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Fetal and Perinatal Mortality, United States, 2003

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Abstract

Objectives—This report presents 2003 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—The U.S. fetal mortality rate in 2003 was 6.23 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths. Fetal and perinatal mortality rates have declined slowly but steadily from 1990 to 2003. 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 higher for a number of groups, including non-Hispanic black women, teenagers, women aged 35 years and over, unmarried women, and multiple deliveries. Over one-half (51 percent) 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

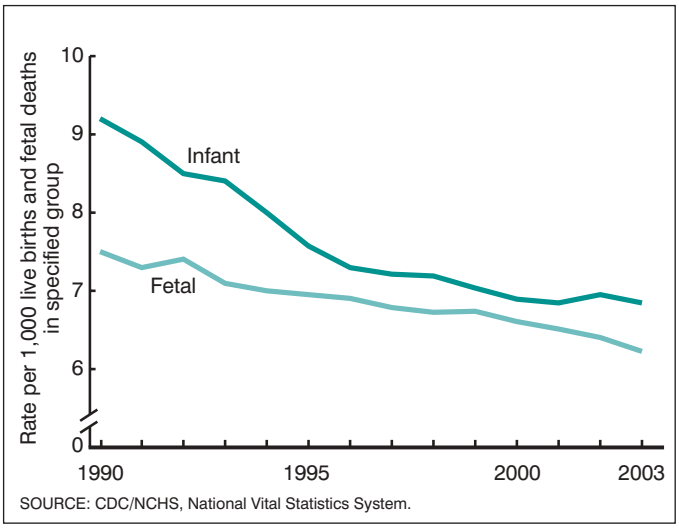

Figure 1. Fetal and infant mortality rates: United States, 1990–2003

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 opportunities for prevention of 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 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

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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 fetal mortality rates in the United States are generally presented for fetal deaths of 20 weeks of gestation or more. These rates have declined about four-fold since 1942 (from 25.0 fetal deaths of 20 weeks of gestation or more per 1,000 live births and fetal deaths in 1942 (4) to 6.23 in 2003). 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 2003. Data are presented by 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

Data sources—Data shown in this report are drawn from two different National Center for Health Statistics (NCHS) vital statistics data files: the 2003 fetal death data file (for fetal deaths), and the 2003 period linked birth/infant death data file (linked file) (for live births and infant deaths). The 2003 fetal death data file contains information from all Reports of Fetal Death filed in the 50 states, the District of Columbia, Puerto Rico, the U.S. 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 2003 (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 United States 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, thus representing 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 the "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 does not have an item on Hispanic origin of mother on its Report of Fetal Death. Data for American Indian or Alaska Native (AIAN) and Asian or Pacific Islander (API) mothers 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, whereas 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."

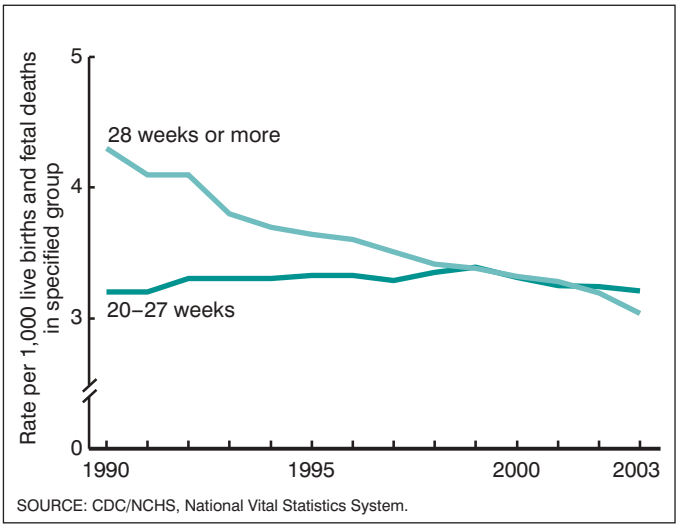
Results

Trends in fetal and perinatal mortality

The fetal mortality rate declined slowly but steadily, by an average of 1.4 percent per year from 1990–2003 (Figure 1). 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 did not decline significantly from 2000–2003.

