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Fetal and Perinatal Mortality, United States, 2004

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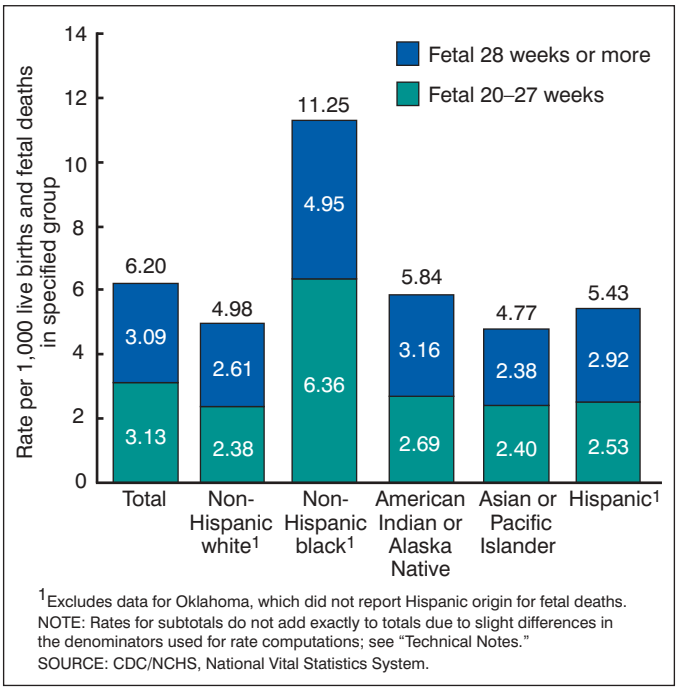
Abstract

Objectives—This report presents 2004 fetal and perinatal mortality data by a variety of characteristics, including maternal age, marital status, race, Hispanic origin and state of residence; and by infant birthweight, gestational age, plurality and sex. Trends in fetal and perinatal mortality are also examined.

Methods—Descriptive tabulations of data are presented and interpreted.

Results—In 2004, there were 25,655 reported fetal deaths of 20 weeks of gestation or more in the United States. The U.S. fetal mortality rate was 6.20 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths, not significantly different from the rate of 6.23 in 2003. The fetal mortality rate for non-Hispanic black women (11.25) was 2.3 times the rate for non-Hispanic white women (4.98), whereas the rate for Hispanic women (5.43) was 9 percent higher than the rate for non-Hispanic white women. Fetal and perinatal mortality rates have declined slowly but steadily from 1990 to 2004. Fetal mortality rates for 28 weeks of gestation or more have declined substantially whereas those for 20–27 weeks of gestation have not declined. Fetal mortality rates are elevated for a number of groups, including teenagers, women aged 35 years and over, unmarried women, and multiple deliveries. In 2004, one-half of fetal deaths of 20 weeks of gestation or more occurred between 20 and 27 weeks of gestation.

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



1Excludes data for Oklahoma, which did not report Hispanic origin for fetal deaths.
NOTE: Rates for subtotals do not add exactly to totals due to slight differences in the denominators used for rate computations; see "Technical Notes."
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 1. Fetal mortality rates by race and Hispanic origin of mother: United States, 2004

Introduction

Fetal mortality is a major, but often overlooked, public health issue. 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. Fetal mortality refers to the intrauterine death of a fetus at any gestational age. Fetal deaths are more numerous than infant deaths. The National Survey of Family Growth collects data on pregnancy losses throughout the gestational period but does not provide

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information by characteristics. Estimates from this survey show a total of about 1 million fetal losses per year in the United States; however, the vast majority of these occur before 20 weeks of gestation (1,2). The concept of a perinatal period emerged in the late 1940s as clinicians and researchers became increasingly aware of the relatively large number of deaths occurring in the period immediately before and after delivery (3). Thus, 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.

Vital statistics-based fetal mortality rates in the United States are generally presented for fetal deaths of 20 weeks of gestation or more. These rates have declined from 25.0 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths in 1942 (4) to 6.20 in 2004. The real decline in fetal mortality was probably larger, as reporting of fetal deaths has improved over time (5,6). Despite this success, fetal and perinatal mortality rates in the United States today are higher than in many other developed countries (7–9). Also of concern are large racial and ethnic disparities in U.S. fetal and perinatal mortality rates. This report presents detailed data on fetal and perinatal deaths and mortality rates for the United States for 2004. Data are presented by maternal age, marital status, race, Hispanic origin and state of residence; and by infant birthweight, gestational age, plurality, and sex (Tables 1–3, A–F, and Figures 1–8). Trends in fetal and perinatal mortality are also examined.

Methods

Data sources—Data shown in this report are drawn from two different NCHS vital statistics data files: the 2004 fetal death data file (for fetal deaths), and the 2004 period linked birth/infant death data file (linked file) (for live births and infant deaths). The 2004 fetal death data file contains information from all Reports of Fetal Death filed in the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam (10,11). 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 2004 (10,12). The purpose of the linkage is to use the many additional variables available from the birth certificate to conduct more detailed analysis of infant and perinatal mortality patterns. The methods for constructing the linked file are described in detail elsewhere (12). 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) (11). Although the vast majority of fetal deaths occur early in pregnancy (1,2), 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 the current analysis. Statistics on fetal death exclude data for induced abortions. 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, see "Technical Notes" (13–17). Thus, 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" (11). 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 or more gestation. 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 gestation. 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.

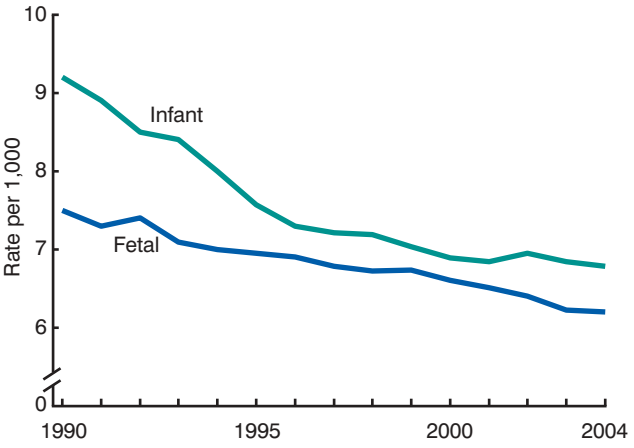
Race and Hispanic origin—Race and Hispanic origin of mother are reported independently on vital records. In tabulations of data by race and Hispanic origin, data for Hispanic persons are not further classified by race as the vast majority of women of Hispanic origin are reported as white. Oklahoma did not have an item on Hispanic origin of mother on its Report of Fetal Death for all of 2004, see "Technical Notes." Data for American Indian or Alaska Natives (AIAN) and Asian or Pacific Islanders (API) are not shown separately by Hispanic origin because the vast majority of these populations are non-Hispanic. Therefore, data for all races combined and for AIANs and APIs in tables and figures in this report are for the United States, and data for non-Hispanic whites, non-Hispanic blacks, and Hispanics exclude Oklahoma.

