mothers born outside of the 50 states and D.C., including possible differences in migration selectivity, social support, and risk behaviors (35,36); however, these

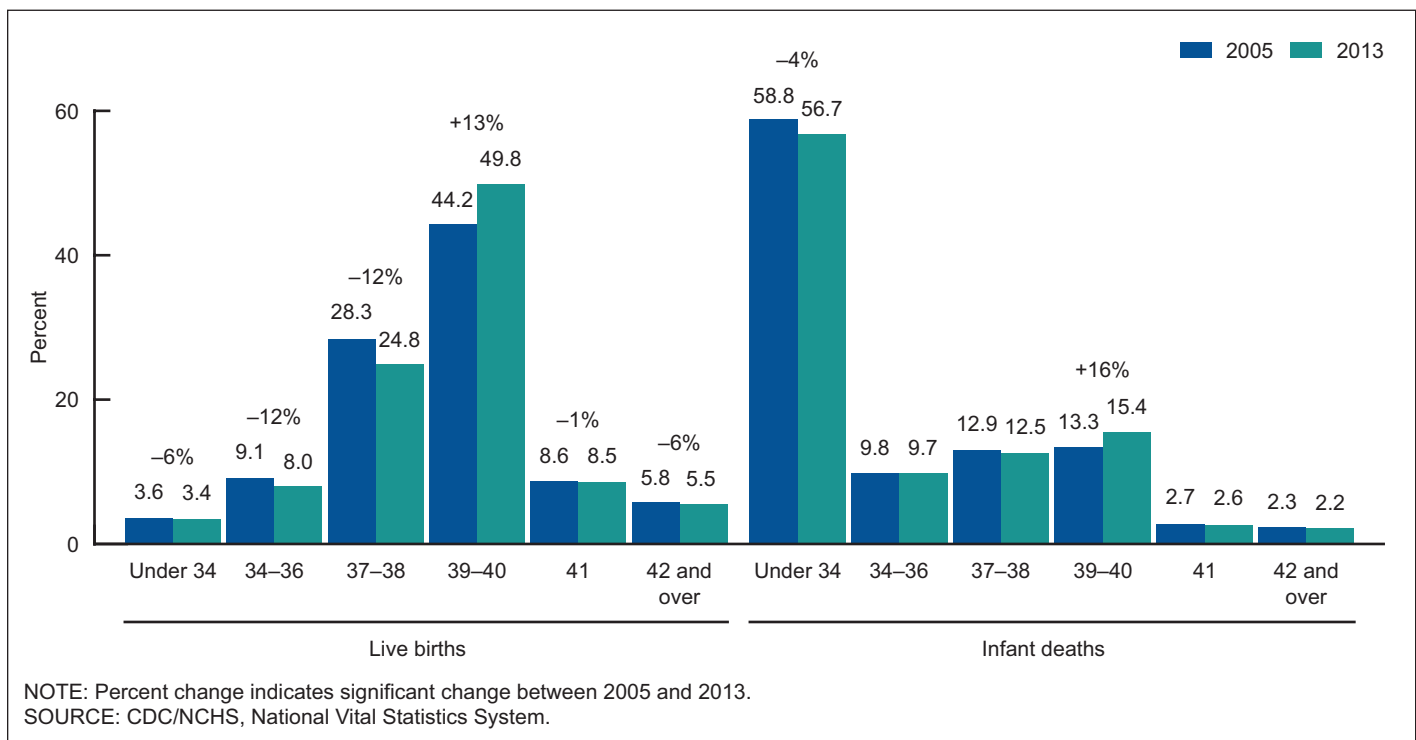


Figure 4. Percent distribution of live births and infant deaths, by gestational age: United States, 2005 and 2013

differences can vary depending on race and ethnicity (37) and other socioeconomic indicators (38).

Leading causes of infant death

Infant mortality rates for the five leading causes of infant death are presented in [Table 5](#) by race and Hispanic origin of mother. The leading cause of infant death in the United States in 2013 was Congenital malformations, deformations and chromosomal abnormalities (congenital malformations), accounting for 20% of all infant deaths. Disorders relating to short gestation and low birthweight, not elsewhere classified (low birthweight) was the second leading cause, accounting for 18% of all infant deaths. Newborn affected by maternal complications of pregnancy (maternal complications) was the third leading cause, with 7% of infant deaths, followed by Sudden infant death syndrome (SIDS) (7%), and Accidents (unintentional injuries) (5%). Together, the five leading causes accounted for 57% of all infant deaths in the United States in 2013. The order of the top five leading causes changed slightly from 2012 to 2013. In 2012, SIDS was the third leading cause, followed by maternal complications, whereas in 2013, maternal complications was third and SIDS was fourth. For 2012–2013, there were no significant changes in infant mortality rates for the leading causes of death. During 2005–2013, the infant mortality rate declined by 10% for congenital malformations, by 6% for low birthweight, and by 26% for SIDS. In contrast, the infant mortality rate for unintentional injuries increased by 11% during 2005–2013.

In 2013, as in previous years, the rank order of leading causes of infant death varied substantially by race and Hispanic origin of the mother. For all groups except non-Hispanic black and Puerto

Rican women, congenital malformations was the leading cause of infant death, followed by low birthweight. For non-Hispanic black and Puerto Rican women, these two categories were reversed.

When differences in cause-specific infant mortality rates were examined by race and ethnicity, infant mortality rates from congenital malformations were 34% higher for AIAN, and 23% higher for non-Hispanic black than for non-Hispanic white women. Infant mortality rates from congenital malformations were 23% lower for API and 21% lower for Mexican than for non-Hispanic white women.

Infants of non-Hispanic black women had the highest mortality rates from low birthweight. The rate for non-Hispanic black women was 2.5 times that for non-Hispanic white women. The rate for Puerto Rican women was 77% higher than for non-Hispanic white women.

For maternal complications (which include incompetent cervix, premature rupture of membranes, and multiple pregnancy, for example), infants of non-Hispanic black women had the highest mortality rates—nearly 3 times those for non-Hispanic white women. Non-Hispanic black women have a much higher percentage of preterm births ([Table 3](#)), which may help to explain the high infant mortality rates from maternal complications, as this cause occurs predominantly among preterm infants. Infant mortality rates from maternal complications were 62% higher for Puerto Rican women than for non-Hispanic white women.

SIDS rates for non-Hispanic black women were 83% higher, and rates for AIAN women were 95% higher than for non-Hispanic white women. In contrast, SIDS rates were 44% lower for Mexican, 53% lower for Puerto Rican, and 64% lower for API women than for non-Hispanic white women. As most SIDS deaths occur during the postneonatal period, the high SIDS rates for infants of non-Hispanic black and AIAN women accounted for much of their elevated risk of postneonatal mortality.

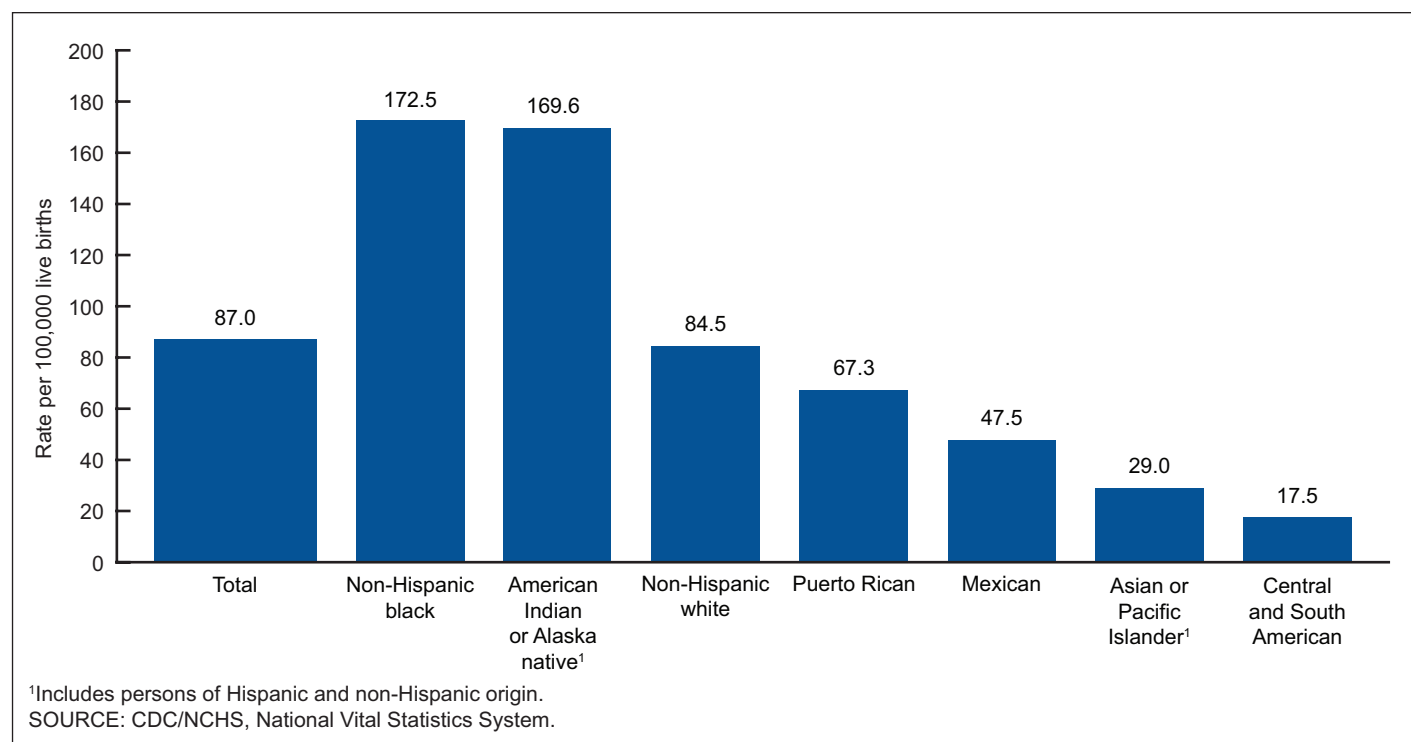


Figure 5. Sudden unexpected infant death rates, by race and Hispanic origin of mother: United States, 2013

