

Fetal and Perinatal Mortality, United States, 2005

by Marian F. MacDorman, Ph.D., and Sharon Kirmeyer, Ph.D., Division of Vital Statistics

Abstract

Objectives—This report presents 2005 fetal and perinatal mortality data by a variety of characteristics, including maternal age, marital status, race, Hispanic origin, and state of residence; and by fetal gestational age at delivery, birthweight, plurality, and sex. Trends in fetal and perinatal mortality are also examined.

Methods—Descriptive tabulations of data are presented and interpreted.

Results—In 2005, there were 25,894 reported fetal deaths of 20 weeks of gestation or more in the United States. The U.S. fetal mortality rate was 6.22 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths, not significantly different from the rate of 6.20 in 2004 or 6.23 in 2003. The fetal mortality rate declined slowly but steadily from 1990 to 2003, but did not decline from 2003 to 2005. Most of the decline in the overall fetal mortality rate from 1990 to 2003 was due to a decline in fetal deaths of 28 weeks of gestation or more; fetal deaths of 20–27 weeks did not decline. From 2003 to 2005, fetal mortality rates did not decline for either gestational age grouping. From 2003 to 2005, fetal mortality rates declined significantly for non-Hispanic white and non-Hispanic black women, but not for Hispanic, American Indian or Alaska Native (AIAN), or Asian or Pacific Islander women. In 2005, the fetal mortality rate for non-Hispanic black women (11.13) was 2.3 times the rate for non-Hispanic white women (4.79). The rate for AIAN women (6.17) was 29% higher, and the rate for Hispanic women (5.44) was 14% higher than the rate for non-Hispanic white women. Fetal mortality rates are elevated for a number of groups, including teenagers, women aged 35 years and over, unmarried women, and multiple deliveries. In 2005, one-half of fetal deaths of 20 weeks of gestation or more occurred at 20–27 weeks of gestation.

Keywords: fetal mortality • perinatal mortality • fetal death • stillbirth • pregnancy loss

Introduction

Fetal mortality is an important public health issue. Fetal mortality refers to the intrauterine death of a fetus at any gestational age. The

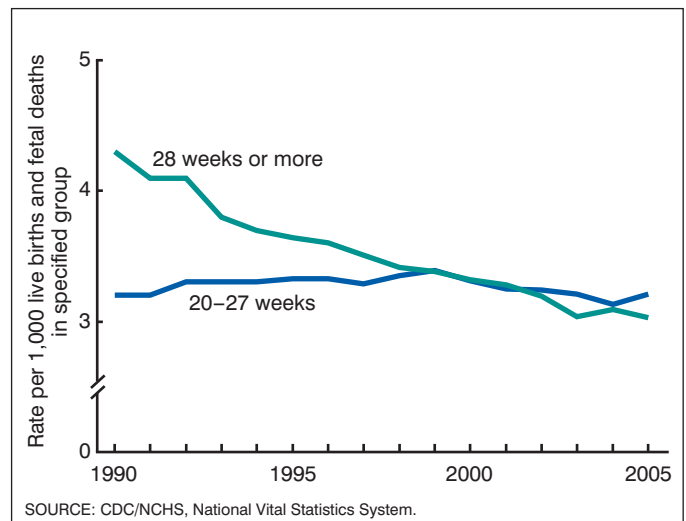


Figure 1. Fetal mortality rates by period of gestation: United States, 1990–2005

National Survey of Family Growth estimates about 1 million fetal losses per year in the United States (1) with the vast majority of these occurring before 20 weeks of gestation. Fetal mortality data from

Acknowledgments

This report was prepared in the Division of Vital Statistics (DVS) under the general direction of Charles J. Rothwell, Director of DVS and Stephanie J. Ventura, Chief of the Reproductive Statistics Branch (RSB). Candace Cosgrove and Steven J. Steimel of the Systems, Programming, and Statistical Resources Branch provided computer programming support. Yashodhara Patel of RSB provided assistance with content review. The Registration Methods staff and the Data Acquisition and Evaluation Branch provided consultation to state vital statistics offices regarding collection of the birth and death certificate data on which this report is based. This report was edited by Demarius V. Miller, CDC/CCHIS/NCHM/Division of Creative Services, Writer-Editor Services Branch; typeset by Jacqueline M. Davis, CDC/CCHIS/NCHM/Division of Creative Services; and graphics were produced by Odell Eldridge, CDC/CCHIS/NCHM/Division of Creative Services, NOVA contractor.

the National Vital Statistics System are usually presented for fetal deaths of 20 weeks of gestation or more. Even when only fetal deaths of 20 weeks or more are considered, there are nearly as many fetal deaths as infant deaths in the United States each year. Perinatal mortality refers to death around the time of delivery and includes both fetal deaths (of at least 20 weeks of gestation) and early infant (neonatal) deaths. Much of the public concern regarding reproductive loss has concentrated on infant mortality; however, a focus on fetal mortality may provide further opportunities for prevention.

The U.S. fetal mortality rate declined from 25.0 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths in 1942 (2) to 6.23 in 2003 (3). The real decline in fetal mortality during this period was probably larger, as reporting of fetal deaths has improved over time (4,5). However, the U.S. fetal mortality rate did not decrease from 2003 to 2005, suggesting a halt in this long-term decline. A similar plateau in the U.S. infant mortality rate from 2000 to 2005 is described in a separate report (6). Also of concern are large racial and ethnic disparities in U.S. fetal and perinatal mortality rates. Fetal and perinatal mortality rates in the United States appear to be higher than those in many other developed countries (comparison made for fetal deaths of 28 weeks of gestation or more to avoid international differences in reporting requirements) (7–9). This report presents detailed data on fetal and perinatal deaths and mortality rates for the United States for 2005. Data are presented by maternal age, marital status, race, Hispanic origin, and state of residence; and by fetal gestational age at delivery, birthweight, plurality, and sex (Tables 1–3, A–F, and Figures 1–7). Trends in fetal and perinatal mortality are also examined.

Methods

Data sources—Data shown in this report are drawn from two different National Center for Health Statistics (NCHS) vital statistics data files: the 2005 fetal death data set (for fetal deaths), and the 2005 period linked birth/infant death data set (linked file) (for live births and infant deaths). The 2005 fetal death data set contains information from all Reports of Fetal Death filed in the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam (10). In the linked file the information from the death certificate is linked to the information from the birth certificate for each infant under 1 year of age who died in 2005 (11,12). The purpose of the linkage is to use the many additional variables available from the birth certificate to conduct more detailed analyses of infant and perinatal mortality patterns. Infant deaths from the linked file are used in preference to those from the main mortality file for tabulating perinatal deaths because the linked file contains data by birth and maternal characteristics, similar to the fetal death file. Tables showing data by state also provide separate information for Puerto Rico, the Virgin Islands, and Guam; however, these data are not included in U.S. totals.

Fetal mortality—Fetal death refers to the intrauterine death of a fetus before delivery (see “[Technical Notes](#)”). Fetal mortality is generally divided into three periods: early (less than 20 completed weeks of gestation), intermediate (20–27 weeks of gestation), and late (28 weeks of gestation or more). Although the vast majority of fetal deaths occur early in pregnancy (1), most states in the U.S. only report fetal deaths of 20 weeks of gestation or more, and these intermediate and late fetal deaths are the subject of this report. Statistics on fetal death

exclude data for induced terminations of pregnancy. There is substantial variation among states in reporting requirements and completeness of reporting for fetal death data, and these variations have important implications for data quality and completeness (13–16). In particular, three states (New Mexico, South Dakota, and Tennessee) require reporting of fetal deaths with birthweights of 500 grams or more (roughly equivalent to 22 weeks of gestation). Lack of full reporting for these states leads to a slight underestimate of the U.S. fetal mortality rate. For example, when data for these three states were excluded, the 2005 fetal mortality rate was 6.28, compared with 6.22 for all states combined (see “[Technical Notes](#)”).

Correct interpretation of fetal death data must include an evaluation of the completeness of reporting of fetal deaths, and also an evaluation of the completeness of reporting for the specific variables of interest. The percentage of not stated responses for fetal death data varies substantially among variables and states (see “[Technical Notes](#)”). Fetal mortality rates in this report are computed as the number of fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths of 20 weeks or more, the population at risk of the event (see “[Technical Notes](#)”).

Perinatal mortality—This report includes two different definitions of perinatal mortality. Perinatal definition I includes infant deaths of less than 7 days of age and fetal deaths of 28 weeks of gestation or more. Perinatal definition II is the most inclusive definition, and includes infant deaths of less than 28 days of age and fetal deaths of 20 weeks or more. The denominators for all perinatal rate computations are per 1,000 live births plus fetal deaths; see “[Technical Notes](#).” Perinatal definition I is preferred for international comparisons due to differences among countries in completeness of reporting of fetal deaths of 20–27 weeks of gestation. Perinatal definition II is useful for monitoring perinatal mortality throughout the gestational age spectrum, as the majority of fetal deaths occur before 28 weeks of gestation.

The 2003 Revision of the U.S. Standard Report of Fetal Death—This report includes data for 11 states (Idaho, Kansas, Kentucky, Maryland, Michigan, Nebraska, New Hampshire, Oklahoma, South Dakota, Utah, and Washington) that implemented the 2003 Revision of the U.S. Standard Report of Fetal Death on or before January 1, 2005 (revised). The remaining reporting areas include data that are based on the 1989 Revision of the U.S. Standard Report of Fetal Death (unrevised); see “[Technical Notes](#).” Because the variables included in this report are comparable between revisions, these changes had little effect on the data in this report.

Race and Hispanic origin—Race and Hispanic origin of mother are reported independently on vital records. In tabulations of data by race and Hispanic origin, data for Hispanic persons are not further classified by race as the vast majority of women of Hispanic origin are reported as white. Data for American Indian or Alaska Native (AIAN) and Asian or Pacific Islander (API) women are not shown separately by Hispanic origin because the vast majority of these populations are non-Hispanic. The 2003 Revision of the U.S. Standard Report of Fetal Death allows the reporting of more than one race (multiple races) for each parent (17). In 2005, 12 states (the 11 revised states and Minnesota) allowed the reporting of more than one race for fetal death data (10). To provide uniformity and comparability of the data, multiple-race data were bridged to a single race; see “[Technical Notes](#).”

Statistical significance—Text statements have been tested for statistical significance, and a statement that a given mortality rate is higher or lower than another rate indicates that the rates are

significantly different. For information on the methods used to test for statistical significance, as well as information on the definition, reporting requirements, and data quality of fetal death data, the 2003 Revision of the U.S. Standard Certificates and Reports, computation of rates, multiple-race data, period of gestation, and availability of fetal and perinatal data, see “[Technical Notes](#).”

Results

Trends in fetal and perinatal mortality

In 2005, the U.S. fetal mortality rate was 6.22 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths. This rate was not significantly different from the rate of 6.20 in 2004 or 6.23 in 2003, halting a long-term decline. From 1990–2003, the fetal mortality rate declined slowly but steadily, by an average of 1.4% per year (Figure 2). In contrast, the infant mortality rate declined twice as fast as the fetal mortality rate from 1990–2000 (by an average of 2.8% per year), but did not decline from 2000–2005.

The trend in fetal mortality rates by period of gestation is shown in Figure 1. The fetal mortality rate for 28 weeks of gestation or more declined by 29% from 1990–2003, but did not decline significantly from 2003–2005. In contrast, the fetal mortality rate for 20–27 weeks of gestation has changed little since 1990 (Figure 1 and Table A). Thus, nearly all the decline in fetal mortality from 1990 to 2003 was among fetal deaths of 28 weeks of gestation or more.