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, please see "Technical Notes."

Results

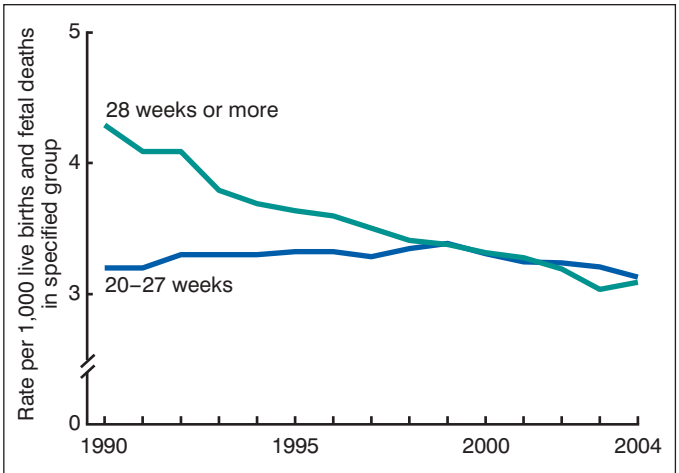
Trends in fetal and perinatal mortality

The fetal mortality rate declined slowly but steadily, by an average of 1.4% per year from 1990–2004 (Figure 2). In contrast, from 1990–2000, the infant mortality rate declined twice as fast as the fetal mortality rate (by an average of 2.8 percent per year), but the infant mortality rate has not declined much since 2000. Figure 3 shows the decline in fetal mortality by period of gestation. The fetal mortality rate for 28 weeks of gestation or more declined by 28 percent from 1990–2004, whereas the fetal mortality rate for 20–27 weeks of gestation has changed little since 1990 (Figure 3 and Table A). Thus, nearly all the decline in fetal mortality since 1990 has been among fetal deaths of 28 weeks of gestation or more.



NOTE: Infant mortality rates are the number of infant deaths per 1,000 live births. Fetal mortality rates are the number of fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 2. Fetal and infant mortality rates: United States, 1990–2004



SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 3. Fetal mortality rates by period of gestation: United States, 1990–2004

Figure 4 shows trends for perinatal mortality rates, definitions I and II, from 1990–2004. The mortality rate for perinatal definition I declined by 25 percent from 1990–2004, more rapidly than the rate for perinatal definition II, which declined by 18 percent (Figure 4 and Table A). This is because perinatal definition I includes only late fetal deaths, and as noted, almost all the decline in fetal mortality from 1990–2004 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 2004 (25,655) was substantially greater then the number of neonatal deaths (18,602). The total number of infant deaths in 2004 was 27,860 (12), just slightly more 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 1). The fetal mortality rate for non-Hispanic white women was 4.98, similar to the rate of 4.77 for API women. In contrast, the fetal mortality rate of 11.25 for non-Hispanic black women was 2.3 times the rate for non-Hispanic white women. About 63 percent 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 37 percent was due to higher mortality at 28 weeks of gestation or more. The rate for AIAN women (5.84) was 17 percent higher and the rate for Hispanic women (5.43) was 9 percent higher than the rate for non-Hispanic white women. Declines in fetal mortality from 1995–2004 have occurred for all race and ethnic groups (Table C) (18).

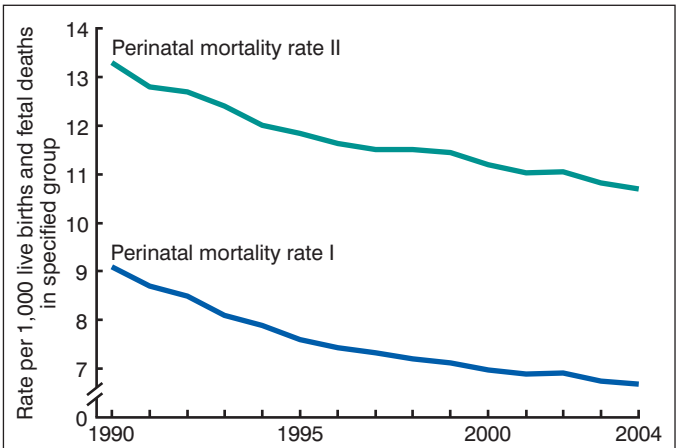
Differences by race and Hispanic origin in perinatal mortality rate, definition I, are shown in Figure 5. Rates were lowest for API women

Table A. Fetal and perinatal mortality rates: United States, 1985, 1990, and 1995–2004

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]
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

[1]Rate is number of fetal deaths in specified group per 1,000 live births and fetal deaths.
[2]Fetal deaths with stated or presumed period of gestation of 20 weeks or more.
[3]Not stated gestational age proportionally distributed; see "Technical Notes."
[4]Infant 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.
[5]Infant 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: NCHS/CDC/National Vital Statistics System.



NOTE: Perinatal I includes infant deaths less than 7 days of age and fetal deaths 28 weeks or more. Perinatal II includes infants less than 28 days of age and fetal deaths 20 weeks or more.
SOURCE: CDC/NCHS; National Vital Statistics System.

Figure 4. Perinatal mortality rates: United States, 1990–2004

(5.00), followed by non-Hispanic white (5.52), Hispanic (5.95), and AIAN women (6.54). The rate for non-Hispanic black women (12.22) was the highest among the race/ethnic groups, and was 2.2 times the rate for non-Hispanic white women.

Data by race and Hispanic origin for 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 (7.95), followed by non-Hispanic white (8.65), Hispanic (9.24), and AIAN women (10.07). The rate for non-Hispanic black women (20.26) was 2.3 times the rate for non-Hispanic white women.

Maternal age

Fetal mortality rates also vary considerably by maternal age. Fetal mortality rates were lowest for women aged 25–34 years and higher for teenagers and those aged 35 years and over (Table 1). The rate for teenagers under 15 years of age was 10.94, twice the rate of 5.45 for women aged 25–29 years—the lowest risk group. Rates for teenagers 15–17 (8.30), and 18–19 years (7.11) were 52 and 30 percent higher, respectively, than for women aged 25–29 years. 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 14.17, 2.6 times the rate 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 (19,20). 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 (21–23).

Marital status

In 2004, 47 percent of fetal deaths were to unmarried women, as compared with 36 percent of live births (Table D) in an area including 45 states and the District of Columbia. Marital status was not reported for fetal deaths in California, Michigan, Nevada, New York, and Texas. In general, fetal mortality rates were lower for married women than for unmarried women (Table E). Differences were largest for non-Hispanic white women, and were much narrower for non-Hispanic black and Hispanic women. Marital status may be a marker for the presence or absence of social, emotional, and financial resources (24,25).