For unintentional injuries, the non-Hispanic black rate was more than twice the non-Hispanic white rate. Infant mortality rates from unintentional injuries were 75% higher for AIAN and 28% higher for Puerto Rican women than for non-Hispanic white women. In contrast, infant mortality rates from unintentional injuries were 41% lower for Mexican than for non-Hispanic white women.

Preterm-related causes of death

To more fully assess the impact of preterm birth on infant mortality, CDC researchers have developed a grouping of *preterm-related* causes of death. A cause of death was considered preterm-related if 75% or more of infants whose deaths were attributed to that cause were born at under 37 weeks of gestation, and the cause of death was a direct consequence of preterm birth based on a clinical evaluation and review of the literature (39,40).

The preterm-related cause-of-death grouping includes Disorders related to short gestation and low birthweight not elsewhere classified, and most of the Maternal complications of pregnancy category from the five leading causes of death. Also included are a variety of other causes of death closely associated with prematurity such as Respiratory distress of newborn, Bacterial sepsis of newborn, Necrotizing enterocolitis of newborn, and others. The comprehensive list of preterm-related cause-of-death categories (ICD-10 codes) is shown in the note on Table 6. Even this comprehensive grouping probably underestimates the total impact of preterm-related infant mortality, as some cause-of-death categories (notably those beginning with the words “Other” and “All

other”) had a high percentage of preterm infant deaths but lacked sufficient specificity to be able to establish the etiologic connection to prematurity with any degree of certainty.

Table 6 shows trends in preterm-related infant mortality by race and Hispanic origin of mother. In 2013, 8,470 out of a total of 23,446 infant deaths (36.1%) in the United States were preterm-related. The impact of preterm-related infant deaths varied considerably by maternal race and ethnicity. In 2013, 44% of non-Hispanic black, and 41% of Puerto Rican infant deaths were due to preterm-related causes, while the percentage was somewhat lower for other racial and ethnic groups (Table 6).

Preterm-related infant mortality rates varied considerably by race and ethnicity of the mother (Table 6). The preterm-related infant mortality rate for non-Hispanic black women (490.9 per 100,000) was 3 times that for non-Hispanic white women (159.1). The preterm-related infant mortality rate was 52% higher for Puerto Rican women (241.6), and 28% higher for AIAN (204.4) women than for non-Hispanic white (159.1) women.

Although preterm-related infant mortality rates were highest for non-Hispanic black and Puerto Rican women, they also experienced the largest declines in recent years. From 2005 (the most recent overall U.S. infant mortality rate high) to 2013, preterm-related infant mortality rates declined by 22% for non-Hispanic black women, and by 30% for Puerto Rican women, compared with a 14% decline for non-Hispanic white women. Preterm-related infant mortality rates also declined by 10% for Mexican women, while changes for other race and ethnic groups were not statistically significant (Table 6).

Sudden unexpected infant deaths

A special cause-of-death category for Sudden unexpected infant deaths (SUID) has recently been developed (41). This was developed in response to variations over time and between those who complete death certificates in how sudden unexpected infant deaths are reported on death certificates (41,42).

The SUID category combines ICD-10 codes for SIDS (R95), Other ill-defined and unspecified causes of mortality (R99), and Accidental suffocation and strangulation in bed (W75). This category is being increasingly used by researchers to produce more accurate comparisons in SUIDs over time and between geographic areas (41,42). SUID is among the leading health indicators measured in Healthy People 2020 (43).

In 2013, there were 3,422 SUIDs in the United States, comprising 14.6% of total infant deaths in that year. The SUID rate was 87.0 infant deaths per 100,000 live births in 2013, 10% lower than the rate of 97.2 in 2005, the most recent overall infant mortality rate high. SUID rates were twice as high for non-Hispanic black (172.5) and AIAN (169.6) women as for non-Hispanic white women (84.5). Compared with non-Hispanic white women, SUID rates were significantly lower for Puerto Rican (67.3), Mexican (47.5), API (29.0), and Central and South American (17.5) women (Table 7 and Figure 5).

Contribution of leading causes of death to racial and ethnic infant mortality differences

The contribution of individual causes of death to racial and ethnic disparities in infant mortality can be assessed by relating differences in rates from individual causes of death to the overall infant mortality difference (10). When this is done, 54% of the higher infant mortality rate for non-Hispanic black women when compared with non-Hispanic white women is due to their higher infant mortality rate from preterm-related causes, and 15% is due to differences in SUIDs. For Puerto Rican women, nearly all (94%) of the difference in overall infant mortality rates between Puerto Rican and non-Hispanic white women was due to preterm-related causes of death. In contrast, for AIAN mothers, 33% of their elevated infant mortality rates when compared with non-Hispanic white women were due to differences in SUID, 18% to differences in preterm-related causes, and 16% due to differences in congenital anomalies.

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Table 1. 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, 2013 linked file

Characteristic	All origins ¹	Non-Hispanic		American Indian or Alaska Native ²	Asian or Pacific Islander	Hispanic				
		White	Black			Total	Mexican	Puerto Rican	Cuban	Central and South American
Infant mortality rates per 1,000 live births in specified group										
Total	5.96	5.06	11.11	7.61	4.07	5.00	4.90	5.93	3.02	4.30
Age at death (days)										
Total neonatal	4.04	3.34	7.46	4.11	2.99	3.55	3.51	4.23	2.28	3.12
Early neonatal (under 7)	3.28	2.68	6.11	3.11	2.49	2.88	2.87	3.56	1.86	2.43
Late neonatal (7–27)	0.76	0.66	1.35	1.00	0.50	0.67	0.63	0.67	*	0.69
Postneonatal	1.92	1.71	3.65	3.50	1.08	1.45	1.40	1.68	*	1.18
Sex										
Male	6.51	5.63	11.97	8.34	4.49	5.36	5.16	6.15	3.29	4.89
Female	5.39	4.46	10.23	6.88	3.63	4.62	4.63	5.67	2.74	3.70
Plurality										
Single births	5.24	4.39	9.78	7.17	3.47	4.56	4.48	5.45	2.58	3.87
Plural births	25.84	21.88	43.58	24.33	22.01	22.43	22.91	19.74	*	21.17
Birthweight (grams)										
Under 2,500	50.26	45.11	63.00	53.64	36.39	49.32	50.85	46.17	32.47	45.17
Under 1,500	219.56	208.58	233.77	221.50	196.57	217.44	218.08	212.99	165.98	210.87
1,500–2,499	13.41	13.68	13.26	17.28	9.41	14.04	15.80	9.66	*	11.36
2,500 or over	2.05	2.01	3.20	3.83	1.11	1.58	1.61	1.71	*	1.24
Period of gestation (weeks)										
Under 37	34.76	30.50	50.01	30.99	28.48	30.05	30.52	32.70	15.37	25.45
Under 32	163.71	150.92	186.41	133.68	157.99	154.43	155.61	151.12	114.75	137.39
32–33	16.02	16.85	15.36	*	11.42	15.23	16.29	*	*	12.94
34–36	7.23	7.43	8.45	9.43	4.77	6.31	6.89	6.25	*	5.04
37–41	2.19	2.13	3.44	3.97	1.25	1.74	1.75	1.84	*	1.42
37–38	3.01	3.12	4.17	4.21	1.72	2.28	2.39	2.16	*	1.84
39–40	1.85	1.76	3.08	3.97	0.95	1.49	1.47	1.73	*	1.14
41	1.80	1.70	2.82	*	1.65	1.47	1.43	*	*	*
42 or over	2.39	2.25	3.58	*	1.92	2.09	2.00	*	*	*
Age of mother										
Under 20	8.52	8.48	11.69	8.12	7.39	6.26	6.30	6.68	*	4.57
20–24	7.00	6.14	11.23	7.55	5.76	5.16	4.72	5.97	*	4.37
25–29	5.59	4.74	10.88	8.52	3.94	4.54	4.37	5.98	*	4.23
30–34	4.87	4.11	10.71	5.28	3.42	4.40	4.57	4.88	*	3.88
35–39	5.35	4.43	11.34	8.35	3.97	5.04	4.95	5.89	*	4.86
40–54	7.77	7.01	11.83	*	5.12	7.78	8.57	*	*	4.58
Live-birth order										
1	6.02	5.01	11.39	7.23	4.12	5.48	5.60	5.70	2.48	4.69
2	5.14	4.46	10.04	6.91	3.55	4.23	4.12	5.71	*	3.52
3	5.84	5.28	10.26	6.16	4.13	4.49	4.36	5.02	*	3.80
4	6.73	6.09	11.13	6.76	5.60	5.15	4.69	7.73	*	4.83
5 or over	9.11	7.49	14.82	13.83	6.64	6.96	6.35	8.45	*	6.83
Marital status										
Married	4.60	4.15	9.10	5.96	3.74	4.65	4.69	5.13	3.19	4.03
Unmarried	7.96	7.25	11.92	8.45	5.73	5.31	5.10	6.37	2.86	4.57
Mother's place of birth										
Born in the 50 states or the District of Columbia.	6.28	5.09	11.65	7.81	4.94	5.42	5.17	6.16	3.86	4.04
Born elsewhere	4.51	3.88	7.04	*	3.73	4.54	4.60	5.22	2.21	4.34