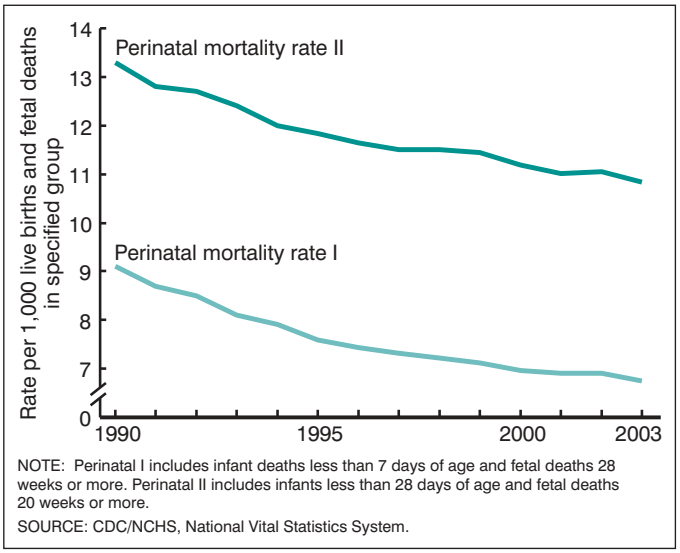
Figure 2 shows the decline in fetal mortality by period of gestation. The fetal mortality rate for 28 weeks of gestation or more declined by 29 percent from 1990–2003, whereas the fetal mortality rate for 20–27 weeks of gestation has changed little since 1990 (Figure 2 and Table A). Thus, nearly all of the decline in fetal mortality since 1990 has been among fetal deaths of 28 weeks of gestation or more. Trends in fetal mortality rates by race and ethnicity have been discussed in detail in another publication (18).

Figure 3 shows trends for perinatal mortality rates, definitions I and II, from 1990–2003. The mortality rate for perinatal definition I declined by 26 percent from 1990–2003, more rapidly than the rate for perinatal definition II, which declined by 19 percent (Figure 3 and Table A). This



SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 2. Fetal mortality rates by period of gestation: United States, 1990–2003



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 3. Perinatal mortality rates: United States, 1990–2003

is because perinatal definition I includes only late fetal deaths, and as noted, almost all of 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. It is interesting to note that there were substantially more fetal deaths of 20 weeks gestation or more (25,653) than neonatal deaths (18,935) in 2003. The total number of infant deaths in 2003 was 27,995 (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 4). The fetal mortality rate for non-Hispanic white women was 4.94, similar to the rate of 4.98 for API women. In contrast, the fetal mortality rate of 11.56 for non-Hispanic black women was 2.3 times the rate for non-Hispanic white women. Nearly two-thirds (64 percent) of the difference between non-Hispanic black and non-Hispanic white fetal mortality was due to non-Hispanic black excess mortality at 20–27 weeks of gestation, whereas about one-third (36 percent) was due to excess fetal mortality at 28 weeks of gestation or more. The rate for AIAN women (6.09) was 24 percent higher than that for non-Hispanic white women, primarily due to higher fetal mortality at 28 weeks or more. The rate for Hispanic women (5.46) was also slightly higher than the non-Hispanic white rate.

Disparities in fetal mortality by race have increased slightly since 1990 when the fetal mortality rate was 12.8 for non-Hispanic black women, 2.2 times the rate of 5.9 for non-Hispanic white women. The 1990 data excluded Louisiana, Maryland, Massachusetts, New Hampshire, Oklahoma, and Rhode Island, which did not report Hispanic origin for fetal deaths (18). Results for 2003 were similar when data from these states were excluded for comparative purposes.

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 1995–2003

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]
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.

Table B. Components of perinatal mortality: United States, 1985, 1990, and 1995–2003

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	
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

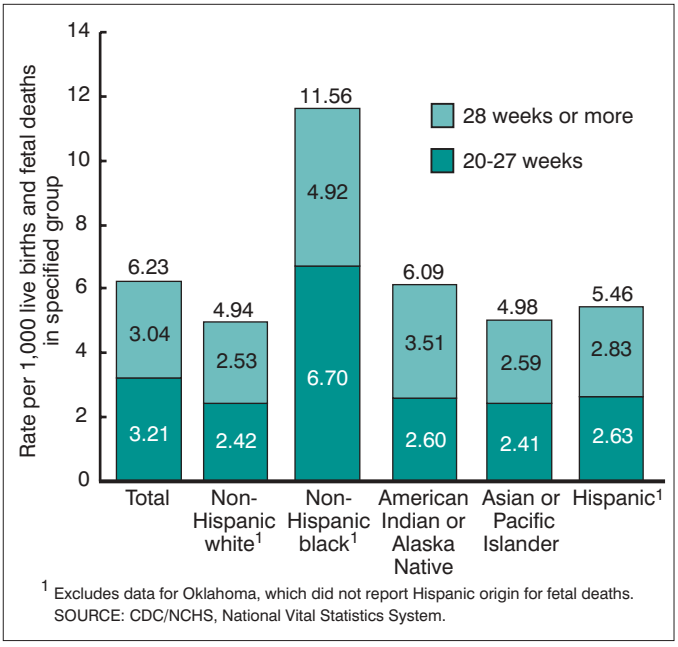
[1]Fetal deaths with stated or presumed period of gestation of 20 weeks or more.
[2]Not stated gestational age proportionally distributed; see "Technical Notes."