Sex of fetus

In 2004, fetal mortality rates were 9 percent higher for male (6.46) than for female (5.92) fetuses (Table E). Sex ratios at the time of delivery were quite different between fetal deaths and live births (Table D). Sex ratios are computed as the number of males divided by the number of females, times 1,000. Sex ratios higher than 1,000 indicate more males than females, and sex ratios under 1,000 indicate more females than males. For live births, the overall sex ratio was 1,048, indicating that on average 1,048 male infants were born for every 1,000 female infants. In contrast, for fetal deaths the sex

Table B. Components of perinatal mortality: United States, 1985, 1990, and 1995–2004

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	
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

[1]Fetal deaths with stated or presumed period of gestation of 20 weeks or more.
[2]Not stated gestational age proportionally distributed; see "Technical Notes."

SOURCE: NCHS/CDC/National Vital Statistics System.

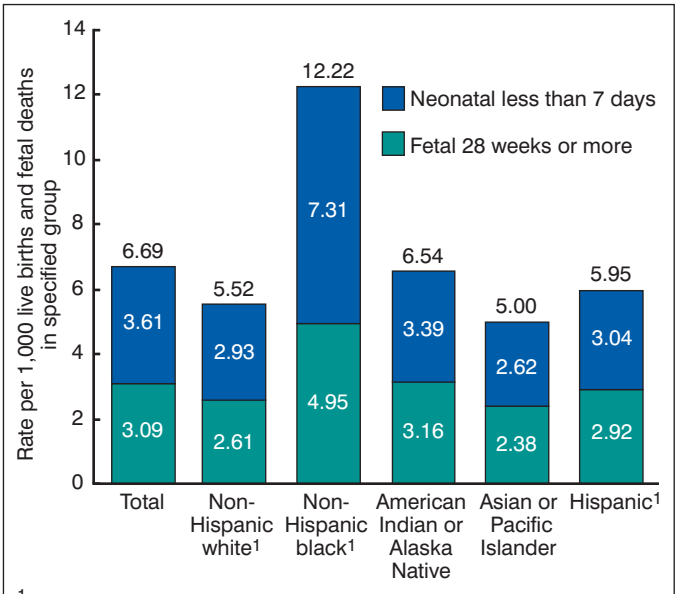
Table C. Fetal deaths and mortality rates by race and Hispanic origin of mother: United States, 1995–2004

						Hispanic[1]					Non-Hispanic[1]	
	All races and origins	White	Black	American Indian or Alaska Native	Asian or Pacific Islander	Total Hispanic	Mexican	Puerto Rican	Cuban	Central and South American	White	Black
Rates												
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												
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

[1]Figures 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.

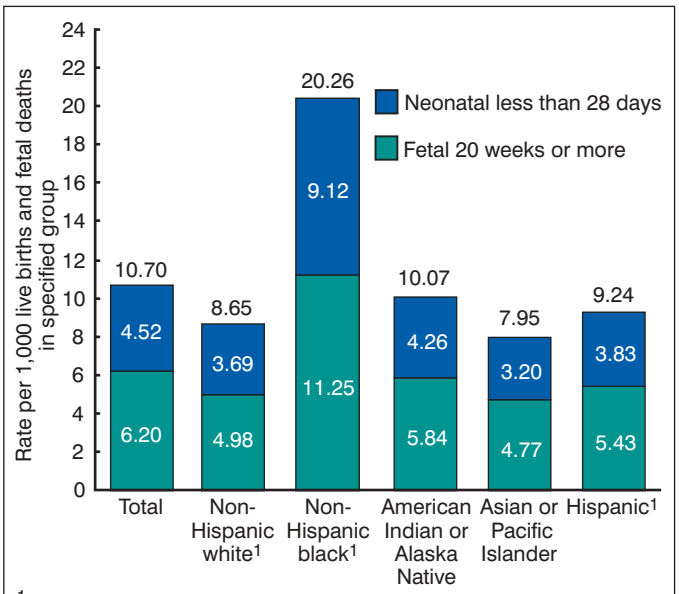
SOURCE: NCHS/CDC/National Vital Statistics System.

ratio was 1,145, nearly 100 points higher than for live births. However, a more detailed examination of sex ratios by gestational age yields similar levels of sex ratios for fetal deaths and live births at any given gestational age (Figure 7). This figure includes data for 3 years combined (2002–2004) to produce more stable estimates by single weeks of gestation. These data indicate that much of the difference in the overall sex ratio between live births and fetal deaths is due to the fact that many more fetal deaths than live births occur at early gestational ages when sex ratios tend to be higher. These findings are consistent with embryological research that has found an



[1]Excludes data for Oklahoma, which did not report Hispanic origin for fetal deaths.
NOTE: Rates for subtotals do not add exactly to totals due to slight differences in the denominators used for rate computations; see "Technical Notes."
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 5. Perinatal mortality rates, definition I, by race and Hispanic origin of mother: United States, 2004



[1]Excludes data for Oklahoma, which did not report Hispanic origin for fetal deaths.
NOTE: Rates for subtotals do not add exactly to totals due to slight differences in the denominators used for rate computations; see "Technical Notes."
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 6. Perinatal mortality rates, definition II, by race and Hispanic origin of mother: United States, 2004

Table D. Percentage of fetal deaths and live births with selected demographic, medical, and health characteristics: United States, 2004

	Fetal deaths				Live births			
	Total[1]	Non-Hispanic white[2]	Non-Hispanic black[2]	Hispanic[2]	Total[1]	Non-Hispanic white[2]	Non-Hispanic black[2]	Hispanic[2]
Mother's characteristics:								
Less than 20 years of age	12.5	9.4	16.7	15.0	10.3	7.4	17.3	14.3
40 years of age and older	4.6	5.2	3.6	4.1	2.7	3.0	2.1	1.9
Unmarried[3]	46.9	32.6	72.5	50.7	35.7	24.9	70.1	48.3
Fetal/infant characteristics:								
Birthweight								
Less than 1,500 grams	63.9	61.2	70.2	60.4	1.5	1.2	3.2	1.2
Less than 2,500 grams	80.8	78.6	86.3	78.1	8.1	7.2	13.8	6.8
4,000 grams or more	2.0	2.0	1.5	3.0	8.5	10.0	4.6	7.9
Period of gestation								
Less than 32 weeks	62.5	59.9	68.8	58.6	2.0	1.6	4.1	1.8
Preterm (less than 37 weeks)	80.7	79.1	85.7	77.3	12.5	11.5	17.9	12.0
Plural delivery	8.8	10.4	7.5	7.1	3.4	3.9	3.7	2.2
Sex ratio[4]	1,145	1,146	1,163	1,111	1,048	1,053	1,037	1,042

[1]Includes races other than white and black and origin not stated.
[2]Excludes data from Oklahoma which did not report Hispanic origin on the fetal death report.
[3]Excludes data from California, Michigan, Nevada, New York, and Texas, which did not report marital status on the fetal death report.
[4]The number of male deliveries divided by the number of female deliveries times 1,000.