Figure 3 shows trends for perinatal mortality rates, definitions I and II, from 1990–2005. The perinatal mortality rate, definition I, declined by 25% from 1990–2003. However, the rate of 6.64 in 2005 was not significantly different from the rate of 6.69 in 2004, or 6.74 in 2003 (Figure 3 and Table A). The perinatal mortality rate, definition II, declined by 17% from 1990–2003. The rate of 10.73 in 2005 was not significantly different from the rate of 10.70 in 2004 or 10.83 in 2003. The decline in the perinatal mortality rate, definition I, was more rapid than for perinatal definition II because perinatal definition I includes only

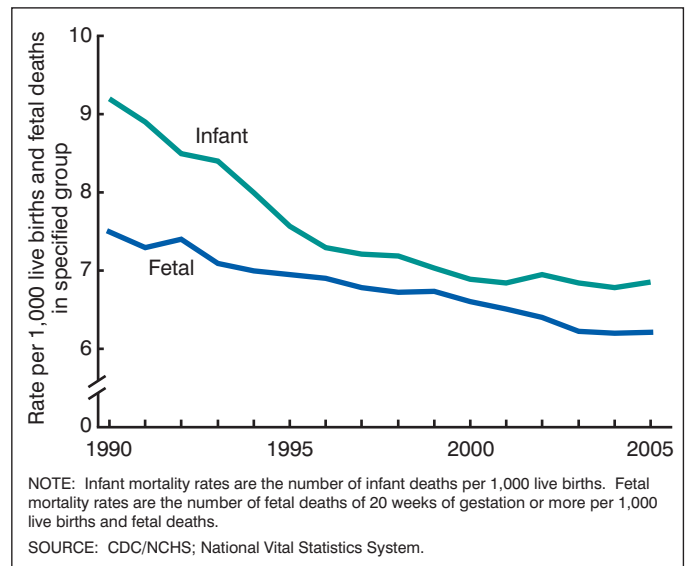


Figure 2. Fetal and infant mortality rates: United States, 1990–2005

late fetal deaths, and as noted, almost all the decline in fetal mortality from 1990–2003 was among late fetal deaths.

Trends in numbers of fetal deaths, neonatal deaths, and live births (the components used to compute fetal and perinatal mortality rates) are shown in Table B. Consistent with a trend observed for many years, the number of fetal deaths of 20 weeks of gestation or more in 2005 (25,894) was substantially greater than the number of neonatal deaths (18,782). The total number of infant deaths in 2005 was 28,384 (12), about 10% higher than the total number of fetal deaths of 20 weeks of gestation or more.

Race and Hispanic origin

Fetal and perinatal mortality rates vary considerably by race and Hispanic origin of mother (Figure 4). The fetal mortality rate for

Table A. Fetal and perinatal mortality rates: United States, 1985, 1990, and 1995–2005

Year	Fetal mortality rate ¹			Perinatal mortality rate	
	Total ²	20–27 weeks ³	28 weeks or more ³	Definition I ⁴	Definition II ⁵
2005	6.22	3.21	3.03	6.64	10.73
2004	6.20	3.13	3.09	6.69	10.70
2003	6.23	3.21	3.04	6.74	10.83
2002	6.41	3.24	3.19	6.91	11.05
2001	6.51	3.25	3.28	6.90	11.02
2000	6.61	3.31	3.32	6.97	11.19
1999	6.74	3.39	3.38	7.12	11.44
1998	6.73	3.35	3.41	7.21	11.50
1997	6.78	3.29	3.51	7.32	11.51
1996	6.91	3.33	3.60	7.43	11.64
1995	6.95	3.33	3.64	7.60	11.84
1990	7.49	3.22	4.30	8.95	13.12
1985	7.83	2.91	4.95	10.59	14.57

¹Rate is number of fetal deaths in specified group per 1,000 live births and fetal deaths.

²Fetal deaths with stated or presumed period of gestation of 20 weeks or more.

³Not stated gestational age proportionally distributed; see “[Technical Notes](#).”

⁴Infant deaths of less than 7 days and fetal deaths with stated or presumed period of gestation of 28 weeks or more, per 1,000 live births and fetal deaths.

⁵Infant deaths of less than 28 days and fetal deaths with stated or presumed period of gestation of 20 weeks or more, per 1,000 live births and fetal deaths.

SOURCE: CDC/NCHS, National Vital Statistics System.

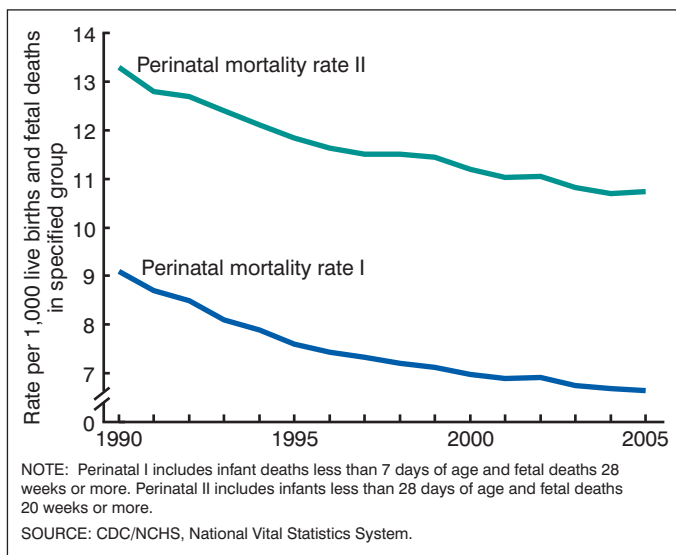


Figure 3. Perinatal mortality rates: United States, 1990–2005

non-Hispanic white women was 4.79, similar to the rate of 4.78 for API women. In contrast, the fetal mortality rate of 11.13 for non-Hispanic black women was 2.3 times the rate for non-Hispanic white women. About two-thirds (64%) of the difference between non-Hispanic black and non-Hispanic white fetal mortality was due to higher non-Hispanic black fetal mortality at 20–27 weeks of gestation and about one-third (36%) was due to higher mortality at 28 weeks of gestation or more. The rate for AIAN women (6.17) was 29% higher and the rate for Hispanic women (5.44) was 14% higher than the rate for non-Hispanic white women. Fetal mortality generally declined for most racial and ethnic groups from 1995–2003 (Table C). From 2003–2005, fetal mortality rates declined significantly for non-Hispanic white and non-Hispanic black women, but not for Hispanic, AIAN, or API women (Table C).

Differences by race and Hispanic origin in the perinatal mortality rate, definition I, are shown in Figure 5. Rates were lowest for API women (4.96), followed by non-Hispanic white (5.36), Hispanic (5.89),

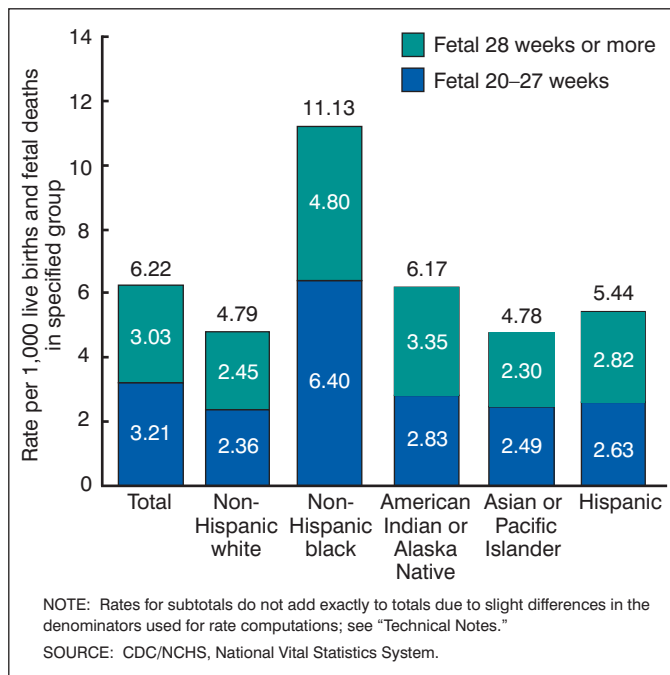


Figure 4. Fetal mortality rates by race and Hispanic origin of mother: United States, 2005

and AIAN women (6.29). The rate for non-Hispanic black women (12.19) was the highest among the racial and ethnic groups, and was 2.3 times the rate for non-Hispanic white women.

Data by race and Hispanic origin for the perinatal mortality rate, definition II, are shown in Figure 6. The patterns were similar to those for definition I. Rates were lowest for API women (8.13), followed by non-Hispanic white (8.48), Hispanic (9.27), and AIAN women (10.18). The rate for non-Hispanic black women (20.17) was 2.4 times the rate for non-Hispanic white women.

Part of the higher risk of fetal and perinatal mortality for non-Hispanic black women relates to their higher risk of preterm delivery (18,19), however, the reasons for the preterm disparity are not well understood. Factors frequently mentioned as contributing to the

Table B. Components of perinatal mortality: United States, 1985, 1990, and 1995–2005

Year	Fetal deaths			Infant deaths		Live births
	Total ¹	20–27 weeks ²	28 weeks or more ²	Less than 7 days	Less than 28 days	
2005	25,894	13,327	12,567	15,013	18,782	4,138,573
2004	25,655	12,894	12,761	14,836	18,602	4,112,055
2003	25,653	13,168	12,485	15,152	18,935	4,090,007
2002	25,943	13,072	12,871	15,020	18,791	4,021,825
2001	26,373	13,122	13,251	14,622	18,275	4,026,036
2000	27,003	13,497	13,506	14,893	18,733	4,058,882
1999	26,884	13,457	13,427	14,874	18,700	3,959,417
1998	26,702	13,229	13,473	15,061	18,915	3,941,553
1997	26,486	12,800	13,686	14,827	18,507	3,880,894
1996	27,069	12,990	14,079	14,947	18,556	3,891,494
1995	27,294	13,043	14,251	15,483	19,186	3,899,589
1990	31,386	13,427	17,959	19,439	23,591	4,158,445
1985	29,661	10,958	18,703	21,317	25,573	3,760,833

¹Fetal deaths with stated or presumed period of gestation of 20 weeks or more.

²Not stated gestational age proportionally distributed; see "Technical Notes."

SOURCE: CDC/NCHS, National Vital Statistics System.

Table C. Fetal deaths and mortality rates by race and Hispanic origin of mother: United States, 1995–2005

	All races and origins	White	Black	American Indian or Alaska Native	Asian or Pacific Islander	Hispanic ¹				Non-Hispanic ¹		
						Total Hispanic	Mexican	Puerto Rican	Cuban	Central and South American	White	Black
Rates												
2005	6.22	5.31	11.35	6.17	4.78	5.44	5.24	6.09	4.15	4.50	4.79	11.13
2004	6.20	5.30	11.45	5.84	4.77	5.43	5.07	6.25	5.46	4.57	4.98	11.25
2003	6.23	5.25	11.97	6.09	4.98	5.43	5.08	7.44	5.09	4.63	4.94	11.56
2002	6.41	5.47	11.91	6.24	4.95	5.71	5.42	7.03	5.32	4.76	5.14	11.47
2001	6.51	5.52	12.13	5.91	5.21	5.64	5.22	6.91	5.40	4.93	5.24	11.72
2000	6.61	5.57	12.45	5.54	5.17	5.79	5.48	6.61	7.55	4.73	5.26	11.97
1999	6.74	5.68	12.63	6.14	5.40	5.84	5.34	7.03	6.84	5.06	5.37	12.18
1998	6.73	5.73	12.31	5.85	5.12	5.74	5.23	6.31	5.59	5.38	5.42	11.75
1997	6.78	5.77	12.45	6.75	4.81	6.01	5.49	7.69	5.24	5.10	5.49	11.90
1996	6.91	5.93	12.49	6.43	5.11	6.03	5.45	7.56	6.15	5.44	5.70	11.81
1995	6.95	5.92	12.71	7.11	5.02	6.09	5.76	8.05	6.37	5.54	5.67	12.18
Number of deaths												
2005	25,894	17,238	7,269	278	1,109	5,387	3,651	388	67	683	10,973	6,573
2004	25,655	17,164	7,135	258	1,098	5,135	3,425	384	82	658	11,316	6,530
2003	25,653	17,016	7,265	264	1,108	4,950	3,315	437	76	629	11,350	6,685
2002	25,943	17,468	7,159	266	1,050	5,002	3,393	406	76	601	11,690	6,654
2001	26,373	17,629	7,446	249	1,049	4,803	3,183	400	76	600	12,080	6,939
2000	27,003	17,883	7,846	232	1,042	4,728	3,189	386	102	538	12,324	7,264
1999	26,884	17,904	7,750	248	982	4,470	2,888	404	90	524	12,484	7,210
1998	26,702	17,974	7,603	237	888	4,197	2,696	362	74	521	12,453	6,712
1997	26,486	17,838	7,566	262	820	4,202	2,738	393	67	474	12,119	6,598
1996	27,069	18,448	7,524	245	852	4,169	2,669	384	77	509	12,731	6,518
1995	27,294	18,452	7,766	267	809	4,079	2,704	409	79	501	12,777	6,840

¹Figures exclude data from Maryland, Massachusetts, and Oklahoma in 1995–1997, Maryland and Oklahoma in 1998, and Oklahoma in 1999–2004, which did not report Hispanic origin on the fetal death report.