(5.33), followed by non-Hispanic white women (5.55), Hispanic women (5.97), and AIAN women (6.91). The rate for non-Hispanic black women (12.28) was the highest among the race or 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. Rates were lowest for API women (8.37), followed by non-Hispanic white women (8.70), Hispanic women (9.35), and AIAN women (10.62). The rate for non-Hispanic black women (20.73) was 2.4 times the rate for non-Hispanic white women.

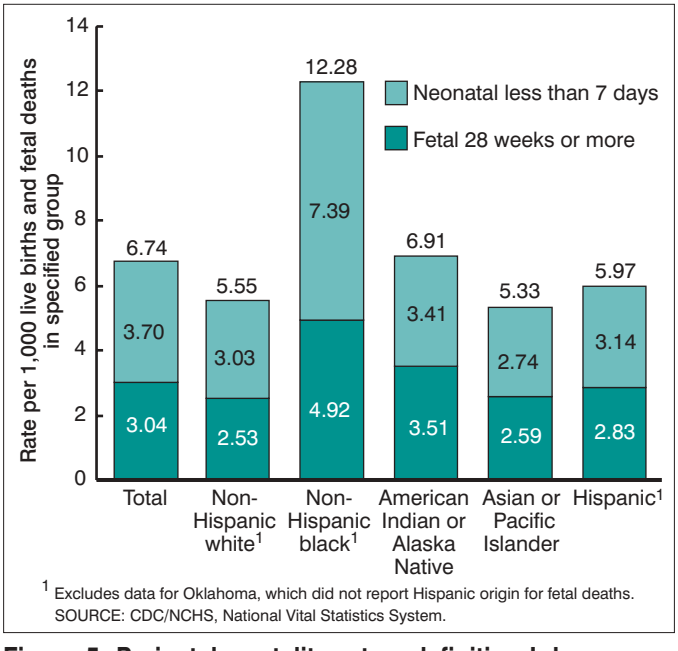
Maternal age

Fetal mortality rates also vary considerably by maternal age. Fetal mortality rates were lowest for women aged 25–34 years and higher for teenage mothers and those aged 35 years and over (Table 1). The rate for teenagers under age 15 years was 13.18, more than twice the rate of 5.48 for mothers aged 25–29 years—the lowest risk group. Rates for teenagers 15–17 years (7.97) and 18–19 years (6.96) were lower than for teenagers under age 15 years, but were still substantially higher than for mothers aged 25–29 years. At the opposite end of the age spectrum, fetal mortality rates increased rapidly for mothers aged 35 years and over. For mothers aged 45 years and over, the fetal mortality rate was 14.83, 2.7 times the rate for mothers aged 25–29 years. Results were similar when data for singletons only were examined (data not shown). The higher risk for teenage mothers may relate to less favorable socioeconomic and behavioral conditions among pregnant teenagers, although biologic immaturity may also play a role, particularly for the youngest teens (19,20). Maternal age over 35 years 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).



[1] Excludes data for Oklahoma, which did not report Hispanic origin for fetal deaths.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 4. Fetal mortality rates by race and Hispanic origin of mother: United States, 2003



[1] Excludes data for Oklahoma, which did not report Hispanic origin for fetal deaths.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 5. Perinatal mortality rates, definition I, by race and Hispanic origin of mother: United States, 2003