NOTE: Not stated responses excluded when computing percent distributions.

SOURCE: NCHS/CDC/National Vital Statistics System.

excess of male fetuses early in pregnancy, more male than female deliveries early in the gestational period, and a declining sex ratio at delivery as pregnancies approached term (26,27).

Plurality

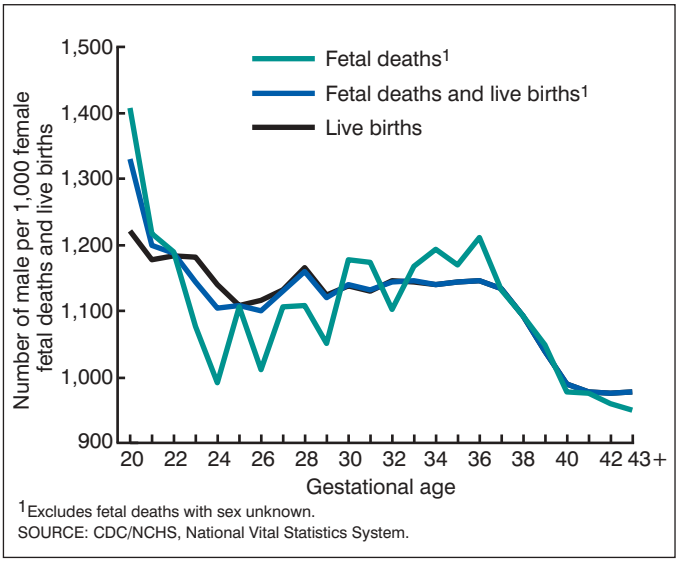
In 2004, 9 percent of fetal deaths occurred in multiple deliveries, as compared with 3 percent of live births (Table D). A multiple delivery is one in which more than one fetus is delivered live or dead at any time during the pregnancy, and a given multiple pregnancy may include any combination of fetal deaths or live births. The fetal mortality rate for twins (15.24) was 2.6 times that for singletons (5.85) (Table E). The fetal mortality rate for triplet or higher order deliveries (29.48) 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, anomalies, abruption,

Table E. Fetal mortality rates by selected characteristics and race and Hispanic origin of mother, United States, 2004

	Fetal mortality rates[1]				Fetal deaths				Live births			
Characteristic	All races[2]	Non-Hispanic white[3]	Non-Hispanic black[3]	Hispanic[3]	All races[2]	Non-Hispanic white[3]	Non-Hispanic black[3]	Hispanic[3]	All races[2]	Non-Hispanic white[3]	Non-Hispanic black[3]	Hispanic[3]
Plurality	6.20	4.98	11.25	5.43	25,655	11,316	6,530	5,135	4,112,055	2,262,483	574,146	940,342
Single	5.85	4.64	10.80	5.16	23,388	10,137	6,039	4,769	3,972,560	2,174,547	553,097	919,386
Twin	15.24	12.46	21.56	16.43	2,046	1,039	451	338	132,219	82,370	20,472	20,236
Triplet or higher order	29.48	24.54	64.83	37.43	221	140	40	28	7,276	5,566	577	720
Sex of fetus	6.20	4.98	11.25	5.43	25,655	11,316	6,530	5,135	4,112,055	2,262,483	574,146	940,342
Male	6.46	5.18	11.87	5.60	13,694	6,043	3,511	2,702	2,104,663	1,160,537	292,321	479,917
Female	5.92	4.76	10.60	5.26	11,961	5,273	3,019	2,433	2,007,392	1,101,946	281,825	460,425
Ratio male to female	1.09	1.09	1.12	1.07	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Marital status, total[4]	6.33	5.01	11.25	5.52	17,656	8,697	4,945	2,217	2,770,995	1,727,927	434,519	399,212
Married	5.03	4.39	10.11	5.11	9,000	5,714	1,326	1,059	1,780,457	1,297,102	129,829	206,362
Unmarried	7.96	6.38	11.36	5.62	7,947	2,768	3,502	1,089	990,538	430,825	304,690	192,850
Ratio unmarried to married	1.58	1.46	1.12	1.10	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

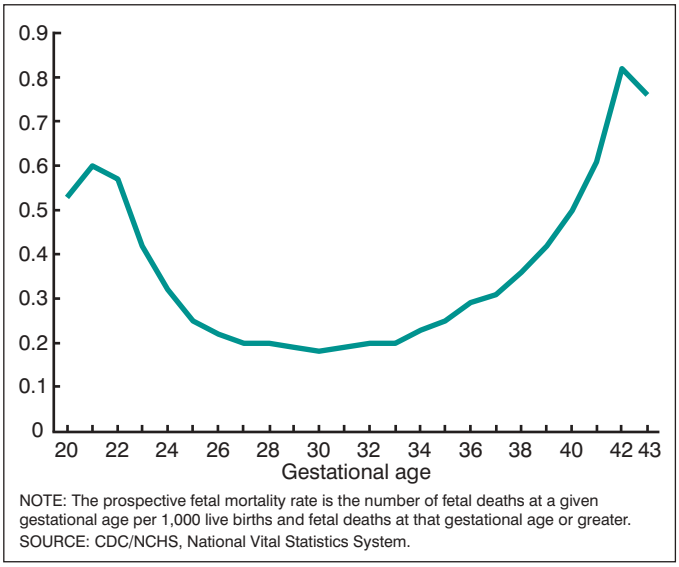
. . . Category not applicable.
[1]Rate per 1,000 live births and fetal deaths in specified group.
[2]Includes races other than white, black, and origin not stated.
[3]Excludes data from Oklahoma, which did not report Hispanic origin on the fetal death report.
[4]Excludes data from California, Michigan, Nevada, New York, and Texas, which did not report marital status on the fetal death report.

SOURCE: NCHS/CDC/National vital statistics system.



[1]Excludes fetal deaths with sex unknown.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 7. Sex ratios by single weeks of gestation for fetal deaths and live births: United States, 2002–2004



NOTE: The prospective fetal mortality rate is the number of fetal deaths at a given gestational age per 1,000 live births and fetal deaths at that gestational age or greater.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 8. Prospective fetal mortality rate by single weeks of gestation: United States, 2004

and cord accidents (28). Also, many multiple pregnancies are the result of assisted reproductive technologies (29). Studies have suggested that both the underlying infertility problem, and the use of these therapies may increase the risk of adverse outcomes (22,29).