See footnotes at end of table.

Table 1. 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, 2013 linked file—Con.

Characteristic	All origins ¹	Non-Hispanic		American Indian or Alaska Native ²	Asian or Pacific Islander	Hispanic				
		White	Black			Total	Mexican	Puerto Rican	Cuban	Central and South American
Live births										
Total	3,932,181	2,129,196	583,834	45,991	265,673	901,033	545,202	68,302	18,854	131,305
Sex										
Male	2,012,954	1,092,625	296,426	23,609	137,008	459,931	278,486	34,800	9,727	66,909
Female	1,919,227	1,036,571	287,408	22,382	128,665	441,102	266,716	33,502	9,127	64,396
Plurality										
Single births	3,795,157	2,047,990	560,865	44,799	256,997	878,879	532,849	66,073	18,205	128,045
Plural births	137,024	81,206	22,969	1,192	8,676	22,154	12,353	2,229	649	3,260
Birthweight (grams)										
Under 2,500	316,597	149,019	76,716	3,449	22,232	64,048	36,207	6,433	1,386	9,010
Under 1,500	56,585	24,029	17,303	614	3,210	11,111	6,273	1,155	241	1,527
1,500–2,499	260,012	124,990	59,413	2,835	19,022	52,937	29,934	5,278	1,145	7,483
2,500 or over	3,614,942	1,980,055	507,053	42,536	243,413	836,940	508,972	61,864	17,468	122,286
Not stated	642	122	65	6	28	45	23	5	*	9
Period of gestation (weeks)										
Under 37	447,361	216,449	94,869	6,002	26,962	101,839	58,780	8,898	2,668	15,364
Under 32	75,464	32,957	21,657	965	4,032	15,535	8,862	1,608	305	2,249
32–33	58,039	28,019	12,764	794	3,239	13,066	7,551	1,209	338	2,010
34–36	313,858	155,473	60,448	4,243	19,691	73,238	42,367	6,081	2,025	11,105
37–41	3,265,630	1,787,743	458,758	36,735	227,053	750,641	457,561	55,524	15,263	108,432
37–38	974,162	493,500	159,554	11,881	71,027	237,124	142,623	17,611	5,086	34,821
39–40	1,957,937	1,096,277	259,803	20,914	135,434	442,537	271,687	32,296	8,930	63,182
41	333,531	197,966	39,401	3,940	20,592	70,980	43,251	5,617	1,247	10,429
42 or over	215,510	123,435	29,568	3,179	11,481	47,924	28,455	3,838	917	7,437
Not stated	3,680	1,569	639	75	177	629	406	42	6	72
Age of mother										
Under 20	276,203	108,603	63,109	5,788	5,141	94,174	60,466	8,080	868	7,661
20–24	896,745	431,540	185,662	14,970	27,250	237,705	146,491	21,289	4,162	24,738
25–29	1,120,777	637,710	153,903	12,673	70,886	244,243	147,783	18,072	5,892	36,128
30–34	1,036,927	620,788	112,650	8,142	95,865	196,417	115,279	13,119	4,584	36,337
35–39	483,873	269,221	53,546	3,591	52,872	102,663	60,020	6,277	2,670	20,983
40–54	117,656	61,334	14,964	827	13,659	25,831	15,163	1,465	678	5,458
Live-birth order										
1	1,546,163	882,604	219,026	15,640	119,546	306,339	173,297	26,513	8,866	44,763
2	1,244,087	699,878	166,905	12,299	94,619	268,700	156,453	21,195	6,570	42,885
3	653,641	331,146	101,365	8,438	32,962	179,412	115,654	11,562	2,312	25,510
4	276,565	125,576	49,127	4,733	10,711	86,400	59,038	5,048	673	10,767
5 or over	193,210	81,969	42,299	4,626	6,931	56,909	38,897	3,670	382	6,879
Not stated	18,515	8,023	5,112	255	904	3,273	1,863	314	51	501
Marital status										
Married	2,336,308	1,505,551	166,543	15,448	220,611	421,282	261,981	24,170	9,399	65,469
Unmarried	1,595,873	623,645	417,291	30,543	45,062	479,751	283,221	44,132	9,455	65,836
Mother's place of birth										
Born in the 50 states or the District of Columbia.	3,043,697	1,992,041	496,298	43,008	60,123	444,023	263,492	49,491	9,325	22,527
Born elsewhere	875,478	132,560	83,288	2,887	204,185	455,182	281,086	18,197	9,512	108,500
Not stated	13,006	4,595	4,248	96	1,365	1,828	624	614	17	278

See footnotes at end of table.

Table 1. 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, 2013 linked file—Con.

Characteristic	All origins¹	Non-Hispanic		American Indian or Alaska Native²	Asian or Pacific Islander	Hispanic				
		White	Black			Total	Mexican	Puerto Rican	Cuban	Central and South American
Infant deaths										
Total	23,446	10,766	6,488	350	1,082	4,507	2,672	405	57	565
Age at death (days)										
Total neonatal.....	15,893	7,119	4,355	189	794	3,200	1,911	289	43	410
Early neonatal (under 7)	12,900	5,706	3,567	143	662	2,598	1,565	243	35	319
Late neonatal (7–27).....	2,993	1,413	788	46	132	602	346	46	8	91
Postneonatal.....	7,553	3,647	2,133	161	288	1,308	761	115	14	155
Sex										
Male.....	13,108	6,147	3,548	197	615	2,467	1,436	214	32	327
Female.....	10,339	4,619	2,939	154	467	2,040	1,236	190	25	238
Plurality										
Single births.....	19,905	8,989	5,487	321	892	4,011	2,389	360	47	496
Plural births.....	3,541	1,777	1,001	29	191	497	283	44	10	69
Birthweight (grams)										
Under 2,500.....	15,912	6,722	4,833	185	809	3,159	1,841	297	45	407
Under 1,500.....	12,424	5,012	4,045	136	631	2,416	1,368	246	40	322
1,500–2,499.....	3,488	1,710	788	49	179	743	473	51	5	85
2,500 or over.....	7,397	3,984	1,621	163	269	1,323	818	106	12	152
Not stated.....	137	59	33	3	4	24	12	2	*	6
Period of gestation (weeks)										
Under 37.....	15,552	6,601	4,744	186	768	3,060	1,794	291	41	391
Less than 32.....	12,354	4,974	4,037	129	637	2,399	1,379	243	35	309
32–33.....	930	472	196	17	37	199	123	10	2	26
34–36.....	2,268	1,155	511	40	94	462	292	38	4	56
37–41.....	7,151	3,799	1,577	146	284	1,305	802	102	14	154
37–38.....	2,933	1,538	666	50	122	540	341	38	6	64
39–40.....	3,617	1,925	800	83	128	661	399	56	8	72
41.....	601	336	111	13	34	104	62	8	*	18
42 or over.....	515	278	106	13	22	100	57	8	1	10
Not stated.....	227	89	62	5	8	44	20	3	1	10
Age of mother										
Under 20.....	2,353	921	738	47	38	590	381	54	4	35
20–24.....	6,274	2,648	2,085	113	157	1,227	691	127	9	108
25–29.....	6,262	3,020	1,674	108	279	1,109	646	108	15	153
30–34.....	5,055	2,553	1,206	43	328	864	527	64	16	141
35–39.....	2,588	1,193	607	30	210	517	297	37	11	102
40–54.....	914	430	177	8	70	201	130	14	2	25
Live-birth order										
1.....	9,303	4,425	2,494	113	493	1,678	970	151	22	210
2.....	6,398	3,123	1,675	85	336	1,136	645	121	16	151
3.....	3,819	1,747	1,040	52	136	806	504	58	9	97
4.....	1,862	765	547	32	60	445	277	39	2	52
5 or over.....	1,760	614	627	64	46	396	247	31	7	47
Not stated.....	305	92	105	4	10	48	29	4	1	7
Marital status										
Married.....	10,750	6,244	1,515	92	824	1,958	1,228	124	30	264
Unmarried.....	12,696	4,522	4,973	258	258	2,549	1,444	281	27	301
Mother's place of birth										
Born in the 50 states or the District of Columbia ..	19,116	10,136	5,783	336	297	2,406	1,363	305	36	91
Born elsewhere.....	3,947	514	586	13	762	2,068	1,294	95	21	471
Not stated.....	384	115	118	1	24	33	16	5	*	3

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

¹Includes other and unknown Hispanic origin not stated, not shown separately.²Includes Aleut and Eskimo persons.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Not stated responses were included in totals but not distributed among groups for rate computations. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. See reference 3.