SOURCE: CDC/NCHS, National Vital Statistics System.

black/white fetal and perinatal mortality gap are racial differences in maternal preconception health, infection, income, access to quality health care, stress and racism, and cultural factors; however, much of the black/white disparity in perinatal mortality remains unexplained (20–23).

Maternal age

Fetal mortality rates vary considerably by maternal age. Fetal mortality rates were lowest for women aged 25–29 years and higher for teenagers and those aged 35 years and over (Table 1). The rate

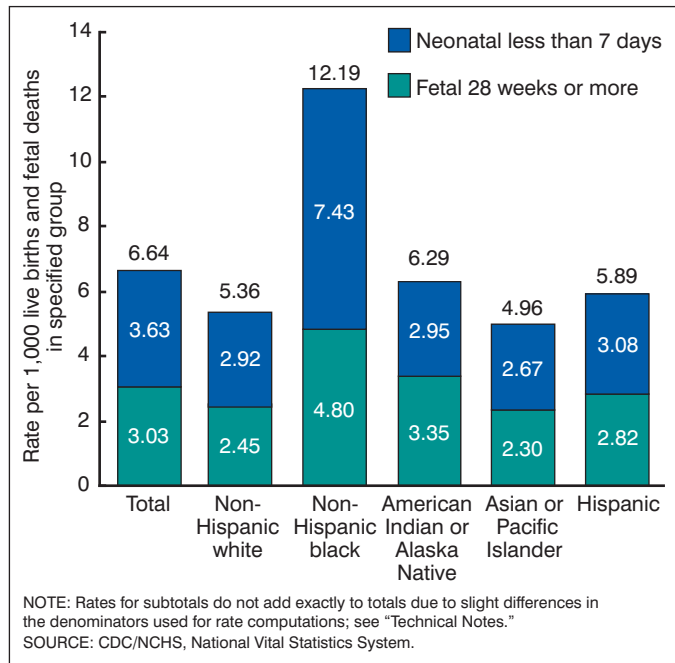


Figure 5. Perinatal mortality rates, definition I, by race and Hispanic origin of mother: United States, 2005

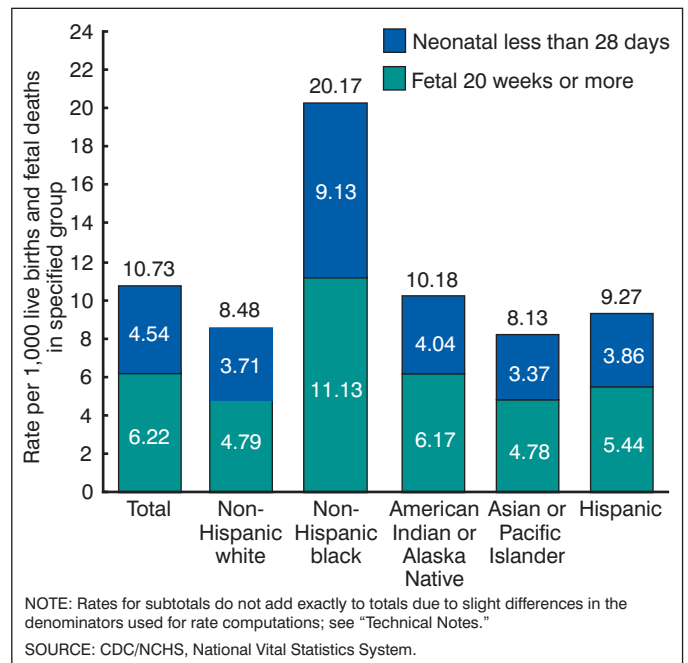


Figure 6. Perinatal mortality rates, definition II, by race and Hispanic origin of mother: United States, 2005

for teenagers under 15 years of age was 12.20, more than twice the rate of 5.47 for women aged 25–29 years—the lowest risk group. Rates for teenagers 15–17 (8.26), and 18–19 years (7.20) were 51% and 32% higher, respectively, than for women aged 25–29 years. The higher risk for teenagers may relate to less favorable socioeconomic and behavioral conditions among pregnant teenagers, although biologic immaturity may also play a role, particularly for the youngest teenagers (24).

At the opposite end of the age spectrum, fetal mortality rates increased rapidly for women aged 35 years and over. For women aged 45 years and over the fetal mortality rate was 15.51, 2.8 times the rate for women aged 25–29 years. Maternal age over 35 appears to be an independent risk factor for fetal death, even after adjusting for medical conditions that are more common among older women, such as hypertension, diabetes, placental problems, and multiple gestation (25–27). However, the magnitude of the elevated risk differs somewhat by race (28).

Marital status

In 2005, 49% of fetal deaths were to unmarried women, as compared with 37% of live births (Table D) in an area including 46 states and the District of Columbia. Marital status was not reported for fetal deaths in California, Nevada, New York, and Texas. In general, fetal mortality rates were higher for unmarried than for married women (Table E). For non-Hispanic white women, the fetal mortality rate for unmarried women was 37% higher than for married women. For non-Hispanic black women, the rate for unmarried women was 9% higher, while the 8% difference for Hispanic women was not statistically significant. Marital status may be a marker for the presence or absence of social, emotional, and financial resources (29,30).

Sex of fetus

In 2005, the fetal mortality rate for male fetuses was 6.43, 7% higher than for female (6.00) fetuses (Table E). Fetal mortality rates were higher for male than for female fetuses for non-Hispanic white, non-Hispanic black, and Hispanic women. The higher risk for males appears to relate in part to a higher risk of preterm delivery and preterm premature rupture of membranes among male fetuses. (31,32) A more detailed discussion of sex ratios for fetal deaths was included in a previous report (33).

Plurality

In 2005, 9% of fetal deaths occurred in multiple deliveries, as compared with 3% of live births (Table D). A multiple delivery is one in which more than one fetus is delivered live or dead at any time during the pregnancy, and a given multiple pregnancy may include any combination of fetal deaths or live births.

The fetal mortality rate for twins (16.08) was 2.7 times that for singletons (5.85) (Table E). The fetal mortality rate for triplet or higher order deliveries (27.18) was five times that for singletons. The increased risks for multiple pregnancies may relate in part to increased rates of preterm labor, fetal growth restriction, pre-eclampsia, congenital anomalies, placental abruption, and cord accidents (34). Also, many multiple pregnancies are the result of assisted reproductive technologies (35). Studies have suggested that both the underlying infertility problem, and the use of these therapies may increase the risk of adverse outcomes (35).

Period of gestation

In general, many more fetal deaths than live births occur early in pregnancy. In 2005, more than one-third (35%) of all fetal deaths at 20 weeks of gestation or more occurred at 20–23 weeks of gestation, and more than one-half (51%) occurred at 20–27 weeks (Table 2).

Table D. Percentage of fetal deaths and live births with selected demographic, medical, and health characteristics: United States, 2005

	Fetal deaths				Live births			
	Total ¹	Non-Hispanic			Total ¹	Non-Hispanic		
		White	Black	Hispanic		White	Black	Hispanic
Mother's characteristics:								
Less than 20 years of age	12.5	9.5	16.8	15.3	10.2	7.3	17.0	14.1
40 years of age and over	4.9	5.5	4.0	4.7	2.7	3.0	2.2	2.0
Unmarried ²	49.0	35.9	72.8	51.4	36.8	26.0	70.9	49.4
Fetal/infant characteristics:								
Birthweight								
Less than 1,500 grams	65.79	62.84	72.42	62.79	1.52	1.23	3.35	1.22
Less than 2,500 grams	82.0	79.9	87.5	79.1	8.2	7.3	14.1	6.9
4,000 grams or more	1.7	1.7	1.4	2.1	8.1	9.6	4.4	7.6
Period of gestation								
Less than 32 weeks	64.20	61.48	70.24	61.37	2.03	1.64	4.17	1.79
Preterm (less than 37 weeks)	82.0	80.4	86.1	79.9	12.7	11.7	18.4	12.1
Plural delivery	9.1	11.0	7.7	7.2	3.4	3.8	3.7	2.3

¹Includes races other than white and black and origin not stated.

²Excludes data from California, Nevada, New York, and Texas, which did not report marital status on the fetal death report.

NOTE: Not stated responses excluded when computing percent distributions.

SOURCE: CDC/NCHS, National Vital Statistics System.

Table E. Fetal mortality rates by selected characteristics and race and Hispanic origin of mother, United States, 2005

Characteristic	Fetal mortality rates ¹				Fetal deaths				Live births			
	All races ²	Non-Hispanic white	Non-Hispanic black	Hispanic	All races ²	Non-Hispanic white	Non-Hispanic black	Hispanic	All races ²	Non-Hispanic white	Non-Hispanic black	Hispanic
Plurality	6.22	4.79	11.13	5.44	25,894	10,973	6,573	5,387	4,138,573	2,279,959	583,764	985,513
Single	5.85	4.43	10.68	5.17	23,532	9,763	6,067	5,000	3,998,753	2,192,768	561,894	963,027
Twin	16.08	13.26	21.95	16.12	2,175	1,105	477	356	133,126	82,225	21,254	21,725
Triplet or higher order	27.18	20.71	44.96	39.14	187	105	29	31	6,694	4,966	616	761
Sex of fetus	6.22	4.79	11.13	5.44	25,894	10,973	6,573	5,387	4,138,573	2,279,959	583,764	985,513
Male	6.43	4.93	11.78	5.58	13,706	5,802	3,530	2,826	2,119,101	1,170,614	296,240	503,489
Female	6.00	4.64	10.47	5.28	12,188	5,171	3,043	2,561	2,019,472	1,109,345	287,524	482,024
Ratio male/female	1.07	1.06	1.12	1.06	...	...	...	...	...	...	...	...
Marital status, total ³	6.27	4.70	10.96	5.26	18,431	8,701	5,164	2,324	2,920,138	1,841,034	466,193	439,713
Married	4.80	3.98	9.85	4.92	8,898	5,439	1,350	1,099	1,844,849	1,362,348	135,678	222,328
Unmarried	7.89	6.32	10.84	5.33	8,550	3,044	3,622	1,164	1,075,289	478,686	330,515	217,385
Ratio unmarried/married	1.64	1.59	1.10	1.08	...	...	...	...	...	...	...	...

... Category not applicable.

¹Rate per 1,000 live births and fetal deaths in specified group.

²Includes races other than white, black, and origin not stated.

³Excludes data from California, Nevada, New York, and Texas, which did not report marital status on the fetal death report. Includes records with marital status not stated.

SOURCE: CDC/NCHS, National Vital Statistics System.

Traditionally, fetal mortality rates by gestational age have been computed as the number of fetal deaths at a given gestational age per 1,000 live births and fetal deaths at that gestational age. Fetal mortality rates computed in this fashion are very high at the earliest gestational ages (where few live births occur), are lowest at 40 and 41 weeks of gestation, and then increase slightly at 42 weeks of gestation or more. In 2005, the fetal mortality rate computed by this method was 504.10 at 20–23 weeks of gestation, declined sharply to a low of 0.86 at 40 weeks of gestation, and then increased to 1.66 for fetal deaths at 42 weeks of gestation or more (Table 2). Gestational age data are primarily based on the interval between the first day of the mother's last normal menstrual period (LMP) and the date of delivery, and is subject to error due to imperfect maternal recall or misidentification of the LMP; see "Technical Notes" (18).

Some researchers have suggested changing the method of computing fetal mortality rates by gestational age to use a different denominator that would more accurately represent the population at risk of the event (36–38). For fetal mortality at a given gestational age, a more appropriate indication of the population at risk of fetal death is actually **all of the women who are still pregnant at that gestational age**. This *prospective fetal mortality rate* is computed as the number of fetal deaths at a given gestational age (in single weeks), per 1,000 live births and fetal deaths at that gestational age or greater. Prospective fetal mortality rates are shown in Figure 7 for fetal deaths between 20 and 43 weeks of gestation. In general, rates were high at the earliest and latest gestational ages. The rate was high (0.56–0.60) at 20–22 weeks of gestation, and declined to a low of 0.19–0.21 at 27–33 weeks of gestation. The rate remained relatively low until about 37 weeks of gestation, and then increased rapidly to a high of 0.81 at 43 weeks of gestation. The lower rate at 20 weeks than 21 weeks of gestation probably reflects underreporting of fetal deaths at 20 weeks of gestation.