Period of gestation

In general, many more fetal deaths than live births occur early in the pregnancy. In 2004, more than one-third (34 percent) of all fetal deaths at 20 weeks of gestation or more occurred between 20–23 weeks of gestation, and one-half occurred between 20–27 weeks (Table 2).

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 (30). 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 2004, the fetal mortality rate computed by this method was 500.40 at 20–23 weeks of gestation, declined sharply to a low of 0.89 for 40 weeks of gestation, and then increased to 1.86 for fetal deaths at 42 weeks of gestation or more (Table 2). Gestational age data is primarily based on the interval between the first day of the mother's last normal menstrual period (LMP) and the date of birth, and is subject to error due to imperfect maternal recall or misidentification of the LMP, see "Technical Notes" (31).

Recently several 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 (32–34). 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 8 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 (0.53–0.60) at 20–22 weeks of gestation, and declined to a low of 0.18–0.20 at 27–33 weeks of gestation. The rate remained relatively low until about 36 weeks of gestation, and then increased rapidly to a high of 0.76–0.82 at 42–43 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 was 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 (35). 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 (22, 35–37).

Birthweight

In 2004, over one-third (34 percent) of fetal deaths at 20 weeks of gestation or more weighed less than 500 grams at delivery, and nearly one-half (48 percent) weighed less than 750 grams (Table 2). Fetal mortality rates were computed by the traditional method as the number of fetal 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 for infants at 3,000–3,999 grams, and then increased slightly for heavier infants (Table 2). However, 10 percent of fetal deaths in the United States in 2003 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 (33), 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 (38). Also, a much higher proportion of fetal deaths than live births are growth-retarded, making birthweight comparisons between the two populations somewhat problematic (33).

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 (2002–2004). The United States fetal mortality rate for this measure was 4.12 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, the District of Columbia, Mississippi, and South Carolina and were lowest (below 3.00) in Maine, New Mexico, and Vermont.

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 6.69 for the United States as a whole (Table 3). The highest rates (9.00 or above) were for the District of Columbia, Mississippi, South Carolina, and Wyoming, whereas the lowest rates (below 5.00) were for Montana, Vermont, and Washington.

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 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 2004, this rate was 10.70 for the United States as a whole. Among the states with comparable data, the highest rates (above 14.50) were for the District of Columbia, Mississippi, South Carolina, and Wyoming, whereas the lowest rates (below 8.50) were for Minnesota, Montana, Oregon, and Vermont.

Differences in population characteristics among states (as regards to 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.

Table F. Fetal deaths of 24 weeks of gestation or more and fetal mortality rates by state, 2002–2004

	Fetal deaths	Fetal mortality rate[1]
United States	50,606	4.12
Alabama	1,015	5.67
Alaska	120	3.94
Arizona	1,147	4.19
Arkansas	593	5.18
California	6,134	3.78
Colorado	813	3.93
Connecticut	435	3.41
Delaware	115	3.39
District of Columbia	116	5.01
Florida	3,036	4.75
Georgia	2,007	4.89
Hawaii	206	3.81
Idaho	270	4.12
Illinois	2,215	4.06
Indiana	1,121	4.32
Iowa	394	3.44
Kansas	436	3.66
Kentucky	791	4.77
Louisiana	912	4.65
Maine	123	2.97
Maryland	1,056	4.72
Massachusetts	872	3.63
Michigan	1,380	3.52
Minnesota	732	3.50
Mississippi	775	6.08
Missouri	989	4.28
Montana	127	3.72
Nebraska	329	4.22
Nevada	475	4.66
New Hampshire	133	3.06
New Jersey	1,437	4.12
New Mexico	221	2.63
New York	3,536	4.66
North Carolina	1,650	4.62
North Dakota	78	3.25
Ohio	1,887	4.20
Oklahoma	596	3.89
Oregon	480	3.50
Pennsylvania	1,726	3.97
Rhode Island	120	3.08
South Carolina	954	5.69
South Dakota	110	3.32
Tennessee	962	4.06
Texas	4,094	3.61
Utah	518	3.45
Vermont	58	2.95
Virginia	1,263	4.13
Washington	860	3.55
West Virginia	296	4.71
Wisconsin	795	3.79
Wyoming	98	4.86
Puerto Rico	939	6.04
Virgin Islands	36	7.55
Guam	73	7.32

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

NOTE: Fetal deaths with not stated period of gestation are proportionally distributed to less than 24 weeks and 24 weeks or more; see "Technical Notes."

Discussion

Fetal and perinatal mortality rates have declined slowly but steadily from 1990 to 2004. Virtually all the decline in the fetal

mortality rate has occurred among fetal deaths at 28 weeks of gestation or more. Mortality rates for fetal deaths at 20–27 weeks of gestation did not decline during the period. In 2004, well over one-half (58 percent) 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.

A large body of literature has attempted to explain the much higher perinatal and infant mortality rates for black women. An important intermediate variable in this discussion is the much higher rate of preterm delivery for non-Hispanic black mothers, compared with non-Hispanic white and Hispanic mothers (31), but the reasons for this disparity are not well understood. Factors frequently mentioned as contributing to the black-white perinatal mortality gap are racial differences in maternal preconceptional 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 (39–42).

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 of fetal mortality and of fetal mortality as a public health problem. The National Institute of Child Health and Human Development is currently sponsoring a major research effort into the etiology and prevention of fetal death (43), and the Centers for Disease Control and Prevention has initiated active fetal death surveillance in Iowa and metropolitan Atlanta (44). The International Stillbirth Alliance facilitates research on the causes and prevention of stillbirth, provides support to parents experiencing a fetal loss, and raises public awareness of fetal mortality as a public health issue (45).

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, infections, placental and cord problems, intrauterine growth retardation, previous perinatal death, and other factors (21,22,28,32,35–37). For example, data from the 2002 National Survey of Family Growth showed that 21 percent of women whose most recent pregnancy ended in a fetal loss reported smoking during the pregnancy compared with 12 percent of those whose most recent pregnancy ended in a live birth (46).

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 critical to the monitoring and assessment of prevention efforts. The 2003 revisions of the U.S. Standard Report of Fetal Death and the U.S. Standard Certificate of Live Birth contain expanded medical and health information (47,48). As more states implement these revisions, it will increase opportunities for fetal and perinatal mortality research. It is hoped that recent research efforts will lead to wider interest in and discussion of factors related to fetal mortality, and ultimately to the development of improved strategies for the prevention of fetal death.