Table 2. Infant mortality rates, by race and Hispanic origin of mother: United States and each state, Puerto Rico, and Guam, 2011–2013 linked files

[By place of residence]

	Total	Race and Hispanic origin of mother				Hispanic	Ratio of rate, non-Hispanic black and non- Hispanic white
		Non-Hispanic white	Non-Hispanic black	American Indian or Alaska Native¹	Asian or Pacific Islander		
Infant mortality rates per 1,000 live births in specified group							
United States²	6.01	5.06	11.25	8.07	4.16	5.09	2.2
Alabama	8.57	6.92	12.90	*	*	5.00	1.9
Alaska	4.90	3.64	*	8.08	*	*	*
Arizona	5.67	4.72	11.05	8.50	5.06	5.61	2.3
Arkansas	7.41	6.70	10.89	*	*	6.15	1.6
California	4.66	3.92	9.35	5.91	3.76	4.59	2.4
Colorado	5.06	4.18	9.59	*	5.32	5.89	2.3
Connecticut	5.07	3.71	10.24	*	*	6.08	2.8
Delaware	7.64	5.60	12.82	*	*	5.14	2.3
District of Columbia	7.33	*	11.12	*	*	5.51	*
Florida	6.24	5.04	10.79	*	3.68	4.55	2.1
Georgia	6.69	5.06	10.02	*	3.90	4.74	2.0
Hawaii	5.50	4.36	*	*	5.66	6.01	*
Idaho	5.38	5.04	*	*	*	6.68	*
Illinois	6.35	4.81	12.93	*	4.67	5.27	2.7
Indiana	7.19	6.46	12.87	*	5.17	6.09	2.0
Iowa	4.77	4.59	10.74	*	*	2.65	2.3
Kansas	6.34	5.54	14.18	*	*	6.84	2.6
Kentucky	6.68	6.40	9.78	*	*	6.75	1.5
Louisiana	8.35	6.15	12.02	*	6.36	4.83	2.0
Maine	6.92	6.77	*	*	*	*	*
Maryland	6.60	4.06	11.06	*	4.46	5.19	2.7
Massachusetts	4.21	3.45	6.90	*	3.32	5.51	2.0
Michigan	6.84	5.30	13.13	8.88	4.34	5.98	2.5
Minnesota	4.95	4.27	8.85	11.29	4.58	5.38	2.1
Mississippi	9.25	6.76	12.41	*	*	6.35	1.8
Missouri	6.49	5.44	12.18	*	4.20	6.08	2.2
Montana	5.82	5.25	*	9.81	*	*	*
Nebraska	5.16	4.47	9.92	*	*	5.66	2.2
Nevada	5.31	5.15	9.52	*	3.96	4.45	1.8
New Hampshire	4.76	4.39	*	*	*	*	*
New Jersey	4.68	3.20	10.34	*	3.78	4.37	3.2
New Mexico	5.89	5.20	*	5.87	*	6.07	*
New York	5.02	4.02	8.95	8.28	3.37	4.99	2.2
North Carolina	7.20	5.44	12.57	10.61	4.31	5.56	2.3
North Dakota	6.29	5.52	*	13.23	*	*	*
Ohio	7.60	6.31	13.57	*	4.22	6.92	2.2
Oklahoma	7.17	6.51	12.50	6.97	7.59	6.54	1.9
Oregon	4.95	4.72	8.29	10.17	4.07	4.75	1.8
Pennsylvania	6.73	5.21	12.66	*	4.19	6.99	2.4
Rhode Island	6.45	4.99	9.45	*	*	7.22	1.9
South Carolina	7.23	5.25	11.48	*	*	4.96	2.2
South Dakota	6.96	5.70	*	11.47	*	*	*
Tennessee	7.16	6.09	11.73	*	3.92	5.25	1.9
Texas	5.77	5.07	10.73	*	3.78	5.25	2.1
Utah	5.16	4.82	12.89	*	7.53	5.12	2.7
Vermont	4.55	4.44	*	*	*	*	*
Virginia	6.49	4.84	11.74	*	4.97	5.79	2.4
Washington	4.78	4.41	8.75	8.74	4.37	4.15	2.0
West Virginia	7.11	6.99	12.01	*	*	*	1.7
Wisconsin	6.06	5.01	14.00	8.03	6.72	5.23	2.8
Wyoming	5.67	5.67	*	*	*	*	*
Puerto Rico	8.25	---	---	---	---	---	*
Guam	11.14	*	*	*	11.36	*	*

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

-- Data not available.

Includes Aleut and Eskimo persons.

Excludes data for Puerto Rico and Guam.

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 3. Percentage of live births with selected maternal and infant characteristics, by race and Hispanic origin of mother: United States, 2013 linked file

Characteristic	All races and origins ¹	Non-Hispanic			Asian or Pacific Islander	Hispanic				
		White	Black	American Indian or Alaska Native ²		Total ¹	Mexican	Puerto Rican	Cuban	Central and South American
Birthweight:										
Under 1,500 grams	1.44	1.13	2.96	1.30	1.20	1.23	1.15	1.69	1.28	1.16
Under 2,500 grams	8.1	7.0	13.1	7.5	8.4	7.1	6.6	9.4	7.4	6.9
Preterm births ³	11.4	10.2	16.3	13.1	10.2	11.3	10.8	13.0	14.2	11.7
Births to mothers under 20	7.0	5.1	10.8	12.6	1.9	10.5	11.1	11.8	4.6	5.8
Fourth and higher order births	12.0	9.8	15.8	20.5	6.7	16.0	18.0	12.8	5.6	13.5
Births to unmarried mothers	40.6	29.3	71.5	66.4	17.0	53.2	51.9	64.6	50.1	50.1
Mothers born in the 50 states or the District of Columbia	77.7	93.8	85.6	93.7	22.7	49.4	48.4	73.1	49.5	17.2

¹Includes other and unknown Hispanic and origin not stated, not shown separately.²Includes Aleut and Eskimo persons.³Born prior to 37 completed weeks of gestation.

NOTES: Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 4. Live births, infant, neonatal, and postneonatal deaths, and mortality rates, by race and Hispanic origin of mother and birthweight: United States, 2013 linked file, and percent change in birthweight-specific infant mortality, 2005 and 2013 linked files