The prospective fetal mortality rate is useful in identifying two distinct peaks in fetal mortality risk: early fetal mortality (less than 23 weeks), and fetal mortality at 40 weeks of gestation or more. These two peaks suggest etiological differences. Early fetal mortality may be

more related to congenital infections, anomalies, utero-placental insufficiency, and underlying maternal medical conditions (39). Fetal mortality at 40 weeks or more may include the previously mentioned conditions, but may also be related to problems that manifest around the time of delivery, such as placental (abruptio, previa) and cord (prolapse) problems, or other problems in the labor and delivery process. However, investigations into late fetal deaths have found that a substantial number are of unknown cause (26, 39–41).

Birthweight

In 2005, over one-third (35%) of fetal deaths at 20 weeks of gestation or more weighed less than 500 grams at delivery, and one-half weighed less than 750 grams (Table 2). Fetal mortality rates were computed by the traditional method as the number of fetal

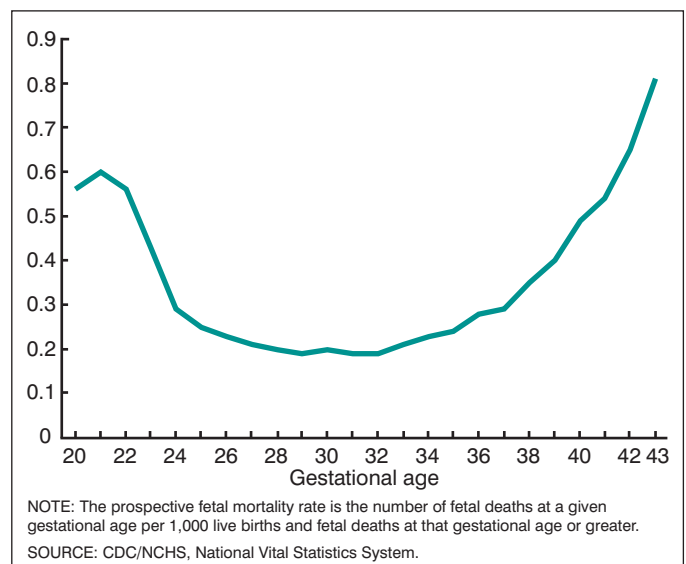


Figure 7. Prospective fetal mortality rate by single weeks of gestation: United States, 2005

deaths at a given birthweight per 1,000 fetal deaths and live births at that birthweight. Rates were highest for less than 500-gram fetuses and decreased rapidly with increasing birthweight. Fetal mortality rates were lowest at 3,000–3,999 grams, and then increased slightly for heavier fetuses (Table 2). However, 12% of fetal deaths in the United States in 2005 had unknown birthweight, and proportional distribution of unknown responses was not attempted as unknowns were more frequent at earlier gestational ages (see “Technical Notes,” Table II). Thus, the birthweight-specific fetal mortality rates shown in Table 2 should be interpreted with caution and may be understated.

Although some researchers have questioned the traditional method of computing fetal mortality rates by birthweight (37), the prospective method of computation does not apply as easily to birthweight as to gestational age. Birthweight is not always a progressive variable for fetal deaths as a fetus may lose weight in utero if the death occurs several days or weeks before delivery (42). Also, a much higher proportion of fetal deaths than live births are small for gestational age, making birthweight comparisons between the two populations somewhat problematic (37, 41).

Fetal and perinatal mortality rates by state

Fetal and perinatal mortality rates by state are shown in Table 3. Comparisons of fetal and perinatal mortality rates by state are affected by differences in reporting requirements for fetal deaths among registration areas; see “Technical Notes.” Although most areas report fetal deaths starting at 20 weeks of gestation if not earlier, three areas (New Mexico, South Dakota, and Tennessee) report fetal deaths of 500 grams or more. Because 500 grams is roughly the equivalent of 22 weeks of gestation, fetal mortality rates are not comparable for these states for measures that include fetal deaths of 20 weeks of gestation or more. Also, small numbers of fetal deaths in some states lead to considerable random variation in fetal mortality rates between years. Table F attempts to address these problems by comparing fetal mortality rates for fetal deaths of 24 weeks of gestation or more for the latest 3-year period (2003–2005). The United States fetal mortality rate specially computed for this measure was 4.06 fetal deaths of 24 weeks of gestation or more per 1,000 live births and fetal deaths. When comparing data by state, fetal mortality rates were highest (5.00 or above) in Alabama, Arkansas, Mississippi, Puerto Rico, the Virgin Islands, and Guam, and were lowest (below 3.00) in Maine, New Mexico, and Vermont. Some variation even in this refined rate may be due to state differences in reporting requirements.

The perinatal mortality rate, definition I, includes fetal deaths of 28 weeks of gestation or more, and infant deaths of less than 7 days. This is the perinatal rate used most often for international comparisons, because it is not affected by differences in reporting of fetal deaths of 20–27 weeks of gestation. It is also suitable for state-to-state comparisons because of variations by state in reporting requirements for fetal deaths. In 2004, the rate was 6.64 for the United States as a whole (Table 3). The highest rates (9.00 or above) were for Alabama, the District of Columbia, Mississippi, the Virgin Islands and Guam, whereas the lowest rates (below 5.00) were for Alaska and New Mexico.

Perinatal definition II (fetal deaths of 20 weeks of gestation or more and infant deaths of less than 28 days) is the most inclusive perinatal definition, and is useful for monitoring perinatal mortality throughout the

Table F. Fetal deaths of 24 weeks of gestation or more and fetal mortality rates by state, 2003–2005

	Fetal deaths	Fetal mortality rate ¹
United States ²	50,263	4.06
Alabama	1,029	5.70
Alaska	117	3.77
Arizona	1,134	4.02
Arkansas	582	5.01
California	6,226	3.79
Colorado	805	3.88
Connecticut	449	3.53
Delaware	112	3.25
District of Columbia	109	4.61
Florida	3,023	4.58
Georgia	1,962	4.68
Hawaii	190	3.49
Idaho	284	4.20
Illinois	2,157	3.96
Indiana	1,083	4.14
Iowa	413	3.55
Kansas	475	3.97
Kentucky	762	4.53
Louisiana	875	4.55
Maine	121	2.88
Maryland	1,024	4.54
Massachusetts	876	3.71
Michigan	1,424	3.65
Minnesota	725	3.41
Mississippi	778	6.06
Missouri	985	4.20
Montana	123	3.55
Nebraska	310	3.94
Nevada	478	4.48
New Hampshire	140	3.22
New Jersey	1,363	3.92
New Mexico	221	2.59
New York	3,411	4.53
North Carolina	1,681	4.63
North Dakota	79	3.21
Ohio	1,832	4.08
Oklahoma	544	3.52
Oregon	435	3.15
Pennsylvania	1,816	4.15
Rhode Island	128	3.30
South Carolina	917	5.37
South Dakota	114	3.36
Tennessee	1,022	4.24
Texas	4,094	3.56
Utah	513	3.36
Vermont	59	2.99
Virginia	1,215	3.91
Washington	883	3.59
West Virginia	292	4.64
Wisconsin	774	3.65
Wyoming	99	4.75
Puerto Rico	908	5.92
Virgin Islands	37	7.81
Guam	85	8.54

¹Rate per 1,000 live births and specified fetal deaths.

²Excludes data for Puerto Rico, Virgin Islands, and Guam.

NOTES: Fetal deaths with not stated period of gestation are proportionally distributed to less than 24 weeks and 24 weeks or more; see “Technical Notes.” Numbers may not add exactly to totals due to rounding.

gestational age spectrum, as the majority of fetal deaths occur before 28 weeks of gestation. As discussed above, New Mexico, South Dakota, and Tennessee were excluded from the comparison of mortality differences for perinatal definition II, due to differences in fetal death

reporting requirements for those states. In 2005, this rate was 10.73 for the United States as a whole; if data from the three states were excluded, the rate was 10.72. Among the states with comparable data, the highest rates (above 15) were for the District of Columbia, Mississippi, Puerto Rico, the Virgin Islands, and Guam, whereas the lowest rates (below 8.5) were for Alaska, Minnesota, Nebraska, Oregon, and Utah.

Differences in population characteristics among states (as regards race, ethnicity, income, access to health care, and prevalence of risk behaviors such as maternal smoking) may help to explain differences in fetal and perinatal mortality rates between states. Caution must be used in interpreting differences in fetal and perinatal mortality rates between states as differences may not be statistically significant.

Discussion

Fetal mortality declined slowly but steadily from 1990–2003. However, the fetal mortality rate did not decline significantly from 2003–2005. Several other developed countries have experienced similar plateaus in fetal (43,44) or perinatal (8) mortality in recent years. Infant mortality in the United States did not decline from 2000–2005, although preliminary data for 2006 suggest a recent decline (6).

Virtually all the decline in the fetal mortality rate from 1990–2003 occurred among fetal deaths at 28 weeks of gestation or more, while mortality rates for fetal deaths at 20–27 weeks of gestation did not decline. In 2005, well over one-half (58%) of all perinatal deaths in the United States were fetal deaths. Fetal mortality rates were elevated for a number of groups, including non-Hispanic black women, teenagers, women aged 35 years and over, unmarried women, and multiple deliveries. Fetal and perinatal mortality rates varied considerably by state, reflecting differences in perinatal risk as well as differences in fetal death reporting among states.

Much of the public concern regarding reproductive loss has concentrated on infant mortality, in part due to a lesser knowledge of the incidence, etiology, and prevention strategies for fetal mortality. The analysis of fetal mortality data presents challenges due to possible underreporting of early fetal deaths, and also due to a high percentage of unknown responses for some fetal death variables. Despite these challenges, there is an increasing awareness of the magnitude and impact of fetal mortality as a public health problem. In particular, several recent initiatives examine the etiology and prevention of fetal death. The Stillbirth Research Collaborative Network is a National Institute of Child Health and Human Development (NICHD)-sponsored multicenter research study on the etiology and prevention of fetal death (45,46). The Centers for Disease Control and Prevention has initiated active fetal death surveillance in Iowa and metropolitan Atlanta (47). The International Stillbirth Alliance facilitates research on the causes and prevention of stillbirth, raises public awareness, and provides support to families experiencing a fetal loss (48).

In addition to the variables discussed in this report, research into risk factors associated with fetal and perinatal mortality has identified a wide variety of related factors, including maternal obesity, smoking during pregnancy, severe or uncontrolled hypertension or diabetes, congenital anomalies, infections, placental and cord problems, intra-uterine growth retardation, previous perinatal death, previous cesarean section, and other factors (49–55).

Considerable programmatic effort has been put into reducing infant mortality in the United States, with sometimes limited results. Prevention of fetal mortality may represent a previously underutilized opportunity to improve perinatal health. Improved reporting of fetal deaths and the promotion of greater consistency in reporting among states will be essential to measure the effectiveness of prevention efforts. Research opportunities will also be improved as more states implement the 2003 Revision of the U.S. Standard Report of Fetal Death, with its expanded medical and health information (56,57). It is hoped that recent research efforts will lead to a more comprehensive understanding of factors related to fetal and perinatal mortality, and ultimately to the development of improved prevention strategies.