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List of Detailed Tables

Table 1. Fetal deaths and mortality rates by period of gestation and age, race and Hispanic origin of mother: United States, 2004

Age, race and Hispanic origin of mother	Fetal deaths			Fetal mortality rate[1]		
	Total	20–27 weeks[2]	28 weeks or more[2]	Total	20–27 weeks[2]	28 weeks or more[2]
All races[3]	25,655	12,894	12,761	6.20	3.13	3.09
Less than 15 years	75	51	24	10.94	7.46	3.53
15–19 years	3,137	1,684	1,453	7.50	4.04	3.49
15–17 years	1,122	612	510	8.30	4.55	3.79
18–19 years	2,015	1,072	943	7.11	3.80	3.34
20–24 years	6,228	3,026	3,202	5.98	2.92	3.09
25–29 years	6,052	2,996	3,056	5.45	2.71	2.76
30–34 years	5,526	2,850	2,676	5.69	2.94	2.76
35–39 years	3,460	1,754	1,706	7.22	3.67	3.57
40–44 years	1,089	497	592	10.39	4.77	5.68
45 years and over	88	36	52	14.17	5.85	8.42
Non-Hispanic white[4]	11,316	5,406	5,910	4.98	2.38	2.61
Less than 15 years	12	9	3	*	*	*
15–19 years	1,054	539	515	6.35	3.26	3.11
15–17 years	329	176	153	7.40	3.97	3.45
18–19 years	725	363	363	5.97	2.99	2.99
20–24 years	2,461	1,123	1,338	4.84	2.21	2.64
25–29 years	2,817	1,323	1,494	4.51	2.12	2.40
30–34 years	2,667	1,315	1,352	4.44	2.20	2.26
35–39 years	1,719	827	892	5.67	2.73	2.95
40–44 years	547	255	292	8.36	3.91	4.48
45 years and over	39	15	24	9.66	*	5.96
Non-Hispanic black[4]	6,530	3,676	2,854	11.25	6.36	4.95
Less than 15 years	32	22	10	11.68	8.06	*
15–19 years	1,060	583	477	10.87	6.01	4.92
15–17 years	404	228	176	11.54	6.55	5.06
18–19 years	656	355	301	10.50	5.71	4.85
20–24 years	1,888	1,016	872	10.00	5.40	4.64
25–29 years	1,462	841	621	10.56	6.10	4.51
30–34 years	1,157	702	455	12.41	7.57	4.92
35–39 years	697	403	294	14.70	8.55	6.25
40–44 years	212	97	115	17.90	8.27	9.79
45 years and over	22	12	10	33.90	*	*
Hispanic[4,5]	5,135	2,384	2,751	5.43	2.53	2.92
Less than 15 years	21	13	8	8.92	*	*
15–19 years	747	391	356	5.63	2.95	2.69
15–17 years	293	152	141	6.03	3.14	2.91
18–19 years	454	240	214	5.39	2.86	2.55
20–24 years	1,360	622	738	4.87	2.23	2.65
25–29 years	1,185	538	647	4.67	2.12	2.55
30–34 years	978	442	536	5.50	2.49	3.02
35–39 years	633	296	337	7.79	3.66	4.16
40–44 years	196	80	116	11.28	4.63	6.70
45 years and over	15	2	13	*	*	*

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

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

[2]Fetal deaths with not stated gestational age were proportionally distributed; see "Technical Notes."

[3]Includes races other than white or black and origin not stated.

[4]Excludes data from Oklahoma which did not report Hispanic origin on the fetal death report.

[5]Includes 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, 2004

Birthweight (grams) and race and Hispanic origin of mother	Gestational age in weeks											
	Total	20–23	24–27	28–31	32–35	36	37–39	40	41	42+	Not stated	Fetal mortality rate[1]
All races[2]	25,655	8,663	4,033	3,089	3,508	1,102	3,296	713	386	470	395	6.20
Less than 500	7,845	5,660	1,509	423	181	21	37	7	2	4	1	555.28
500–749	3,315	1,452	1,144	455	138	22	28	7	4	9	56	227.18
750–999	1,530	171	558	551	165	20	21	1	1	7	35	111.78
1,000–1,249	1,116	53	210	477	260	33	36	5	3	8	31	73.00
1,250–1,499	928	42	81	351	304	31	67	5	8	16	23	52.49
1,500–1,999	1,933	35	68	409	870	177	244	25	21	34	50	28.58
2,000–2,499	1,964	–	19	126	777	281	552	65	37	49	58	9.47
2,500–2,999	1,765	–	22	36	326	245	772	151	80	87	46	2.41
3,000–3,499	1,486	–	–	23	127	130	753	202	88	123	40	0.94
3,500–3,999	702	–	–	11	48	34	339	133	66	51	20	0.62
4,000 or more	465	–	–	–	30	30	221	68	47	44	25	1.33
Not stated	2,606	1,250	422	227	282	78	226	44	29	38	56	- - -
Fetal mortality rate[1]	6.20	500.40	164.70	57.14	14.49	5.82	1.54	0.89	1.02	1.86	- - -	- - -
Non-Hispanic white[3]	11,316	3,593	1,761	1,354	1,598	561	1,572	359	190	218	110	4.98
Less than 500	3,276	2,303	665	183	83	10	25	3	1	2	1	579.52
500–749	1,356	580	474	197	59	10	17	4	1	1	13	232.51
750–999	664	69	248	250	69	10	6	1	–	2	9	110.46
1,000–1,249	483	16	92	201	116	24	17	1	1	4	11	67.72
1,250–1,499	400	19	36	157	130	14	28	1	2	4	9	46.13
1,500–1,999	842	16	29	191	380	80	99	17	7	11	12	24.63
2,000–2,499	910	–	10	52	385	137	247	24	20	21	14	8.83
2,500–2,999	858	–	10	12	159	132	387	67	40	35	16	2.41
3,000–3,499	747	–	–	9	55	76	381	107	42	67	10	0.89
3,500–3,999	352	–	–	5	20	15	168	71	39	30	4	0.52
4,000 or more	203	–	–	–	13	11	89	36	22	24	8	0.89
Not stated	1,225	590	197	97	129	42	108	27	15	17	9	- - -
Fetal mortality rate[1]	4.98	522.24	170.31	52.99	13.07	5.52	1.32	0.80	0.89	1.60	- - -	- - -
Non-Hispanic black[3]	6,530	2,574	1,062	807	872	219	660	119	64	82	71	11.25
Less than 500	2,388	1,778	421	126	49	5	4	4	1	–	–	502.74
500–749	921	441	281	141	33	8	4	–	1	5	7	190.96
750–999	391	43	152	135	43	4	8	–	–	2	4	95.86
1,000–1,249	290	18	57	127	65	4	11	1	1	–	6	68.98
1,250–1,499	208	7	17	81	74	5	14	1	4	2	3	47.22
1,500–1,999	495	7	16	96	249	45	53	2	5	10	12	31.61
2,000–2,499	469	–	7	36	178	60	135	20	8	12	13	10.19
2,500–2,999	352	–	7	7	76	43	156	24	16	17	6	2.51
3,000–3,499	241	–	–	5	29	19	121	31	8	17	11	1.10
3,500–3,999	131	–	–	2	14	7	75	19	5	6	3	1.19
4,000 or more	92	–	–	–	6	8	47	11	12	3	5	3.46
Not stated	552	280	104	51	56	11	32	6	3	8	1	- - -
Fetal mortality rate[1]	11.25	450.31	139.13	59.50	18.29	6.74	2.27	1.20	1.41	2.46	- - -	- - -
Hispanic[3,4]	5,135	1,557	768	609	709	232	743	169	98	124	126	5.43
Less than 500	1,402	1,016	269	75	33	3	5	–	–	1	–	563.28
500–749	673	268	249	79	36	4	5	2	2	2	26	235.81
750–999	326	36	102	121	38	3	7	–	1	3	15	123.39
1,000–1,249	224	12	40	98	51	4	6	3	1	3	6	78.49
1,250–1,499	205	13	20	61	69	10	16	3	2	6	5	62.83
1,500–1,999	412	9	16	77	170	37	70	4	8	7	14	32.54
2,000–2,499	419	–	1	30	144	65	120	17	8	12	22	10.30
2,500–2,999	378	–	3	12	63	48	154	45	13	27	13	2.28
3,000–3,499	353	–	–	7	30	25	182	42	29	29	9	0.93
3,500–3,999	157	–	–	4	14	10	64	27	19	13	6	0.61
4,000 or more	137	–	–	–	9	11	66	18	11	13	9	1.84
Not stated	449	203	68	45	52	12	48	8	4	8	1	- - -
Fetal mortality rate[1]	5.43	494.29	161.41	55.02	13.07	5.70	1.58	0.91	1.10	1.95	- - -	- - -