Race and birthweight (grams)	Number in 2013				Mortality rate per 1,000 live births in 2013			Percent change in infant mortality rate 2005–2013
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
All races ¹	3,932,181	23,446	15,893	7,553	5.96	4.04	1.92	†–13.1
Under 2,500	316,597	15,912	13,147	2,765	50.26	41.53	8.73	†–12.4
Under 1,500	56,585	12,424	11,068	1,357	219.56	195.60	23.98	†–10.4
Under 500	6,634	5,659	5,535	124	853.03	834.34	18.69	–0.4
500–749	10,010	3,947	3,378	569	394.31	337.46	56.84	†–15.8
750–999	11,164	1,391	1,094	297	124.60	97.99	26.60	†–17.2
1,000–1,249	12,812	790	594	196	61.66	46.36	15.30	†–13.5
1,250–1,499	15,965	637	466	171	39.90	29.19	10.71	†–14.5
1,500–1,999	61,386	1,515	1,020	495	24.68	16.62	8.06	†–8.2
2,000–2,499	198,626	1,973	1,059	914	9.93	5.33	4.60	†–8.8
2,500 or over	3,614,942	7,397	2,610	4,787	2.05	0.72	1.32	†–10.9
2,500–2,999	716,305	2,594	982	1,612	3.62	1.37	2.25	†–13.6
3,000–3,499	1,530,243	2,894	946	1,948	1.89	0.62	1.27	†–12.1
3,500–3,999	1,055,367	1,472	510	962	1.39	0.48	0.91	–5.4
4,000–4,499	269,759	352	129	223	1.30	0.48	0.83	–10.3
4,500–4,999	38,852	62	31	31	1.60	0.80	0.80	–27.6
5,000 or over	4,416	23	12	11	5.21	*	*	17.1
Not stated	642	137	136	1	...	...	...	...
Non-Hispanic white	2,129,196	10,766	7,119	3,647	5.06	3.34	1.71	†–12.2
Under 2,500	149,019	6,723	5,604	1,119	45.12	37.61	7.51	†–10.3
Under 1,500	24,029	5,012	4,513	499	208.58	187.81	20.77	†–8.2
Under 500	2,401	2,074	2,040	34	863.81	849.65	14.16	0.4
500–749	3,900	1,621	1,437	185	415.64	368.46	47.44	†–11.9
750–999	4,569	625	502	123	136.79	109.87	26.92	†–16.0
1,000–1,249	5,610	382	306	76	68.09	54.55	13.55	–9.0
1,250–1,499	7,549	310	228	81	41.07	30.20	10.73	–7.2
1,500–1,999	29,952	734	515	219	24.51	17.19	7.31	–4.7
2,000–2,499	95,038	977	576	401	10.28	6.06	4.22	–7.1
2,500 or over	1,980,055	3,984	1,456	2,528	2.01	0.74	1.28	†–9.9
2,500–2,999	335,712	1,307	523	783	3.89	1.56	2.33	†–10.2
3,000–3,499	803,280	1,551	516	1,035	1.93	0.64	1.29	†–11.5
3,500–3,999	635,922	886	316	570	1.39	0.50	0.90	–1.4
4,000–4,499	177,001	204	81	124	1.15	0.46	0.70	–14.2
4,500–4,999	25,587	30	17	13	1.17	*	*	–36.8
5,000 or over	2,553	6	3	3	*	*	*	*
Not stated	122	59	59	–	...	...	...	...
Non-Hispanic black	583,834	6,488	4,355	2,133	11.11	7.46	3.65	†–18.5
Under 2,500	76,716	4,833	3,880	952	63.00	50.58	12.41	†–15.7
Under 1,500	17,303	4,045	3,511	534	233.77	202.91	30.86	†–12.0
Under 500	2,440	2,043	1,979	64	837.30	811.07	26.23	–1.7
500–749	3,482	1,265	1,020	245	363.30	292.94	70.36	†–18.5
750–999	3,555	377	273	103	106.05	76.79	28.97	†–21.1
1,000–1,249	3,786	209	141	68	55.20	37.24	17.96	–13.0
1,250–1,499	4,040	151	97	54	37.38	24.01	13.37	†–19.9
1,500–1,999	14,491	347	195	152	23.95	13.46	10.49	–11.0
2,000–2,499	44,922	440	175	266	9.79	3.90	5.92	†–12.9
2,500 or over	507,053	1,621	441	1,180	3.20	0.87	2.33	†–9.1
2,500–2,999	144,705	649	175	473	4.48	1.21	3.27	†–11.6
3,000–3,499	226,785	651	168	484	2.87	0.74	2.13	–8.3
3,500–3,999	109,933	250	74	177	2.27	0.67	1.61	–6.2
4,000–4,499	21,989	52	14	38	2.36	*	1.73	–8.2
4,500–4,999	3,177	13	7	6	*	*	*	*
5,000 or over	464	6	3	3	*	*	*	*
Not stated	65	33	33	–	...	...	...	...

See footnotes at end of table.

Table 4. Live births, infant, neonatal, and postneonatal deaths, and mortality rates, by race and Hispanic origin of mother and birthweight: United States, 2013 linked file, and percent change in birthweight-specific infant mortality, 2005 and 2013 linked files—Con.

Race and birthweight (grams)	Number in 2013				Mortality rate per 1,000 live births in 2013			Percent change in infant mortality rate 2005–2013
	Live births	Infant deaths	Neonatal deaths	Postneonatal deaths	Infant	Neonatal	Postneonatal	
American Indian or Alaska Native ²	45,991	350	189	161	7.61	4.11	3.50	–5.6
Under 2,500	3,449	185	147	38	53.64	42.62	11.02	0.4
Under 1,500	614	136	119	17	221.50	193.81	*	–6.3
Under 500	57	48	48	—	842.11	842.11	*	6.2
500–749	85	47	41	6	552.94	482.35	*	22.7
750–999	111	19	14	5	*	*	*	*
1,000–1,249	161	11	6	5	*	*	*	*
1,250–1,499	200	10	9	1	*	*	*	*
1,500–1,999	650	25	19	6	38.46	*	*	25.2
2,000–2,499	2,185	24	9	15	10.98	*	*	–19.6
2,500 or over	42,536	163	39	123	3.83	0.92	2.89	–13.5
2,500–2,999	7,743	47	18	29	6.07	*	3.75	–15.3
3,000–3,499	17,428	62	8	54	3.56	*	3.10	–14.0
3,500–3,999	12,875	39	9	30	3.03	*	2.33	–5.6
4,000–4,499	3,685	10	2	8	*	*	*	*
4,500–4,999	682	2	1	1	*	*	*	*
5,000 or over	123	2	1	1	*	*	*	*
Not stated	6	3	3	—	...	...	...	...
Asian or Pacific Islander	265,673	1,082	794	288	4.07	2.99	1.08	†–16.8
Under 2,500	22,232	809	681	128	36.39	30.63	5.76	†–17.6
Under 1,500	3,210	631	574	57	196.57	178.82	17.76	†–17.3
Under 500	323	284	281	3	879.26	869.97	*	3.4
500–749	493	198	173	25	401.62	350.91	50.71	†–20.5
750–999	618	75	62	13	121.36	100.32	*	–15.9
1,000–1,249	759	39	28	11	51.38	36.89	*	–29.8
1,250–1,499	1,017	34	29	5	33.43	28.52	*	–30.9
1,500–1,999	4,053	71	49	22	17.52	12.09	5.43	–33.8
2,000–2,499	14,969	108	59	49	7.21	3.94	3.27	0.7
2,500 or over	243,413	269	109	160	1.11	0.45	0.66	†–22.9
2,500–2,999	61,779	94	39	55	1.52	0.63	0.89	†–38.5
3,000–3,499	111,955	114	46	67	1.02	0.41	0.60	–19.0
3,500–3,999	56,981	43	19	24	0.75	*	0.42	–10.7
4,000–4,499	11,074	15	5	10	*	*	*	*
4,500–4,999	1,431	3	—	3	*	*	*	*
5,000 or over	193	—	—	—	*	*	*	*
Not stated	28	4	4	—	...	...	...	...
Hispanic	901,033	4,507	3,199	1,308	5.00	3.55	1.45	†–11.0
Under 2,500	64,048	3,160	2,644	515	49.34	41.28	8.04	†–11.5
Under 1,500	11,111	2,416	2,173	243	217.44	195.57	21.87	†–11.3
Under 500	1,294	1,096	1,073	22	846.99	829.21	17.00	–1.1
500–749	1,967	769	659	109	390.95	335.03	55.41	†–18.6
750–999	2,254	285	232	53	126.44	102.93	23.51	†–15.6
1,000–1,249	2,472	143	110	33	57.85	44.50	13.35	–18.6
1,250–1,499	3,124	124	99	25	39.69	31.69	8.00	†–21.8
1,500–1,999	12,000	328	237	91	27.33	19.75	7.58	–9.4
2,000–2,499	40,937	415	235	181	10.14	5.74	4.42	–7.1
2,500 or over	836,940	1,323	531	793	1.58	0.63	0.95	†–16.0
2,500–2,999	165,323	480	213	267	2.90	1.29	1.62	†–19.0
3,000–3,499	369,017	512	196	317	1.39	0.53	0.86	†–15.2
3,500–3,999	238,082	242	86	157	1.02	0.36	0.66	†–18.4
4,000–4,499	55,524	67	25	41	1.21	0.45	0.74	–2.4
4,500–4,999	7,910	13	6	7	*	*	*	*
5,000 or over	1,084	9	5	4	*	*	*	*
Not stated	45	24	24	—	...	...	...	...

† Significant at $p < 0.05$.

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

... Category not applicable.

— Quantity zero.

¹Includes races other than white or black.²Includes Aleut and Eskimo persons.