References

1. Ventura SJ, Abma JC, Mosher WD, Henshaw S. Estimated pregnancy rates by outcome for the United States, 1990–2004. *National vital statistics reports*; vol 56 no 15. Hyattsville, MD: National Center for Health Statistics. 2008.
2. National Center for Health Statistics. *Vital statistics of the United States 1993, vol II, mortality part A*. Hyattsville, MD: National Center for Health Statistics. 2002.
3. MacDorman MF, Hoyert DL, Martin JA, et al. Fetal and perinatal mortality, United States, 2003. *National vital statistics reports vol 55 no 6*. Hyattsville, MD: National Center for Health Statistics. 2007.
4. Shapiro S, Schlesinger ER, Nesbitt REL. *Infant, perinatal, maternal and childhood mortality in the United States*. Harvard University Press. Cambridge, MA. 1968.
5. Golding J. Epidemiology of fetal and neonatal death. In: Keeling, Jean W., (Ed.) *Fetal and Neonatal Pathology*, 3rd edition, 175–90. Springer-Verlag, London, England. 2001.
6. MacDorman MF, Mathews TJ. Recent trends in infant mortality in the United States. NCHS Data Brief no 9. Hyattsville, MD: National Center for Health Statistics. 2008. Available from: <http://www.cdc.gov/nchs/products/pubs/pubd/databriefs/databriefs.htm#db09>.
7. United Nations. *United Nations Demographic Yearbook, 2006*. New York, NY: United Nations; 2008. Available from: <http://unstats.un.org/unsd/demographic/products/dyb/dyb2006.htm>.
8. Organization for Economic Cooperation and Development. *OECD Health Data 2008, Statistics and Indicators for 30 Countries*. OECD: Paris, France. June 2008. Available from: <http://www.ecosante.org/index2.php?base=OCDE&iangh=ENG&iangs=ENG>.
9. Graafmans WC, Richardus JH, Macfarlane A, et al. Comparability of published perinatal mortality rates in Western Europe: The quantitative impact of differences in gestational age and birthweight criteria. *BJOG* 108:1237–45. 2001.
10. National Center for Health Statistics. 2005 Fetal death data set and user's guide. Hyattsville, MD: National Center for Health Statistics. Forthcoming.
11. National Center for Health Statistics. 2005 period linked birth/infant death data set and user's guide. Hyattsville, MD: National Center for Health Statistics. Available from: <http://www.cdc.gov/nchs/about/major/dvs/Vitalstatsonline.htm>.
12. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2005 period linked birth/infant death data set. *National vital statistics reports*; vol 57 no 2. Hyattsville, MD: National Center for Health Statistics. 2008.
13. Duke CW, Alverson CJ, Correa A. Fetal death certificates as a source of surveillance data for stillbirths with birth defects. *Public Health Rep* 122:664–9. 2007.

14. Lydon-Rochelle MT, Cardenas V, Nelson JL. Validity of maternal and perinatal risk factors reported on fetal death certificates. *Am J Public Health* 95:1948–51. 2008.
15. Martin JA, Hoyert DL. The national fetal death file. *Semin Perinatol* 21:3–11. 2002.
16. Alexander GR. Annotation: The accurate measurement of gestational age—A critical step toward improving fetal death reporting and perinatal health. *Am J Public Health* 87:1278–9. 1997.
17. National Center for Health Statistics. U.S. Standard Report of Fetal Death. Available from: http://www.cdc.gov/nchs/vital_certs_rev.htm.
18. Martin JA, Hamilton BE, Sutton PD, et al. Births: Final data for 2005. National vital statistics reports; vol 56 no 6. Hyattsville, MD: National Center for Health Statistics. 2007.
19. Balchin I, Steer PJ. Race, prematurity and immaturity. *Early Hum Dev* 83:749–54. 2007.
20. Fiscella K. Racial disparity in infant and maternal mortality: Confluence of infection and microvascular dysfunction. *Matern Child Health J* 8(2):45–54. 2004.
21. Allen CL, Hulseley TM, Hulseley TC. The influence of race on fetal outcome. *Am J Perinatol* 22(5): 245–8. 2005.
22. Vintzileos AM, Ananth CV, Smulian JC, Scorza WE, Knuppel RA. Prenatal care and black-white fetal death disparity in the United States: Heterogeneity by high-risk conditions. *Obstet Gynecol* 99:483–9. 2002.
23. Hogan VK, Njoroge T, Durant TM, Ferre CD. Eliminating disparities in perinatal outcomes—Lessons learned. *Matern Child Health J* 5(2):135–40. 2001.
24. Bateman BT, Simpson LL. Higher rate of stillbirth at the extremes of reproductive age: A large nationwide sample of deliveries in the United States. *Am J Obstet Gynecol* 194:840–5. 2006.
25. Reddy UM, Ko CW, Willinger M. Maternal age and the risk of stillbirth throughout pregnancy in the United States. *Am J Obstet Gynecol* 197:114. 2006.
26. Smith GCS, Fretts RC. Stillbirth. *Lancet* 370:1715–24. 2007.
27. Huang L, Asuve R, Birkett N, et al. Maternal age and risk of stillbirth: A systematic review. *CMAJ* 187:183–4. 2008.
28. Nabukera SK, Wingate MS, Owen J, et al. Racial disparities in perinatal outcomes and pregnancy spacing among women delaying initiation of childbearing. *Matern Child Health J* 13(1):81–9. Jan 2009.
29. Luo ZC, Wilkins R, Kramer MS. Disparities in pregnancy outcomes according to marital and cohabitation status. *Obstet Gynecol* 103:1300–7. 2004.
30. Raatikainen K, Heiskanen N, Heinonen S. Marriage still protects pregnancy. *BJOG* 112:1411–6. 2005.
31. DiRenzo GC, Rosati A, Sarti RD, et al. Does fetal sex affect pregnancy outcome? *Gend Med* 4: 19–30. 2007.
32. Ingemarsson I. Gender aspects of preterm birth. *BJOG* 110 (suppl 20): 34–8. 2003.
33. MacDorman MF, Munson ML, Kirmeyer S. Fetal and perinatal mortality, United States, 2004. National vital statistics reports; vol 56 no 3. Hyattsville, MD: National Center for Health Statistics. 2007.
34. Goldenberg RL, Kirby R, Culhane JF. Stillbirth: A review. *J Matern Fetal Med* 16:79–94. 2004.
35. Wright VC, Chang J, Jeng G, Macaluso M. Assisted reproductive technology surveillance—United States, 2005. *MMWR* 57(SS-5): 1–23. 2008.
36. Yudkin PL, Wood L, Redman CWG. Risk of unexplained stillbirth at different gestational ages. *Lancet* 329:1192–4. 1987.
37. Kramer MS, Liu S, Luo Z, et al. Analysis of perinatal mortality and its components: Time for a change? *Am J Epidemiol* 156:493–7. 2002.
38. Kahn B, Lumey LH, Zybert PA, et al. Prospective risk of fetal death in singleton, twin, and triplet gestations: Implications for practice. *Obstet Gynecol* 102:685–92. 2003.
39. Rasmussen S, Albrechtsen S, Irgens LM, et al. Unexplained antepartum fetal death in Norway, 1985–7: Diagnostic validation and some epidemiologic aspects. *Acta Obstet Gynecol Scand* 82: 109–15. 2003.
40. Silver RM. Fetal death. *Obstet Gynecol* 109:153–67. 2007.
41. Reddy UM. Prediction and prevention of recurrent stillbirth. *Obstet Gynecol* 110:1151–64. 2007.
42. Chard T. Does the fetus lose weight in utero following fetal death: A study in preterm infants. *BJOG* 108:1113–5. 2001.
43. Confidentiality Enquiry into Maternal and Child Health (CEMACH). Perinatal mortality 2006: England, Wales, and Northern Ireland. CEMACH: London, 2008. Available from: <http://www.cemach.org.uk/Publications/CEMACH-Publications/Maternal-and-Perinatal-Health.aspx>.
44. Statistics Canada. Detailed tables: Fetal and perinatal mortality, 2000–2006. Available from: <http://cansim2.statcan.ca>.
45. National Institute of Child Health and Human Development, National Institutes of Health. Stillbirth Collaborative Research Network—Research to determine the extent and causes of stillbirth. Available from: <http://scrn.rti.org/>.
46. Silver RM, Varner MW, Reddy U, et al. Work-up of stillbirth: a review of the evidence. *Am J Obstet Gynecol* 196: 433–44. 2007.
47. CDC. Stillbirth. Available from: <http://www.cdc.gov/ncbddd/bd/stillbirths.htm>.
48. International Stillbirth Alliance. Information available from: <http://www.stillbirthalliance.org>.
49. Chu SY, Kim SY, Lau J, et al. Maternal obesity and risk of stillbirth: A metaanalysis. *Am J Obstet Gynecol* 199:e17–e18. 2008.
50. Salihu HM, Dunlop AL, Hedayatzadeh M, et al. Extreme obesity and risk of stillbirth among black and white gravidas. *Obstet Gynecol* 110:552–7. 2007.
51. Hogberg L, Cnattingius S. The influence of maternal smoking habits on the risk of subsequent stillbirth: Is there a causal relation? *BJOG* 114:699–704. 2007.
52. Salihu HM, Sharma PP, Getahun D, et al. Prenatal tobacco use and risk of stillbirth: A case-control and bi-directional case-crossover study. *Nicotine Tob Res* 10:159–66. 2008.
53. Dudley DJ. Diabetic-associated stillbirth: incidence, pathophysiology, and prevention. *Obstet Gynecol Clin North Am* 43:293–307. 2007.
54. Sharma PP, Salihu HM, Kirby RS. Stillbirth recurrence in a population of relatively low-risk mothers. *Paediatric Perinat Epidemiol*. 21 (Suppl. 1), 24–30. 2007.
55. Gray R, Quigley MA, Hockley C, et al. Caesarean delivery and risk of stillbirth in subsequent pregnancy: A retrospective cohort study in an English population. *BJOG* 114:264–70. 2007.
56. National Center for Health Statistics. Report of the Panel to Evaluate the U.S. Standard Certificates. Hyattsville, MD: National Center for Health Statistics. 2000. Available from: http://www.cdc.gov/nchs/vital_certs_rev.htm.
57. Martin JA, Menacker F. Expanded health data from the new birth certificate, 2005. National vital statistics reports; vol 56 no 13. Hyattsville, MD: National Center for Health Statistics. 2008.
58. Model State Vital Statistics Act and Regulations, 1992 Revision, DHHS Publication no. (PHS). 94–1115.
59. Kowaleski J. State definitions and reporting requirements for live births, fetal deaths, and induced terminations of pregnancy (1997 revision). Hyattsville, MD: National Center for Health Statistics. 1997.
60. Hoyert DL. Perinatal mortality in the United States, 1985–91. *Vital Health Stat* 20(26). Hyattsville, MD: National Center for Health Statistics. 1995.

61. Office of Management and Budget. Revisions to the standards for the classification of federal data on race and ethnicity. Federal Register 62FR58782–58790. October 30, 1997. Available from: <http://www.whitehouse.gov/omb/fedreg/ombdir15.html>.
62. Johnson D. Coding and editing multiple race. Presented at the 2004 Joint Meeting of NAPHSIS and VSCP. Portland, OR. June 6–10, 2004.
63. National Center for Health Statistics. NCHS Procedures for Multiple-Race and Hispanic Origin Data: Collection, Coding, Editing and Transmitting. Available from: http://www.cdc.gov/nchs/data/dvs/Multiple_race_docu_5-10-04.pdf.
64. Schenker N, Parker JD. From single-race reporting to multiple-race reporting: Using imputation methods to bridge the transition. Stat Med 22:1571–87. 2003.
65. Ingram DD, Parker JD, Schenker N, et al. United States Census 2000 with bridged race categories. National Center for Health Statistics. Vital Health Stat 2(135). 2003. Available from: http://www.cdc.gov/nchs/data/series/sr_02/sr02_135.pdf.
66. National Center for Health Statistics. Editing specifications for fetal death records. Unpublished manuscript. Hyattsville, MD: Public Health Service. 2005.
67. Brillinger DR. The natural variability of vital rates and associated statistics. Biometrics 42:693–734. 1986.