– Quantity zero. - - - Category not applicable.

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

[2]Includes races other than white or black and origin not stated.

[3]Excludes data from Oklahoma which did not report Hispanic origin on the fetal death report.

[4]Includes all persons of Hispanic origin of any race.

Table 3. Fetal and perinatal deaths and mortality rates, United States and each state and territory, 2004

	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	25,655	6.20	27,596	6.69	44,257	10.70
Alabama	536	8.93	502	8.40	841	14.01
Alaska	53	5.10	66	6.36	89	8.57
Arizona	548	5.82	609	6.48	978	10.38
Arkansas	281	7.23	300	7.75	476	12.25
California	2,819	5.15	3,116	5.70	4,718	8.61
Colorado	388	5.63	465	6.77	693	10.06
Connecticut	254	6.00	246	5.83	427	10.08
Delaware	49	4.29	70	6.14	115	10.07
District of Columbia	59	7.38	84	10.55	129	16.14
Florida	1,649	7.51	1,526	6.97	2,643	12.03
Georgia	1,175	8.39	1,126	8.08	1,967	14.05
Hawaii	97	5.28	109	5.95	176	9.58
Idaho	129	5.69	161	7.12	217	9.58
Illinois	1,117	6.14	1,291	7.12	2,016	11.08
Indiana	523	5.97	660	7.55	995	11.35
Iowa	215	5.56	206	5.34	338	8.74
Kansas	193	4.84	271	6.81	376	9.43
Kentucky	361	6.44	381	6.81	581	10.36
Louisiana	459	6.97	529	8.07	863	13.11
Maine	67	4.78	82	5.87	126	8.99
Maryland	592	7.87	623	8.32	1,045	13.89
Massachusetts	420	5.32	486	6.17	717	9.09
Michigan	745	5.71	918	7.05	1,439	11.03
Minnesota	363	5.11	370	5.22	587	8.27
Mississippi	401	9.28	409	9.50	659	15.24
Missouri	463	5.92	549	7.04	838	10.71
Montana	42	3.63	47	4.07	71	6.14
Nebraska	163	6.15	183	6.93	274	10.34
Nevada	256	7.22	237	6.71	407	11.48
New Hampshire	67	4.58	91	6.23	132	9.02
New Jersey	751	6.47	722	6.25	1,208	10.41
New Mexico[6]	87	3.06	144	5.06	197	6.92
New York	2,109	8.37	1,642	6.55	3,198	12.69
North Carolina	798	6.61	1,011	8.41	1,518	12.58
North Dakota	37	4.50	53	6.46	74	9.00
Ohio	970	6.47	1,082	7.24	1,699	11.33
Oklahoma	255	4.95	310	6.03	496	9.62
Oregon	195	4.25	256	5.59	370	8.07
Pennsylvania	903	6.20	1,007	6.94	1,615	11.09
Rhode Island	67	5.22	84	6.56	121	9.42
South Carolina	479	8.39	525	9.24	843	14.77
South Dakota[6]	37	3.25	77	6.78	93	8.18
Tennessee[6]	384	4.80	649	8.12	816	10.20
Texas	2,070	5.40	2,274	5.95	3,635	9.48
Utah	279	5.48	271	5.33	454	8.91
Vermont	29	4.38	33	4.99	48	7.24
Virginia	725	6.93	713	6.84	1,246	11.91
Washington	433	5.27	407	4.97	706	8.59
West Virginia	146	6.94	151	7.21	247	11.75
Wisconsin	359	5.09	419	5.96	638	9.05
Wyoming	58	8.45	67	9.79	100	14.57
Puerto Rico	535	10.36	412	8.03	845	16.36
Virgin Islands	18	*	16	*	26	16.33
Guam	34	9.88	36	10.52	59	17.15

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

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

[2]Infant 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.

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

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

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

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

Technical Notes

Definition of fetal death

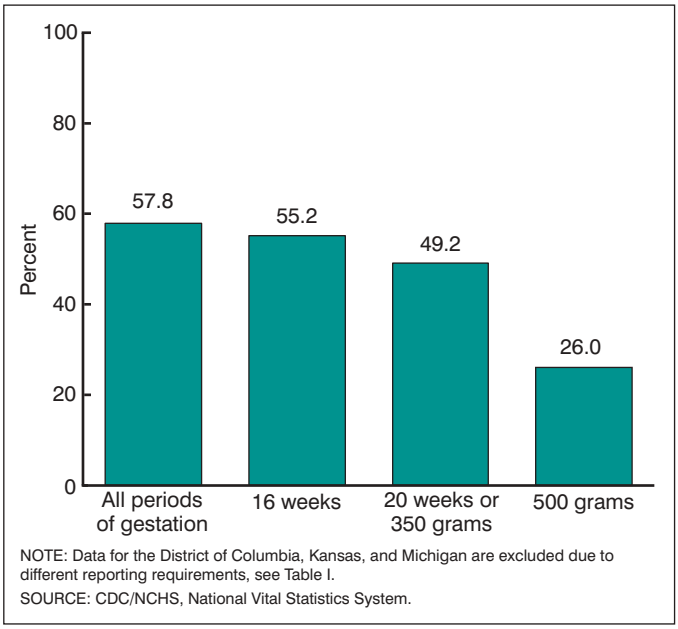
> "Fetal death" means death prior to the complete expulsion or extraction from its mother of a product of human conception, irrespective of the duration of pregnancy and which is not an induced termination of pregnancy. The death is indicated by the fact that after such expulsion or extraction, the fetus 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 (49).