NOTES: Infant deaths are weighted so numbers may not exactly add to totals due to rounding. Neonatal is under 28 days and postneonatal is 28 days to under age 1 year. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 5. Infant deaths and mortality rates for the five leading causes of infant death, by race and Hispanic origin of mother: United States, 2013 linked file

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

Cause of death (based on <i>International Classification of Diseases, 10th Revision, 1992</i>)	All races			Non-Hispanic white			Non-Hispanic black			American Indian or Alaska Native			Asian or Pacific Islander ¹		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes	...	23,446	596.3	...	10,766	505.6	...	6,488	1,111.3	...	350	761.0	...	1,082	407.3
Congenital malformations, deformations and chromosomal abnormalities (Q00–Q99)	1	4,778	121.5	1	2,443	114.7	2	827	141.6	1	71	154.4	1	236	88.8
Disorders related to short gestation and low birth weight, not elsewhere classified (P07)	2	4,213	107.1	2	1,585	74.4	1	1,522	260.7	2	44	95.7	2	193	72.6
Newborn affected by maternal complications of pregnancy (P01)	3	1,597	40.6	4	635	29.8	3	505	86.5	5	19	*	3	97	36.5
Sudden infant death syndrome (R95)	4	1,561	39.7	3	854	40.1	4	428	73.3	3	36	78.3	5	38	14.3
Accidents (unintentional injuries) (V01–X59)	5	1,150	29.2	5	583	27.4	5	371	63.5	4	22	47.8	9	18	*

Cause of death (based on <i>International Classification of Diseases, 10th Revision, 1992</i>)	Total Hispanic ²			Mexican ³			Puerto Rican ⁴			Central and South American ⁵		
	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate	Rank	Number	Rate
All causes	...	4,507	500.2	...	2,672	490.1	...	405	593.0	...	565	430.3
Congenital malformations, deformations and chromosomal abnormalities (Q00–Q99)	1	1,166	129.4	1	754	138.3	2	66	96.6	1	158	120.3
Disorders related to short gestation and low birth weight, not elsewhere classified (P07)	2	794	88.1	2	446	81.8	1	90	131.8	2	106	80.7
Newborn affected by maternal complications of pregnancy (P01)	3	298	33.1	3	178	32.6	3	33	48.3	3	40	30.5
Sudden infant death syndrome (R95)	4	195	21.6	4	123	22.6	6	13	*	7	11	*
Accidents (unintentional injuries) (V01–X59)	6	151	16.8	6	88	16.1	4	24	35.1	10	10	*

... Category not applicable.

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

¹Newborn affected by complications of placenta, cord and membranes (P02) was the fourth leading cause of death, with 43 deaths and a rate of 16.2.²Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death, with 168 deaths and a rate of 18.6.³Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death, with 100 deaths and a rate of 18.3.⁴Newborn affected by complications of placenta, cord and membranes (P02) was the fifth leading cause of death, with 15 deaths.⁵Newborn affected by complications of placenta, cord and membranes (P02) was the fourth leading cause of death, with 24 deaths and a rate of 18.3. Bacterial sepsis of newborn (P36) was the fifth leading cause of death, with 20 deaths and a rate of 15.2.

NOTE: Reliable cause-specific infant mortality rates cannot be computed for Cuban infants because of the small number of infant deaths (57). Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race.

Table 6. Number and percentage of preterm-related infant deaths and preterm-related infant mortality rates, by race and Hispanic origin of mother: United States, 2000–2013 linked files

Year	All races	Non-Hispanic white	Non-Hispanic black	American Indian or Alaska native	Asian or Pacific Islander	Total Hispanic ¹	Mexican	Puerto Rican	Central and South American
Number of preterm-related infant deaths									
2013.....	8,470	3,387	2,866	94	410	1,581	901	165	219
2012.....	8,465	3,390	2,844	99	404	1,610	933	193	185
2011.....	8,500	3,314	2,887	89	424	1,680	971	201	246
2010.....	8,650	3,433	2,874	92	402	1,724	1,041	196	207
2009.....	9,341	3,624	3,294	108	386	1,781	1,045	210	252
2008.....	9,952	3,843	3,466	97	418	2,009	1,303	222	229
2007.....	10,498	4,104	3,755	111	430	1,956	1,276	208	269
2006.....	10,303	4,134	3,709	100	358	1,868	1,229	221	252
2005.....	10,364	4,206	3,655	86	401	1,880	1,266	218	241
2004.....	10,180	4,171	3,641	83	378	1,752	1,192	195	238
2003.....	10,331	4,358	3,615	91	364	1,761	1,163	200	256
2002.....	9,965	4,342	3,581	90	321	1,540	1,018	190	192
2001.....	9,767	4,289	3,561	79	280	1,436	951	196	189
2000.....	9,673	4,141	3,586	96	298	1,411	929	189	170
Percent of total infant deaths that are preterm-related									
2013.....	36.1	31.5	44.2	26.9	37.9	35.1	33.7	40.7	38.8
2012.....	35.8	31.5	43.6	25.6	36.5	34.7	33.5	41.9	33.9
2011.....	35.4	30.4	43.3	23.4	38.3	35.5	34.3	38.2	41.5
2010.....	35.2	30.7	42.5	23.8	38.2	34.7	34.0	41.6	32.8
2009.....	35.4	30.8	43.6	26.2	34.9	33.7	31.6	42.7	37.9
2008.....	35.4	30.7	43.9	23.3	36.6	34.5	34.1	44.1	30.9
2007.....	36.0	31.6	45.0	24.3	35.4	33.4	32.6	39.4	34.6
2006.....	36.1	32.1	45.0	25.3	32.6	33.2	32.0	41.2	33.7
2005.....	36.5	32.0	45.9	23.8	35.5	34.0	33.0	41.4	34.0
2004.....	36.5	32.1	46.3	22.4	35.3	33.4	32.2	40.7	35.7
2003.....	36.9	32.9	46.1	24.2	34.1	34.2	32.4	41.8	37.4
2002.....	35.6	32.6	44.6	24.6	31.9	31.3	29.9	40.3	30.1
2001.....	35.5	32.2	44.9	19.6	29.6	31.0	29.8	39.9	31.3
2000.....	34.6	30.8	43.7	27.7	30.5	30.9	29.4	39.6	32.3
Preterm-related infant mortality rate ²									
2013.....	215.4	159.1	490.9	204.4	154.3	175.5	165.3	241.6	166.8
2012.....	214.1	158.9	487.4	214.8	148.1	177.4	167.9	287.3	140.4
2011.....	215.0	154.4	495.8	191.7	167.0	183.0	171.3	299.9	180.6
2010.....	216.3	158.8	487.3	196.7	162.8	182.4	174.0	295.3	145.1
2009.....	226.1	163.8	540.4	221.9	153.7	178.2	161.9	306.6	169.5
2008.....	234.3	169.5	556.3	195.8	165.1	192.9	190.3	321.7	147.2
2007.....	243.2	177.6	598.7	224.5	169.0	184.0	176.7	303.7	158.4
2006.....	241.5	179.1	600.9	209.6	148.5	179.8	171.1	330.2	152.4
2005.....	250.4	184.5	626.1	191.9	173.5	190.8	182.6	344.2	159.4
2004.....	247.6	181.6	629.1	188.9	165.0	185.1	175.9	318.5	165.8
2003.....	252.6	187.7	627.6	211.4	164.6	193.0	177.7	342.5	188.8
2002.....	247.8	188.9	619.2	212.4	152.2	175.7	162.2	330.6	152.4
2001.....	242.6	184.3	603.6	188.7	139.8	168.6	155.6	340.5	155.7
2000.....	238.3	175.2	593.3	230.4	148.6	172.9	159.6	325.2	150.0

¹Includes Cuban and other and unknown Hispanic persons. Data for Cuban persons were not shown separately because of small numbers of infant deaths.²Rate per 100,000 live births in specified group.

NOTES: Preterm-related deaths are those where the infant was born preterm (before 37 completed weeks of gestation) with the underlying cause of death assigned to one of the following *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* categories: K550, P000, P010, P011, P015, P020, P021, P027, P070–P073, P102, P220–229, P250–279, P280, P281, P360–369, P520–523, P77. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Table 7. Number and percentage of SUID and SUID mortality rates, by race and Hispanic origin of mother: United States, 2000 and 2005–2013 linked files