List of Detailed Tables

1. Fetal deaths and mortality rates, by period of gestation, age, and race and Hispanic origin of mother: United States, 2005.	12
2. Fetal deaths and mortality rates, by birthweight, gestational age, and race and Hispanic origin of mother: United States, 2005. . .	13
3. Fetal and perinatal deaths and mortality rates: United States and each state and territory, 2005	14

Table 1. Fetal deaths and mortality rates, by period of gestation, age, and race and Hispanic origin of mother: United States, 2005

Age and race and Hispanic origin of mother	Fetal deaths			Fetal mortality rate ¹		
	Total	20–27 weeks ²	28+ weeks ²	Total	20–27 weeks ²	28+ weeks ²
All races ³	25,894	13,327	12,567	6.22	3.21	3.03
Less than 15 years	83	50	33	12.20	7.38	4.89
15–19 years	3,152	1,717	1,435	7.54	4.12	3.45
15–17 years	1,110	627	483	8.26	4.69	3.61
18–19 years	2,042	1,090	952	7.20	3.86	3.37
20–24 years	6,135	3,035	3,100	5.86	2.91	2.97
25–29 years	6,221	3,211	3,010	5.47	2.83	2.65
30–34 years	5,495	2,892	2,603	5.75	3.03	2.73
35–39 years	3,530	1,800	1,730	7.25	3.71	3.57
40–44 years	1,175	568	607	11.10	5.40	5.77
45 years and over	103	54	49	15.51	8.19	7.44
Non-Hispanic white	10,973	5,382	5,591	4.79	2.36	2.45
Less than 15 years	13	5	8	*	*	*
15–19 years	1,033	530	503	6.22	3.20	3.04
15–17 years	311	163	148	7.04	3.70	3.36
18–19 years	722	367	355	5.92	3.02	2.92
20–24 years	2,375	1,104	1,271	4.59	2.14	2.46
25–29 years	2,752	1,372	1,380	4.26	2.13	2.14
30–34 years	2,487	1,252	1,235	4.26	2.15	2.12
35–39 years	1,710	836	874	5.57	2.73	2.86
40–44 years	547	259	288	8.43	4.01	4.46
45 years and over	56	24	32	13.09	5.65	7.52
Non-Hispanic black	6,573	3,758	2,815	11.13	6.40	4.80
Less than 15 years	45	28	17	16.41	10.28	*
15–19 years	1,058	622	436	10.81	6.38	4.48
15–17 years	378	222	156	10.94	6.45	4.54
18–19 years	680	400	280	10.74	6.35	4.45
20–24 years	1,829	996	833	9.60	5.25	4.40
25–29 years	1,422	823	599	9.85	5.73	4.17
30–34 years	1,202	708	494	12.85	7.61	5.32
35–39 years	753	433	320	15.63	9.05	6.70
40–44 years	246	136	110	19.68	10.97	8.90
45 years and over	18	12	6	*	*	*
Hispanic ⁴	5,387	2,598	2,789	5.44	2.63	2.82
Less than 15 years	19	12	7	*	*	*
15–19 years	806	422	384	5.85	3.07	2.80
15–17 years	327	186	141	6.49	3.70	2.81
18–19 years	479	237	242	5.48	2.72	2.78
20–24 years	1,363	636	727	4.71	2.20	2.52
25–29 years	1,315	632	683	4.91	2.37	2.56
30–34 years	1,050	522	528	5.60	2.79	2.82
35–39 years	581	270	311	6.73	3.14	3.61
40–44 years	242	97	145	12.85	5.19	7.74
45 years and over	11	7	4	*	*	*

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

¹Rate per 1,000 live births and fetal deaths in specified group.²Fetal deaths with not stated gestational age were proportionally distributed; see "Technical Notes."³Includes races other than white or black and origin not stated.⁴Includes all persons of Hispanic origin of any race.

Table 2. Fetal deaths and mortality rates, by birthweight, gestational age, and race and Hispanic origin of mother: United States, 2005

Birthweight (grams) and race and Hispanic origin of mother	Gestational age in weeks											Fetal mortality rate ¹
	Total	20-23	24-27	28-31	32-33	34-36	37-39	40	41	42+	Not stated	
All races ²	25,894	8,922	4,051	3,212	1,589	2,896	3,132	684	324	399	685	6.22
Less than 500	7,942	5,743	1,368	417	81	108	77	7	8	19	114	545.69
500-749	3,394	1,513	1,212	437	81	61	27	3	3	9	48	228.52
750-999	1,530	172	590	523	97	87	22	3	5	5	26	109.75
1,000-1,249	1,141	58	226	521	147	87	49	7	3	6	37	74.06
1,250-1,499	1,008	39	89	394	208	184	45	6	3	13	27	55.79
1,500-1,999	1,910	42	73	420	445	578	232	32	21	32	35	27.94
2,000-2,499	1,785	-	26	140	257	717	474	59	32	48	32	8.42
2,500-2,999	1,715	-	17	46	81	510	762	145	59	68	27	2.29
3,000-3,499	1,389	-	-	21	32	215	714	210	96	72	29	0.87
3,500-3,999	625	-	-	8	12	75	312	109	44	45	20	0.56
4,000 or more	384	-	-	-	10	50	173	59	34	40	18	1.14
Not stated	3,071	1,355	450	285	138	224	245	44	16	42	48	---
Fetal mortality rate ¹	6.22	504.10	160.49	58.36	23.56	7.69	1.42	0.86	0.91	1.66	---	---
Non-Hispanic white	10,973	3,597	1,693	1,341	687	1,350	1,465	309	158	186	187	4.86
Less than 500	3,153	2,242	568	176	29	49	36	5	5	9	34	562.33
500-749	1,393	617	501	186	43	24	8	-	2	4	8	235.30
750-999	618	73	253	202	41	34	9	1	2	-	3	103.94
1,000-1,249	464	20	91	223	53	39	23	3	1	1	10	66.79
1,250-1,499	404	12	38	154	82	75	23	3	1	4	12	46.73
1,500-1,999	814	17	30	167	200	255	100	11	7	13	14	23.95
2,000-2,499	823	-	6	62	117	353	214	18	14	23	16	7.90
2,500-2,999	806	-	9	14	33	261	350	60	36	36	7	2.24
3,000-3,499	662	-	-	9	11	103	356	100	44	30	9	0.78
3,500-3,999	298	-	-	2	9	31	144	63	20	24	5	0.45
4,000 or more	164	-	-	-	2	22	77	22	17	18	6	0.76
Not stated	1,374	616	197	146	67	104	125	23	9	24	12	---
Fetal mortality rate ¹	4.86	526.80	163.35	52.79	21.11	6.95	1.21	0.71	0.80	1.45	---	---
Non-Hispanic black	6,573	2,603	1,076	841	412	610	656	111	56	70	138	11.22
Less than 500	2,390	1,765	394	116	31	30	16	2	-	4	32	492.78
500-749	920	421	341	110	15	19	5	-	-	1	8	186.73
750-999	389	40	148	146	21	17	7	1	1	3	5	89.73
1,000-1,249	305	23	49	146	44	19	13	2	1	2	6	68.66
1,250-1,499	264	12	22	111	61	37	8	2	1	4	6	56.98
1,500-1,999	481	9	17	116	118	135	63	5	8	7	3	29.82
2,000-2,499	406	-	9	26	62	156	112	19	7	10	5	8.67
2,500-2,999	342	-	5	9	18	87	168	29	11	13	2	2.38
3,000-3,499	211	-	-	5	8	36	110	26	13	6	7	0.96
3,500-3,999	102	-	-	2	1	14	64	4	5	6	6	0.94
4,000 or more	83	-	-	-	3	8	40	15	8	8	1	3.23
Not stated	680	333	91	54	30	52	50	6	1	6	57	...
Fetal mortality rate ¹	11.22	448.10	132.01	60.49	28.29	8.89	2.19	1.13	1.32	2.27	---	---
Hispanic ³	5,387	1,670	839	682	325	639	692	178	79	96	187	5.47
Less than 500	1,522	1,075	269	81	14	23	17	-	3	4	36	558.12
500-749	729	310	252	93	15	14	13	1	-	4	27	246.62
750-999	343	42	116	118	26	22	5	-	2	1	11	128.18
1,000-1,249	252	11	60	104	33	20	9	1	1	2	11	85.51
1,250-1,499	228	13	19	82	44	52	10	1	1	2	4	65.33
1,500-1,999	430	10	18	92	75	146	54	12	1	7	15	32.97
2,000-2,499	371	-	11	35	53	130	103	17	7	9	6	8.54
2,500-2,999	391	-	3	18	24	112	160	41	7	13	13	2.22
3,000-3,499	362	-	-	6	10	51	169	58	30	26	12	0.91
3,500-3,999	166	-	-	4	1	24	75	28	16	13	5	0.63
4,000 or more	102	-	-	-	5	15	41	14	9	8	10	1.37
Not stated	491	209	91	49	25	30	36	5	2	7	37	...
Fetal mortality rate ¹	5.47	494.81	169.39	57.70	20.97	7.49	1.36	0.93	0.90	1.54	---	...

- Quantity zero.

--- Data not available.

... Category not applicable.

¹Rate per 1,000 live births and fetal deaths in specified group.²Includes races other than white or black and origin not stated.³Includes all persons of Hispanic origin of any race.

Table 3. Fetal and perinatal deaths and mortality rates: United States and each state and territory, 2005

	Fetal deaths ¹		Perinatal definition I ²		Perinatal definition II ³	
	Number of deaths	Mortality rate ⁴	Number of deaths ⁵	Mortality rate ⁴	Number of deaths ⁵	Mortality rate ⁴
United States	25,894	6.22	27,580	6.64	44,676	10.73
Alabama	534	8.76	551	9.07	886	14.53
Alaska	48	4.57	51	4.86	79	7.52
Arizona	569	5.88	617	6.39	1,000	10.33
Arkansas	279	7.07	290	7.36	470	11.90
California	3,051	5.53	3,243	5.89	5,041	9.13
Colorado	378	5.45	487	7.04	708	10.21
Connecticut	253	6.03	268	6.41	429	10.22
Delaware	66	5.64	98	8.40	145	12.38
District of Columbia	68	8.46	80	10.01	146	18.16
Florida	1,608	7.06	1,537	6.77	2,640	11.59
Georgia	1,066	7.44	1,076	7.54	1,832	12.79
Hawaii	112	6.21	90	5.01	189	10.48
Idaho	129	5.56	152	6.57	223	9.62
Illinois	1,126	6.25	1,303	7.26	2,022	11.22
Indiana	492	5.61	652	7.46	967	11.03
Iowa	222	5.62	228	5.78	359	9.08
Kansas	200	4.99	287	7.17	394	9.83
Kentucky	338	5.95	337	5.95	565	9.95
Louisiana	483	7.86	466	7.62	816	13.29
Maine	76	5.36	88	6.22	145	10.22
Maryland	631	8.35	567	7.54	1,026	13.57
Massachusetts	419	5.42	434	5.63	707	9.15
Michigan	742	5.78	915	7.14	1,441	11.22
Minnesota	339	4.76	371	5.22	571	8.01
Mississippi	419	9.79	404	9.49	705	16.47
Missouri	444	5.62	525	6.66	814	10.30
Montana	54	4.64	78	6.71	103	8.85
Nebraska	134	5.10	141	5.38	221	8.41
Nevada	268	7.14	215	5.75	394	10.50
New Hampshire	64	4.42	91	6.29	125	8.63
New Jersey	703	6.14	632	5.54	1,100	9.61
New Mexico ⁶	82	2.84	140	4.84	186	6.43
New York	2,062	8.30	1,610	6.51	3,056	12.30
North Carolina	847	6.83	1,034	8.37	1,605	12.95
North Dakota	46	5.45	58	6.89	82	9.72
Ohio	898	6.02	1,074	7.22	1,720	11.52
Oklahoma	288	5.53	316	6.09	537	10.31
Oregon	203	4.40	231	5.02	380	8.24
Pennsylvania	1,031	7.04	1,130	7.75	1,786	12.20
Rhode Island	83	6.49	98	7.69	148	11.58
South Carolina	500	8.59	482	8.32	839	14.41
South Dakota ⁶	46	4.00	78	6.79	98	8.52
Tennessee ⁶	393	4.78	657	8.01	854	10.40
Texas	2,082	5.37	2,279	5.89	3,670	9.46
Utah	266	5.13	268	5.18	424	8.18
Vermont	31	4.77	39	6.01	57	8.76
Virginia	693	6.58	726	6.92	1,234	11.72
Washington	496	5.96	430	5.18	748	8.99
West Virginia	126	6.01	151	7.22	232	11.07
Wisconsin	364	5.10	462	6.49	681	9.54
Wyoming	42	5.77	57	7.84	74	10.16
Puerto Rico	544	10.64	435	8.57	879	17.20
Virgin Islands	20	12.31	21	12.92	30	18.46
Guam	40	12.42	40	12.47	62	19.25

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

¹Fetal deaths with stated or presumed period of gestation of 20 weeks or more.

²Infant deaths of less than 7 days and fetal deaths with stated or presumed period of gestation of 28 weeks or more. Fetal deaths with not stated gestational age are proportionally distributed to 20–27 weeks and 28 weeks or more.

³Infant deaths of less than 28 days and fetal deaths with stated or presumed period of gestation of 20 weeks or more.

⁴Rate per 1,000 live births and specified fetal deaths.

⁵Infant deaths are weighted so numbers may not exactly add to totals due to rounding.