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 (11,50). 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 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 underestimate of the US fetal mortality rate. For example, when data for these three states were excluded, the fetal mortality rate was 6.26 in 2004, compared with 6.20 for all states combined.

There is substantial evidence that not all fetal deaths for which reporting is required are reported (13–16). Underreporting of fetal deaths is most likely to occur in the earlier part of the required reporting period for each state (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, 58 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 26 percent were at 20–27 weeks, thus indicating substantial underreporting of early fetal deaths.



NOTE: Data for the District of Columbia, Kansas, and Michigan are excluded due to different reporting requirements, see Table I.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure I. Percentage of fetal deaths 20–27 weeks of all fetal deaths 20 weeks or more according to state reporting requirements, 2004

Variations in fetal death reporting requirements and practices have implications for comparing fetal and perinatal mortality rates among 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 (11).

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.

Table I. Period of gestation at which fetal-death reporting is required: Each reporting area, 2004

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					

[1]Although state law requires the reporting of fetal deaths of all periods of gestation, only data for fetal deaths of 20 completed weeks of gestation or more are provided to NCHS.
[2]If weight is unknown, 20 completed weeks of gestation or more.
[3]If gestational age is unknown, weight of 500 grams or more.
[4]If weight is unknown, 22 completed weeks of gestation or more.
[5]If gestational age is unknown, weight of 400 grams or more, 15 ounces or more.

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

This report includes data for four states, Idaho, Michigan, Utah, and Washington, which implemented the 2003 revision of the U.S. Standard Report of Fetal Death as of January 1, 2004, or in 2003 (revised). Two additional states, Kentucky and Oklahoma, implemented in 2004 but after January 1. Data from all other areas are based on the 1989 revision (unrevised).

For live births, seven states (Idaho, Kentucky, New York (excluding New York City), Pennsylvania, South Carolina, Tennessee, and Washington) implemented the 2003 revision of the U.S. Standard Certificate

Table II. Percent of unknown responses for selected variables for fetal deaths and live births, United States, 2004

	Fetal deaths			
	Total[1]	20–27 weeks	28 weeks or more	Live births[2]
Marital status[3]	4.02	4.41	3.45	0.04
Hispanic origin	†4.81	†5.60	†3.88	0.79
Period of gestation	1.54	. . .	. . .	1.05
Birthweight	10.16	13.17	7.35	††0.01

† Excludes data from Oklahoma, which did not report Hispanic origin for fetal deaths.
. . . 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.
[1]Includes fetal deaths with stated or presumed period of gestation of 20 weeks or more.
[2]Based on the denominator file for the linked file. Figures for the linked file differ slightly from the natality file.
[3]For fetal deaths, excludes data for residents of California, Michigan, 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 non-reporting states and not stated marital status was imputed in reporting states (31).

of Birth as of January 1, 2004, or in 2003. Two additional states, Florida and New Hampshire, implemented the revised birth certificate in 2004, but after January 1. Data from all other areas are based on the 1989 revision.

For infant deaths included in perinatal mortality rates, 10 states (California, Idaho, Michigan, Montana, New Jersey, New York, Oklahoma, South Dakota, Washington, and Wyoming) implemented the 2003 revision of the U.S. Standard Certificate of Death as of January 1, 2004, or in 2003. Two additional states, New Hampshire and Connecticut, implemented the revised death certificate in 2004, but after January 1. 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 (47). 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 1, 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 (51). 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.

$$\text{Prospective fetal mortality rate}_w = \text{Fetal deaths}_w / \left(\sum_w^{max} \text{fetal deaths} + \sum_w^{max} \text{live births}\right) * 1000;$$

where w = specific gestational age in weeks, and max = highest gestational age in weeks. A slight change (related to the handling of not stated gestational age) in the method of computation of this rate occurred from last year's report, making the prospective fetal mortality rates for post-term pregnancies not strictly comparable between the two reports (52).

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 (53). For fetal deaths, states reporting multiple-race data in 2004 were: Idaho, Michigan, Minnesota, Utah, and Washington (full year), and Kentucky and Oklahoma (partial year). For 2004 births, states reporting multiple-race data were: California, Hawaii, Idaho, Kentucky, Michigan, Minnesota, New York (excluding New York City), Ohio, Pennsylvania, South Carolina, Tennessee, Utah, and Washington (full year), and Florida and New Hampshire (partial year). 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 (31, 54–57). 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 postconception 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 (14.7 percent of fetal death records and 5.9 percent of live birth records in 2004). These procedures are described in more detail elsewhere (31,58).

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, and separately for the entire United States. Thus, the sum of fetal or perinatal deaths for the areas may differ slightly from the total number of perinatal deaths for the United States.

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 (59). 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.

The formula for the RSE of fetal or perinatal deaths and live births is:

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

where D is the number of deaths and

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

where B is the number of births.

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

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

$$\text{whereas the RSE of the births} = 100 \bullet \sqrt{\frac{1}{32{,}650}} = 0.55.$$

The formula for the RSE of the fetal mortality rate (FMR) is:

$$\mathrm{RSE(FMR)} = 100 \bullet \sqrt{\frac{1}{D} + \frac{1}{B}}$$

The RSE of the FMR for the example above

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

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

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

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

Thus, for group A:

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

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

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

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

$$\text{Lower: } \mathrm{FMR} \bullet L\ (.95,\ D_{adj})$$

$$\text{Upper: } \mathrm{FMR} \bullet U\ (.95,\ D_{adj})$$

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 and live births, and is computed as follows:

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

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

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

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

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

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

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

Lower: 6.39 • 0.78384 = 5.01

Upper: 6.39 • 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 95 percent level. If they do not overlap, the difference is statistically significant. If both of the two rates (R_1 and R_2) to be compared are based on 100 or more deaths, the following z-test may be used to define a significance test statistic:

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

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

Fetal and perinatal data are available on the Perinatal CD-ROM, which contains all of the variables included in this report, plus many additional variables (10). This CD-ROM has been published annually since 1995, and is available from NCHS by calling 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.

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