Year	All races and origins	Non- Hispanic white	Non- Hispanic black	American Indian or Alaska native	Asian or Pacific Islander	Total Hispanic ¹	Mexican	Puerto Rican	Central and South American
Number of SUIDs									
2013.....	3,422	1,799	1,007	78	77	444	259	46	23
2012.....	3,454	1,769	1,028	96	89	461	254	61	48
2011.....	3,399	1,798	944	94	96	459	257	80	45
2010.....	3,603	1,872	1,042	85	98	499	302	55	43
2009.....	3,996	2,079	1,170	104	92	530	297	79	49
2008.....	4,191	2,105	1,224	89	106	639	390	58	59
2007.....	4,213	2,197	1,225	121	95	562	364	58	55
2006.....	3,959	2,067	1,133	109	104	531	349	70	48
2005.....	4,021	2,148	1,108	88	112	541	371	58	57
2000.....	3,814	1,951	1,155	74	98	491	328	64	56
Percent of total infant deaths that are SUIDs									
2013.....	14.6	16.7	15.5	22.3	7.1	9.9	9.7	11.4	4.1
2012.....	14.6	16.4	15.7	24.8	8.0	9.9	9.1	13.2	8.8
2011.....	14.2	16.5	14.2	24.7	8.7	9.7	9.1	15.2	7.6
2010.....	14.7	16.7	15.4	22.0	9.3	10.1	9.9	11.7	6.8
2009.....	15.1	17.6	15.5	25.2	8.3	10.0	9.0	16.1	7.4
2008.....	14.9	16.8	15.5	21.3	9.3	11.0	10.2	11.5	8.0
2007.....	14.5	16.9	14.7	26.5	7.8	9.6	9.3	11.0	7.1
2006.....	13.9	16.0	13.7	27.6	9.5	9.4	9.1	13.1	6.4
2005.....	14.2	16.4	13.9	24.4	9.9	9.8	9.7	11.0	8.1
2000.....	13.6	14.5	14.1	21.4	10.0	10.8	10.4	13.4	10.6
SUID mortality rate ²									
2013.....	87.0	84.5	172.5	169.6	29.0	49.3	47.5	67.3	17.5
2012.....	87.4	82.9	176.2	208.3	32.6	50.8	45.7	90.8	36.4
2011.....	86.0	83.8	162.1	202.5	37.8	50.0	45.4	119.4	33.0
2010.....	90.1	86.6	176.7	181.8	39.7	52.8	50.5	82.9	30.1
2009.....	96.7	94.0	191.9	213.7	36.6	53.0	46.0	115.4	33.0
2008.....	98.7	92.8	196.5	179.7	41.9	61.4	56.9	84.0	37.9
2007.....	97.6	95.1	195.3	244.7	37.3	52.9	50.4	84.7	32.4
2006.....	92.8	89.5	183.6	228.4	43.1	51.1	48.6	104.6	29.0
2005.....	97.2	94.2	189.8	196.4	48.5	54.9	53.5	91.6	37.7
2000.....	94.0	82.6	191.1	177.6	48.9	60.2	56.4	110.1	49.4

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

²Rate per 100,000 live births in specified group.

NOTES: SUIDs are sudden unexpected infant deaths. *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* codes R95, R99, and W75. Race and Hispanic origin are reported separately on birth certificates. Race categories are consistent with the 1977 Office of Management and Budget standards. Persons of Hispanic origin may be of any race. In this table, Hispanic women are classified only by place of origin; non-Hispanic women are classified by race. Forty-four states and the District of Columbia reported multiple-race data on the birth certificate for 2013. The multiple-race data for these states were bridged to the single-race categories of the 1977 standards for comparability with other states; see references 2 and 3.

Technical Notes

Differences between period and cohort data

From 1983 through 1991, the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS) produced linked files in a birth cohort format (44). Beginning with 1995 data, linked files are produced first using a period format. The 2013 period linked file contains a numerator file that consists of all infant deaths occurring in 2013 that have been linked to their corresponding birth certificates, whether the birth occurred in 2012 or in 2013. The birth cohort linked file contains a numerator file that consists of all infant deaths to babies born in a single year, whether the death occurred in that year or the next. Beginning with 1995 data, the period linked file is the basis for all official NCHS linked file statistics.

Weighting

In 2013, a record weight was added to the linked file to compensate for the 1.0% of infant death records that could not be linked to their corresponding birth certificates. This procedure was initiated in 1995. Records for Puerto Rico and Guam were not weighted. The percentage of records linked varied by registration area (from 95.6%–100.0%, with all but Texas at 98.0% or higher) (Table I). The number of infant deaths in the linked file for the 50 states and the District of Columbia (D.C.) was weighted to equal the sum of the linked plus unlinked infant deaths by state of occurrence of birth and age of death (under 7 days, 7–27 days, and 28 days to under 1 year). The addition of the weight reduced the potential for bias in comparing infant mortality rates by characteristics.

The 2013 linked file started with 23,465 infant death records. Of these 23,465 records, 23,242 were linked; 223 were unlinked because corresponding birth certificates could not be identified. The 23,465 linked and unlinked records contained records of infants whose mothers' usual place of residence was outside of the United States. These records were excluded to derive a weighted total of 23,446 infant deaths for 2013.

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

The overall infant mortality rate from the 2013 period linked file of 5.96 is the same as that from the 2013 vital statistics mortality file (5.96) (45). The number of infant deaths in the linked file (23,242) differs slightly from the number in the mortality file (23,440) (45). Differences in numbers of infant deaths between the two data sources are primarily due to geographic coverage differences. For the vital statistics mortality file, all deaths occurring in the 50 states and D.C. are included regardless of the place of birth of the infant. In contrast, to be included in the U.S. linked file, both the birth and death must occur in the 50 states and D.C. (the territory linked file is a separate file). Also, weighting of the linked file may contribute to small differences in numbers and rates by specific variables between these two data sets.

Table I. Percentage of infant death records that were linked to their corresponding birth records: United States and each state, Puerto Rico, and Guam, 2013 linked file

State	Percent linked by state of occurrence of death
United States ¹	99.0
Alabama	100.0
Alaska	100.0
Arizona	99.1
Arkansas	100.0
California	98.2
Colorado	100.0
Connecticut	99.4
Delaware	100.0
District of Columbia	100.0
Florida	100.0
Georgia	99.7
Hawaii	100.0
Idaho	100.0
Illinois	100.0
Indiana	99.3
Iowa	99.3
Kansas	100.0
Kentucky	98.7
Louisiana	98.7
Maine	98.9
Maryland	100.0
Massachusetts	99.0
Michigan	99.7
Minnesota	100.0
Mississippi	100.0
Missouri	99.3
Montana	100.0
Nebraska	100.0
Nevada	100.0
New Hampshire	100.0
New Jersey	98.0
New Mexico	98.4
New York (excluding New York City)	99.2
New York City	99.5
North Carolina	99.6
North Dakota	100.0
Ohio	98.7
Oklahoma	100.0
Oregon	100.0
Pennsylvania	99.4
Rhode Island	100.0
South Carolina	100.0
South Dakota	100.0
Tennessee	99.7
Texas	95.6
Utah	100.0
Vermont	100.0
Virginia	99.7
Washington	100.0
West Virginia	98.7
Wisconsin	100.0
Wyoming	100.0
Puerto Rico	100.0
Guam	96.8

¹Excludes data for Puerto Rico and Guam.

Marital status

National estimates of births to unmarried women are based on two methods of determining marital status. In 2013, marital status was based on a direct question in 49 states, D.C., and New York City. New York (excluding New York City) used inferential procedures to compile birth statistics by marital status; a birth is categorized as nonmarital if either of these factors, listed in priority-of-use order, is present: a paternity acknowledgement was received or the father's name is missing (3).

Multiple race

For the birth certificates in the 2013 data year, multiple race was reported by 44 states, D.C., and Guam (both revised and non-revised): Alaska, California, Colorado, Delaware, D.C., Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine (revised after January 1, 2013), Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming (3). Data from the vital records of the remaining states and territories followed the 1977 Office of Management and Budget standards in which a single race is reported (46,47).

To provide uniformity and comparability of the data during the transition period, before multiple-race data are available for all reporting areas, it is necessary to bridge the responses of those who reported more than one race to a single race. Multiple race is imputed to a single race (one of the following: American Indian or Alaska Native, Asian or Pacific Islander, black, or white) according to the combination of races, Hispanic origin, sex, and age indicated on the birth certificate using methods described elsewhere (3,8,48).

Period of gestation

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. When the LMP date was not reported or was inconsistent with birthweight, the obstetric estimate of gestation was used (5.5% of births) (2,3). Beginning in 2014, gestational age will be based on the obstetric estimate of gestation (49).

Birthweight

For the linked file, not stated birthweight was imputed for 3,812 records or 0.10% of the birth records in 2013 when birthweight was not stated but the period of gestation was known. In this case, birthweight was assigned the value from the previous record with the same period of gestation, maternal race, sex, and plurality. If birthweight and period of gestation were both unknown, the not stated value for birthweight was retained. This imputation was done to improve the accuracy of birthweight-specific infant mortality rates

because the percentage of records with not stated birthweight was higher for infant deaths (4.20% before imputation) than for live births (0.10% before imputation). The imputation reduced the percentage of not stated records to 0.59% for infant deaths, and 0.02% for births. The not stated birthweight cases in the natality/birth file, as distinct from the linked file, are not imputed (3).

Cause-of-death classification

The mortality statistics presented in this report were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify and code causes of death in accordance with the current revision of the *International Statistical Classification of Diseases and Related Health Problems* (ICD). The ICD provides the basic guidance used in virtually all countries to code and classify causes of death. The ICD not only details disease classification but also provides definitions, tabulation lists, the format of the death certificate, and the rules for coding cause of death. Cause of death data presented in this report were coded by procedures outlined in annual issues of the *NCHS Instruction Manual* (50,51).

In this report, tabulations of cause-of-death statistics are based solely on the underlying cause of death. The underlying cause is defined by WHO as "the disease or injury which initiated the train of events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury" (5). 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 and modification rules. Generally, more medical information is reported on death certificates than is directly reflected in the underlying cause of death. This is captured in NCHS multiple cause-of-death statistics (45,52).

About every 10 to 20 years, the ICD is revised to take into account advances in medical knowledge. Effective with deaths occurring in 1999, the United States began using the 10th Revision (ICD-10) (5); during the period 1979-1998, causes were coded and classified according to the 9th Revision (ICD-9) (52).