⁶State reports only fetal deaths of 500 grams or more; data for fetal and perinatal definition II are not comparable to data from other states; see "Technical Notes."

Technical Notes

Definition of fetal death

“Fetal death” means death prior to the complete expulsion or extraction from its mother of a product of human conception, irrespective of the duration of pregnancy and which is not an induced termination of pregnancy. The death is indicated by the fact that after such expulsion or extraction, the fetus does not breathe or show any other evidence of life such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles. Heartbeats are to be distinguished from transient cardiac contractions; respirations are to be distinguished from fleeting respiratory efforts or gasps (58).

The term “fetal death” is defined on an all-inclusive basis to end confusion arising from the use of such terms as stillbirth, spontaneous abortion, and miscarriage. This definition has been adopted by NCHS as the nationally recommended standard, and is based on the definition published by the World Health Organization in 1950 and revised in 1988. All U.S. states and registration areas have definitions similar to the standard definition, except for Puerto Rico and Wisconsin, which have no formal definition (10,59). Fetal deaths do not include induced terminations of pregnancy.

Reporting requirements for fetal death data

Reporting requirements for fetal deaths vary by state and these differences have important implications for comparisons of fetal and perinatal mortality rates by state. Table I shows the period of gestation at which fetal death reporting is required for each reporting area. The majority of states require reporting of fetal deaths of 20 weeks of gestation or more, or a minimum of 350 grams birthweight (roughly equivalent to 20 weeks) or some combination of the two. However, seven states (and the U.S. Virgin Islands) require reporting of fetal deaths of all periods of gestation (although three of these do not send data for fetal deaths of less than 20 weeks of gestation to NCHS), whereas one state requires reporting beginning at 16 weeks of gestation. At the other end of the spectrum, three states (New Mexico, South Dakota and Tennessee) require reporting of fetal deaths with birthweights of 500 grams or more (roughly equivalent to 22 weeks of gestation). Lack of full reporting for these states leads to a slight overestimate of the U.S. fetal mortality rate. For example, when data for these three states were excluded, the fetal mortality rate was 6.28 in 2005, compared with 6.22 for all states combined.

There is substantial evidence that not all fetal deaths for which reporting is required are reported (10,13,15). Underreporting of fetal deaths is most likely to occur in the earlier part of the required reporting period for each state (10,15). This is illustrated in Figure I, which compares the percentage of fetal deaths 20 weeks or more that are 20 to 27 weeks of gestation by state reporting requirements. In general, fetal deaths tend to be somewhat underreported near the lower limit of the reporting requirement. For those states requiring reporting of fetal deaths of all periods of gestation, 57 percent of fetal deaths 20 weeks or more were 20–27 weeks, whereas for states requiring reporting of fetal deaths of 500 grams or more, only 27 percent were at 20–27 weeks, thus indicating substantial underreporting of early fetal deaths.

Variations in fetal death reporting requirements and practices have implications for comparing fetal and perinatal mortality rates among

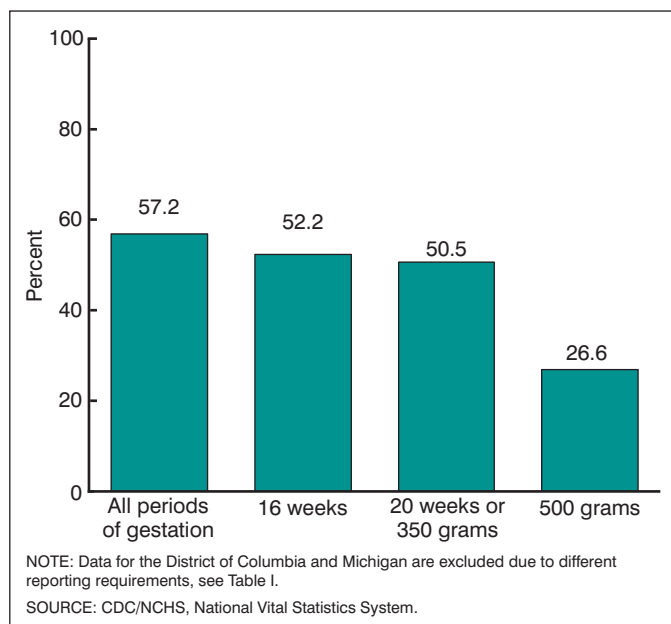


Figure I. Percentage of fetal deaths 20–27 weeks of all fetal deaths 20 weeks or more according to state reporting requirements, 2005

states. Because reporting is generally incomplete near the lower limit of the reporting requirement, states that require reporting of all products of pregnancy, regardless of gestation, are likely to have more complete reporting of fetal deaths at 20 weeks or more than those states that do not. The larger number of fetal deaths reported for these “all periods” states may result in higher perinatal mortality rates than those rates reported for states whose reporting is less complete. Accordingly, reporting completeness may account, in part, for differences in fetal and perinatal mortality rates among states. To promote the comparability of data by year and by state while including as much meaningful data as possible, this report presents data on fetal deaths with a stated or presumed period of gestation of 20 weeks or more (10).

Percentage of unknown responses by characteristics

Table II shows the percentage of unknown responses for particular variables shown in this report, in the fetal death file, and for U.S. live births. In general, percentages of unknown responses are considerably higher for fetal deaths than for live births; and among fetal deaths the percentage unknown is higher for fetal deaths that occur earlier in the gestational period. In the tables shown in this report, unknown responses are shown in frequencies tables, but are excluded from the computation of percent distributions and fetal and perinatal mortality rates. Thus, rates published in this report by variables with a substantial percentage of unknown responses (such as birthweight) may understate the “true” rates of fetal mortality for that characteristic.

The 1989 and 2003 Revisions of the U.S. Standard Certificates and Reports

This report includes data for 11 states: Idaho, Kansas, Kentucky, Maryland, Michigan, Nebraska, New Hampshire, Oklahoma, South

Table I. Period of gestation and weight minimums at which fetal death reporting is required: Each reporting area, 2005

Area	All periods of gestation	16 weeks	20 weeks	20 weeks or 350 grams	20 weeks or 400 grams	20 weeks or 500 grams	5 months	350 grams	500 grams
Alabama			X						
Alaska			X						
Arizona				X					
Arkansas	¹ X								
California			X						
Colorado	¹ X								
Connecticut			X						
Delaware								² X	
District of Columbia						X			
Florida			X						
Georgia	¹ X								
Hawaii	X								
Idaho				X					
Illinois			X						
Indiana			X						
Iowa			X						
Kansas								X	
Kentucky				X					
Louisiana				X					
Maine			X						
Maryland			³ X						
Massachusetts				X					
Michigan					X				
Minnesota			X						
Mississippi				X					
Missouri				X					
Montana								² X	
Nebraska			X						
Nevada			X						
New Hampshire				X					
New Jersey			X						
New Mexico									X
New York	X								
New York excluding New York City	X								
New York City	X								
North Carolina			X						
North Dakota			X						
Ohio			X						
Oklahoma			X						
Oregon			X						
Pennsylvania		X							
Rhode Island	X								
South Carolina				X					
South Dakota									X
Tennessee									⁴ X
Texas			X						
Utah			X						
Vermont			⁵ X						
Virginia	X								
Washington			X						
West Virginia			X						
Wisconsin				X					
Wyoming			X						
Puerto Rico							X		
Virgin Islands	X								
Guam				X					

¹Although state law requires the reporting of fetal deaths of all periods of gestation, only data for fetal deaths of 20 weeks of gestation or more are provided to NCHS.

²If weight is unknown, 20 completed weeks of gestation or more.

³If gestational age is unknown, weight of 500 grams or more.

⁴If weight is unknown, 22 completed weeks of gestation or more.

⁵If gestational age is unknown, weight of 400 grams or more, 15 ounces or more.

Dakota, Utah, and Washington, which implemented the 2003 Revision of the U.S. Standard Report of Fetal Death by January 1, 2005. Data from all other areas are based on the 1989 revision (unrevised).

For live births, 12 states—Florida, Idaho, Kansas, Kentucky, Nebraska, New Hampshire, New York (excluding New York City), Pennsylvania, South Carolina, Tennessee, Texas, and Washington—

implemented the 2003 revision of the U.S. Standard Certificate of Birth by January 1, 2005. Data from all other areas are based on the 1989 revision.

For infant deaths included in perinatal mortality rates, 17 states (California, Connecticut, Florida, Idaho, Kansas, Michigan, Montana, Nebraska, New Hampshire, New Jersey, New York, Oklahoma, South

Table II. Percentage of unknown responses for selected variables for fetal deaths and live births, United States, 2005

	Fetal deaths			Live births ¹
	Total ²	20–27 weeks	28 weeks or more	
Marital status ³	5.33	5.22	3.80	0.03
Hispanic origin	6.80	6.98	5.80	0.72
Period of gestation	2.65	...	...	0.71
Birthweight	11.86	13.91	8.12	+0.01

... Category not applicable.

+ For the linked file, not stated birthweight is imputed for records with known period of gestation; the percentage of unknown responses before imputation is 0.09.

¹Based on the denominator file for the linked file. Figures for the linked file differ slightly from the natality file.

²Includes fetal deaths with stated or presumed period of gestation of 20 weeks or more.

³For fetal deaths, excludes data for residents of California, Nevada, New York, and Texas, which did not report marital status on the fetal death report. For live births, excludes data from Michigan and New York, which did not report marital status on the birth certificate. For births only, marital status was inferred for nonreporting states and not stated marital status was imputed in reporting states (31). See "Technical Notes," Births: 2005.

Carolina, South Dakota, Utah, Washington, and Wyoming) implemented the 2003 Revision of the U.S. Standard Certificate of Death as of January 1, 2005. Data from all other areas are based on the 1989 revision.

The 2003 Revision of the U.S. Standard Certificates and Reports is described in detail elsewhere (56). Because the variables included in this report are comparable between the 1989 and 2003 revisions, these changes had little effect on the data included in this report.

Computation of rates

Fetal mortality rates in this report are computed as the number of fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths of 20 weeks or more. Perinatal mortality rates are computed in similar fashion, as shown below. The denominators for all fetal and perinatal mortality rates are live births plus fetal deaths in the specified gestational age group, thus representing the population at risk of the event.

$$\text{Fetal mortality rate} = \frac{\text{Fetal deaths 20 weeks of gestation or more}}{\text{Live births and fetal deaths 20 weeks or more}} \times 1,000$$

$$\text{Perinatal mortality rate, Definition I} = \frac{\text{Fetal deaths 28 weeks or more and infant deaths less than 7 days}}{\text{Live births and fetal deaths 28 weeks or more}} \times 1,000$$

$$\text{Perinatal mortality rate, Definition II} = \frac{\text{Fetal deaths 20 weeks or more and infant deaths less than 28 days}}{\text{Live births and fetal deaths 20 weeks or more}} \times 1,000$$

In each case, the fetal deaths included in the denominator of each rate mirror the fetal deaths included in the numerator. Thus, rates for subtotals in Figures 4, 5, and 6 do not exactly add to the total fetal or perinatal rates, due to the slightly different denominators used to compute the subtotal rates. A previous NCHS report contains information on the historical development of various perinatal measures (60). An asterisk (*) is shown in place of any rate based on fewer than 20 fetal or perinatal deaths in the numerator.

Prospective fetal mortality rate—When examining fetal mortality at a given gestational age, the prospective fetal mortality rate may provide a more appropriate indication of the population at risk of fetal death,

as the denominator for this rate is all of the women who are still pregnant at that gestational age. The prospective fetal mortality rate is computed as the number of fetal deaths at a given gestational age (in single weeks), per 1,000 live births and fetal deaths at that gestational age or greater. Records with not stated gestational age are excluded from totals before computations are begun.

$$\text{Prospective fetal mortality rate}_w = \frac{\text{Fetal deaths}_w}{(\sum_w^{\text{max}} \text{fetal deaths} + \sum_w^{\text{max}} \text{live births})} \times 1000;$$

where w = specific gestational age in weeks, and max = highest gestational age in weeks.

Multiple race data

Beginning in 2003 some states revised their race reporting to allow respondents to select one or more race categories, to comply with the current Office of Management and Budget (OMB) standards (61). For fetal deaths, states reporting multiple-race data by January 2005 were Idaho, Kansas, Kentucky, Maryland, Michigan, Minnesota, Nebraska, New Hampshire, Oklahoma, South Dakota, Utah, and Washington. For 2005 births, the 18 states reporting multiple-race data were: California, Florida, Hawaii, Idaho, Kansas, Kentucky, Michigan, Minnesota, Nebraska, New Hampshire, New York (excluding New York City), Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Utah, and Washington. Eventually all U.S. states will report multiple-race data. However, in the interim, the numerators for fetal mortality rates are incompatible with the denominators (births). In order to compute rates, it is necessary to "bridge" data for multiple-race persons to single-race categories, using methods described elsewhere (18,62–65). This has been done for fetal and perinatal mortality rates by race presented in this report. Once all states revise their registration systems to be compliant with the current OMB standards, the use of "bridged" data can be discontinued. This change should have little or no impact on the data in this report.

Period of gestation

The primary measure used to determine the gestational age of the fetus is the interval between the first day of the mother's last normal menstrual period (LMP) and the date of delivery. It is subject to error for several reasons, including imperfect maternal recall or misidentification of the LMP because of post-conception bleeding, delayed ovulation, or intervening early miscarriage. These data are edited for LMP-based gestational ages that are clearly inconsistent with birthweight and plurality, but reporting problems for this item persist. If the date of LMP is not reported or if the computed period of gestation is inconsistent with birthweight, the clinical or obstetric estimate of gestation is used (14.6 percent of fetal death records and 5.1 percent of live birth records in 2005). These procedures are described in more detail elsewhere (18,66).

Not stated—Fetal deaths with not stated gestational age are presumed to be 20 weeks of gestation or more if the state requires reporting of all fetal deaths at a gestational age of 20 weeks or more, or the fetus weighed 500 grams or more in those states requiring reporting of all fetal deaths regardless of gestational age. Furthermore, in Tables A, B, 1, and 3 fetal deaths with not stated gestational age are allocated to 20–27 weeks and 28 weeks or more according to the proportion of fetal deaths with stated gestational age that fall into each

category (proportional distribution). Similarly, for [Table F](#), fetal deaths with not stated gestational age are proportionally distributed into the 20–23 week and 24 weeks or more categories. Proportional distribution is not performed for tables showing more detailed gestational age categories ([Table 2](#)). The allocation of not stated gestational age for fetal deaths is made individually for each maternal age, race and Hispanic origin group, and state.

Random variation in fetal and perinatal mortality rates

The number of fetal deaths, perinatal 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 (67). As a result, numbers of births, fetal deaths, perinatal deaths, and fetal and perinatal 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 (perhaps less than 100) and the probability of such an event is small, considerable caution must be observed in interpreting the data. Such infrequent events may be assumed to follow a Poisson probability distribution. Estimates of RSEs and 95 percent confidence intervals are shown below. **In the formulas below, D = the number of fetal or perinatal deaths, and B = the number of live births plus fetal deaths used as the denominator in computing fetal and perinatal mortality rates.**

The formulas for the two RSEs are:

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

and

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

For example, let us say that for group A the number of fetal deaths was 238, whereas the number of live births plus fetal deaths in the denominator was 32,650, yielding a fetal mortality rate of 7.29 fetal deaths per 1,000 live births and fetal deaths.

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

whereas the RSE for the births plus fetal deaths in the denominator =

$$100 \cdot \sqrt{\frac{1}{32,650}} = 0.55.$$

The formula for the RSE of the fetal mortality rate is:

$$\text{RSE} = 100 \cdot \sqrt{\frac{1}{D} + \frac{1}{B}}$$

Thus the RSE for the example above is:

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

Normal distribution—When the number of events is greater than 100, the normal distribution is used to estimate the 95 percent confidence intervals of a rate, R_1 , 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:

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

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

Thus the chances are 95 out of 100 that the true fetal or perinatal mortality rate for Group A lies somewhere in the 6.36 to 8.22 interval.

Poisson distribution—When the number of events in the numerator is less than 100 the confidence interval for the rate, R_1 , can be estimated based on the Poisson distribution using the values in [Table III](#).

$$\text{Lower: } R_1 \cdot L(.95, D_{\text{adj}})$$

$$\text{Upper: } R_1 \cdot U(.95, D_{\text{adj}})$$

where D_{adj} is the adjusted number of fetal or perinatal deaths (rounded to the nearest integer) used to take into account the RSE of the number of deaths in the numerator and the number of live births plus fetal deaths in the denominator, 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 III](#) corresponding to the value of D_{adj} .

For example, let us say that for Group B the number of fetal deaths was 73, and the number of live births plus fetal deaths in the denominator was 11,422, and the fetal mortality rate was 6.39.

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

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

$$\text{Lower: } 6.39 \cdot 0.78384 = 5.01$$

$$\text{Upper: } 6.39 \cdot 1.25735 = 8.03$$

Comparison of two fetal or perinatal mortality rates—If either of the two rates to be compared is based on less than 100 deaths, compute the confidence intervals for both rates and check to see if they overlap. If so, the difference is not statistically significant at the

Table III. Lower and upper 95 percent and 96 percent confidence limit factors for a death rate based on a Poisson variable of 1 through 99 deaths, *D*

<i>D</i>	L(1- α = .95, <i>D</i>)	U(1- α = .95, <i>D</i>)	L(1- α = .96, <i>D</i>)	U(1- α = .96, <i>D</i>)	<i>D</i>	L(1- α = .95, <i>D</i>)	U(1- α = .95, <i>D</i>)	L(1- α = .96, <i>D</i>)	U(1- α = .96, <i>D</i>)
1	0.02532	5.57164	0.02020	5.83392	51	0.74457	1.31482	0.73385	1.33057
2	0.12110	3.61234	0.10735	3.75830	52	0.74685	1.31137	0.73621	1.32694
3	0.20622	2.92242	0.18907	3.02804	53	0.74907	1.30802	0.73851	1.32342
4	0.27247	2.56040	0.25406	2.64510	54	0.75123	1.30478	0.74075	1.32002
5	0.32470	2.33367	0.30591	2.40540	55	0.75334	1.30164	0.74293	1.31671
6	0.36698	2.17658	0.34819	2.23940	56	0.75539	1.29858	0.74506	1.31349
7	0.40205	2.06038	0.38344	2.11666	57	0.75739	1.29562	0.74713	1.31037
8	0.43173	1.97040	0.41339	2.02164	58	0.75934	1.29273	0.74916	1.30734
9	0.45726	1.89831	0.43923	1.94553	59	0.76125	1.28993	0.75113	1.30439
10	0.47954	1.83904	0.46183	1.88297	60	0.76311	1.28720	0.75306	1.30152
11	0.49920	1.78928	0.48182	1.83047	61	0.76492	1.28454	0.75494	1.29873
12	0.51671	1.74680	0.49966	1.78566	62	0.76669	1.28195	0.75678	1.29601
13	0.53246	1.71003	0.51571	1.74688	63	0.76843	1.27943	0.75857	1.29336
14	0.54671	1.67783	0.53027	1.71292	64	0.77012	1.27698	0.76033	1.29077
15	0.55969	1.64935	0.54354	1.68289	65	0.77178	1.27458	0.76205	1.28826
16	0.57159	1.62394	0.55571	1.65610	66	0.77340	1.27225	0.76373	1.28580
17	0.58254	1.60110	0.56692	1.63203	67	0.77499	1.26996	0.76537	1.28340
18	0.59266	1.58043	0.57730	1.61024	68	0.77654	1.26774	0.76698	1.28106
19	0.60207	1.56162	0.58695	1.59042	69	0.77806	1.26556	0.76856	1.27877
20	0.61083	1.54442	0.59594	1.57230	70	0.77955	1.26344	0.77011	1.27654
21	0.61902	1.52861	0.60435	1.55563	71	0.78101	1.26136	0.77162	1.27436
22	0.62669	1.51401	0.61224	1.54026	72	0.78244	1.25933	0.77310	1.27223
23	0.63391	1.50049	0.61966	1.52602	73	0.78384	1.25735	0.77456	1.27014
24	0.64072	1.48792	0.62666	1.51278	74	0.78522	1.25541	0.77598	1.26810
25	0.64715	1.47620	0.63328	1.50043	75	0.78656	1.25351	0.77738	1.26610
26	0.65323	1.46523	0.63954	1.48888	76	0.78789	1.25165	0.77876	1.26415
27	0.65901	1.45495	0.64549	1.47805	77	0.78918	1.24983	0.78010	1.26223
28	0.66449	1.44528	0.65114	1.46787	78	0.79046	1.24805	0.78143	1.26036
29	0.66972	1.43617	0.65652	1.45827	79	0.79171	1.24630	0.78272	1.25852
30	0.67470	1.42756	0.66166	1.44922	80	0.79294	1.24459	0.78400	1.25672
31	0.67945	1.41942	0.66656	1.44064	81	0.79414	1.24291	0.78525	1.25496
32	0.68400	1.41170	0.67125	1.43252	82	0.79533	1.24126	0.78648	1.25323
33	0.68835	1.40437	0.67575	1.42480	83	0.79649	1.23965	0.78769	1.25153
34	0.69253	1.39740	0.68005	1.41746	84	0.79764	1.23807	0.78888	1.24987
35	0.69654	1.39076	0.68419	1.41047	85	0.79876	1.23652	0.79005	1.24824
36	0.70039	1.38442	0.68817	1.40380	86	0.79987	1.23499	0.79120	1.24664
37	0.70409	1.37837	0.69199	1.39743	87	0.80096	1.23350	0.79233	1.24507
38	0.70766	1.37258	0.69568	1.39134	88	0.80203	1.23203	0.79344	1.24352
39	0.71110	1.36703	0.69923	1.38550	89	0.80308	1.23059	0.79453	1.24201
40	0.71441	1.36172	0.70266	1.37991	90	0.80412	1.22917	0.79561	1.24052
41	0.71762	1.35661	0.70597	1.37454	91	0.80514	1.22778	0.79667	1.23906
42	0.72071	1.35171	0.70917	1.36938	92	0.80614	1.22641	0.79771	1.23762
43	0.72370	1.34699	0.71227	1.36442	93	0.80713	1.22507	0.79874	1.23621
44	0.72660	1.34245	0.71526	1.35964	94	0.80810	1.22375	0.79975	1.23482
45	0.72941	1.33808	0.71816	1.35504	95	0.80906	1.22245	0.80074	1.23345
46	0.73213	1.33386	0.72098	1.35060	96	0.81000	1.22117	0.80172	1.23211
47	0.73476	1.32979	0.72370	1.34632	97	0.81093	1.21992	0.80269	1.23079
48	0.73732	1.32585	0.72635	1.34218	98	0.81185	1.21868	0.80364	1.22949
49	0.73981	1.32205	0.72892	1.33818	99	0.81275	1.21746	0.80458	1.22822
50	0.74222	1.31838	0.73142	1.33431					

95 percent level. If they do not overlap, the difference is statistically significant. If both of the two rates (R_1 and R_2) to be compared are based on 100 or more deaths, the following z-test should be used to define a significance test statistic:

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

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

Availability of fetal and perinatal data

Beginning with the 1982 data year, fetal death data and associated User's Guides can be downloaded from the NCHS website at: <http://www.cdc.gov/nchs/about/major/dvs/Vitalstatsonline.htm>. Each file contains all of the variables included in this report plus many additional variables (10). Fetal mortality data are also available on CD-ROMs by request from NCHS. Questions about these data may be directed to 1-866-441-6247 or by e-mail to births@cdc.gov. Additional information on fetal and perinatal mortality is available from: <http://www.cdc.gov/nchs>.

Contents

Abstract	1
Introduction	1
Methods	2
Results	3
Trends in fetal and perinatal mortality	3
Race and Hispanic origin	3
Maternal age	5
Marital status	6
Sex of fetus	6
Plurality	6
Period of gestation	6
Birthweight	7
Fetal and perinatal mortality rates by state	8
Discussion	9
References	9
List of Detailed Tables	11
Technical Notes	15

Copyright information

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

Suggested citation

MacDorman MF, Kirmeyer S. Fetal and perinatal mortality, United States, 2005. National vital statistics reports; vol 57 no 8. Hyattsville, MD: National Center for Health Statistics. 2009.

National Center for Health Statistics

Director
Edward J. Sondik, Ph.D.

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

Division of Vital Statistics

Director, Charles J. Rothwell

U.S. DEPARTMENT OF
HEALTH & HUMAN SERVICES

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

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

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

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