Changes in classification of causes of death due to these revisions may result in discontinuities in cause-of-death trends. Measures of this discontinuity are essential to the interpretation of mortality trends, and are discussed in detail in other NCHS publications (4,53,54).

Tabulation lists and cause-of-death ranking

The cause-of-death rankings for ICD-10 are based on the List of 130 Selected Causes of Infant Death. The tabulation lists and rules for ranking leading causes of death are published in the *NCHS Instruction Manual, part 9, ICD-10 Cause-of-death Lists for Tabulating Mortality Statistics, Effective 1999* (55). Briefly, category titles that begin with the words "Other" and "All other" are not ranked to determine the leading causes of death. When one of the titles that represents a subtotal is ranked [for example, Influenza and pneumonia (J10-J18)], its component parts are not ranked [in this case, Influenza (J10-J11) and Pneumonia (J12-18)].

Preterm-related causes of death

Preterm-related causes of death are those causes that have a direct etiological connection to preterm birth. For an underlying cause of death to be considered preterm-related, 75% or more of infants whose deaths were attributed to that cause had to be born preterm, and the cause of death had to be a direct consequence of preterm birth based on a clinical evaluation and review of the literature (39). The cause-of-death categories included in this grouping are shown in the note in Table 6. Causes that are incidental to preterm birth (for example, a Motor vehicle accident to a preterm infant) are not included. This grouping of preterm-related causes probably underestimates the total impact of preterm-related infant death, as some ICD categories (notably those beginning with the words “Other” and “All other”) had a high percentage of preterm infant deaths but lacked sufficient specificity to be able to establish the etiologic connection to prematurity with any degree of certainty. Further details on the development of this cause-of-death grouping are available in related publications (39,40).

Sudden unexpected infant death

Recent studies have identified changes in how sudden unexplained infant deaths have been classified over time by medical examiners and coroners, with large decreases in sudden infant death syndrome (SIDS) accompanied by corresponding increases in cause unknown and accidental suffocation and strangulation in bed (41,56,57). To facilitate more consistent tracking of trends in these deaths, unaffected by classification differences, a special cause-of-death category has been developed for Sudden Unexpected Infant Deaths (SUID) (41,42). SUID is defined as, “The death of an infant less than one year of age in which investigation, autopsy, medical history review and appropriate laboratory testing fail to identify a specific cause of death. SUID includes cases that meet the definition of sudden infant death syndrome” (58). The SUID category combines ICD–10 codes for Sudden Infant Death Syndrome, or SIDS (R95), Accidental Suffocation and Strangulation in Bed, or ASSB (W75), and Unknown cause (R99) based on underlying cause of death. This category is currently being used as a key indicator by Healthy People 2020 Maternal, Infant, and Child Health outcomes (43), the Collaborative Improvement & Innovation Network to Reduce Infant Mortality (59), and *Child Health USA* (60).

Computation of rates

Infant mortality rates are the most commonly used index for measuring the risk of dying during the first year of life. For the linked birth/infant death data set, they are calculated by dividing the number of infant deaths in a calendar year by the number of live births registered for the same period and are presented as rates per 1,000 or per 100,000 live births. Both the mortality file and the linked birth/infant death file use this computation method, but due to unique numbers of infant deaths, as explained in the section above on the comparison of these two files, the rates will often differ for specific variables (particularly for race and ethnicity). Infant mortality rates in the linked file use the number of live births in the denominator to approximate the population at risk of dying before the first birthday. In contrast to the infant mortality rates based on live births, infant

death rates, used only in age-specific death rates with the mortality file, use the estimated population of persons under age 1 year as the denominator.

For all variables, not stated responses were shown in tables of frequencies but were subtracted before rates were computed. Rates per 1,000 live births display two digits after the decimal place to provide a more precise and sensitive measurement. For rates per 100,000 live births (by cause of death), the infant mortality rate is shown for one decimal place. Adding an additional decimal for rates per 100,000 does not increase precision as it does for rates per 1,000.

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

Random variation in infant mortality rates

The number of infant deaths and live births reported for an area represent complete counts of such events. As such, they are not subject to sampling error, although they are subject to nonsampling error in the registration process. However, when the figures are used for analytic purposes, such as the comparison of rates over time, for different areas, or among different subgroups, the number of events that actually occurred may be considered as one of a large series of possible results that could have arisen under the same circumstances (61). As a result, numbers of births, deaths, and infant mortality rates are subject to random variation. The probable range of values may be estimated from the actual figures according to certain statistical assumptions.

In general, distributions of vital events may be assumed to follow the normal distribution. When the number of events is large, the relative standard error (RSE) is usually small. When the number of events is small (i.e., fewer than 100) and the probability of such an event is small, considerable caution must be observed in interpreting the data. Such infrequent events may be assumed to follow a Poisson probability distribution (3,4). Estimates of RSEs and 95% confidence intervals are shown below.

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

$$RSE(D)=100 \cdot \sqrt{\frac{1}{D}} \text{ where } D \text{ is the number of deaths and}$$

$$RSE(B)=100 \cdot \sqrt{\frac{1}{B}} \text{ where } B \text{ is the number of births.}$$

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

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

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

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

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

The RSE of the IMR for the example above

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

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

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

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

Thus, for Group A:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Comparison of two infant mortality rates—If either of the two rates to be compared is based on fewer 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% level. If they do not overlap, the difference is statistically significant. If both of the two rates (R_1 and R_2) to be compared are based on 100 or more deaths, the following z test may be used to define a significance test statistic:

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

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

Availability of linked file data

Linked file data are available for download at: http://www.cdc.gov/nchs/data_access/VitalStatsOnline.htm. Beginning with 2005, the public-use file no longer includes geographic detail; such files are available upon special request (see: http://www.cdc.gov/nchs/nvss/dvs_data_release.htm). Data are also available in issues of Vital and Health Statistics, Series 20, National Vital Statistics Reports, and Data Briefs from the NCHS website: <http://www.cdc.gov/nchs/>.

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

N	L	U	N	L	U
1.....	0.025	5.572	51.....	0.745	1.315
2.....	0.121	3.612	52.....	0.747	1.311
3.....	0.206	2.922	53.....	0.749	1.308
4.....	0.272	2.560	54.....	0.751	1.305
5.....	0.325	2.334	55.....	0.753	1.302
6.....	0.367	2.177	56.....	0.755	1.299
7.....	0.402	2.060	57.....	0.757	1.296
8.....	0.432	1.970	58.....	0.759	1.293
9.....	0.457	1.898	59.....	0.761	1.290
10.....	0.480	1.839	60.....	0.763	1.287
11.....	0.499	1.789	61.....	0.765	1.285
12.....	0.517	1.747	62.....	0.767	1.282
13.....	0.532	1.710	63.....	0.768	1.279
14.....	0.547	1.678	64.....	0.770	1.277
15.....	0.560	1.649	65.....	0.772	1.275
16.....	0.572	1.624	66.....	0.773	1.272
17.....	0.583	1.601	67.....	0.775	1.270
18.....	0.593	1.580	68.....	0.777	1.268
19.....	0.602	1.562	69.....	0.778	1.266
20.....	0.611	1.544	70.....	0.780	1.263
21.....	0.619	1.529	71.....	0.781	1.261
22.....	0.627	1.514	72.....	0.782	1.259
23.....	0.634	1.500	73.....	0.784	1.257
24.....	0.641	1.488	74.....	0.785	1.255
25.....	0.647	1.476	75.....	0.787	1.254
26.....	0.653	1.465	76.....	0.788	1.252
27.....	0.659	1.455	77.....	0.789	1.250
28.....	0.664	1.445	78.....	0.790	1.248
29.....	0.670	1.436	79.....	0.792	1.246
30.....	0.675	1.428	80.....	0.793	1.245
31.....	0.679	1.419	81.....	0.794	1.243
32.....	0.684	1.412	82.....	0.795	1.241
33.....	0.688	1.404	83.....	0.796	1.240
34.....	0.693	1.397	84.....	0.798	1.238
35.....	0.697	1.391	85.....	0.799	1.237
36.....	0.700	1.384	86.....	0.800	1.235
37.....	0.704	1.378	87.....	0.801	1.234
38.....	0.708	1.373	88.....	0.802	1.232
39.....	0.711	1.367	89.....	0.803	1.231
40.....	0.714	1.362	90.....	0.804	1.229
41.....	0.718	1.357	91.....	0.805	1.228
42.....	0.721	1.352	92.....	0.806	1.226
43.....	0.724	1.347	93.....	0.807	1.225
44.....	0.727	1.342	94.....	0.808	1.224
45.....	0.729	1.338	95.....	0.809	1.222
46.....	0.732	1.334	96.....	0.810	1.221
47.....	0.735	1.330	97.....	0.811	1.220
48.....	0.737	1.326	98.....	0.812	1.219
49.....	0.740	1.322	99.....	0.813	1.217
50.....	0.742	1.318			

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