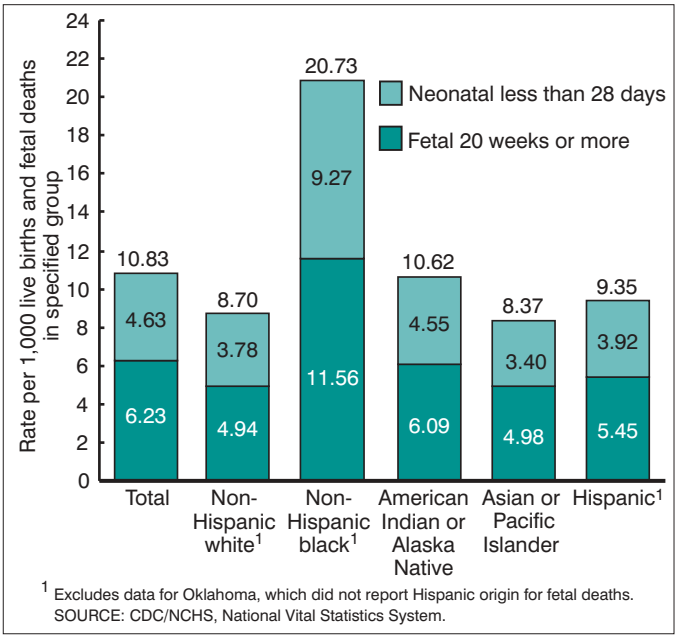


Figure 6. Perinatal mortality rates, definition II, by race and Hispanic origin of mother: United States, 2003

Marital status

In 2003, 47 percent of fetal deaths were to unmarried women, as compared with 35 percent of live births (Table C) 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 D), and this was true regardless of maternal age (data not shown). Differences were largest for non-Hispanic white women, and were 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 2003, fetal mortality rates were 9 percent higher for male (6.51) than for female (5.95) fetuses (Table D). Sex ratios at the time of delivery were quite different between fetal deaths and live births (Table C). 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 1,049, indicating that on average, 1,049 male infants were born for every 1,000 female infants. In contrast, for fetal deaths, the sex ratio was 1,148, 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 (2001–2003) to produce more stable estimates by single weeks of gestational age. 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 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 2003, 9 percent of fetal deaths occurred in multiple deliveries, as compared with 3 percent of live births (Table C). A multiple delivery

Table C. Percentage of fetal deaths and live births with selected demographic, medical, and health characteristics: United States, 2003

	Fetal deaths				Live births			
	Total	Non-Hispanic white[1]	Non-Hispanic black[1]	Hispanic[1]	Total	Non-Hispanic white	Non-Hispanic black	Hispanic
Mother's characteristics:								
Under 20 years of age	12.2	9.3	16.3	15.1	10.3	7.5	17.4	14.3
40 years of age and over	4.6	5.2	3.8	3.5	2.6	3.0	2.1	1.9
Unmarried[2]	46.8	32.4	72.7	50.6	34.6	23.6	68.5	45.0
Fetal or infant characteristics:								
Birthweight								
Less than 1,500 grams	59.1	57.1	65.1	57.8	1.5	1.2	3.2	1.2
Less than 2,500 grams	73.9	71.6	79.6	73.4	8.0	7.1	13.6	6.7
4,000 grams or more	1.6	1.7	1.2	2.1	8.9	10.4	4.8	8.2
Period of gestation								
Less than 32 weeks	62.7	60.6	69.4	59.3	1.9	1.6	4.0	1.7
Preterm (less than 37 weeks)	80.3	78.7	85.7	77.4	12.2	11.2	17.7	11.6
Plural delivery	9.1	10.8	7.1	8.0	3.3	3.8	3.6	2.2
Sex ratio[3]	1,148	1,118	1,163	1,205	1,049	1,053	1,036	1,041

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

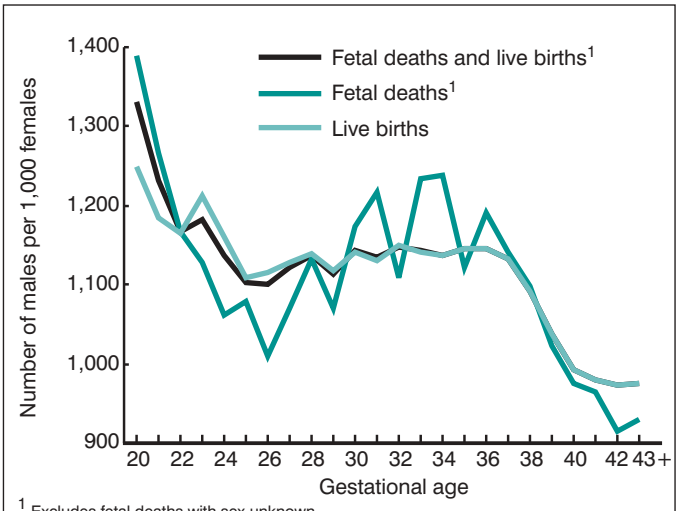
NOTE: Not stated responses excluded when computing percent distributions.

Table D. Fetal mortality rates by selected characteristics and race and Hispanic origin of mother: United States, 2003

	Fetal mortality rates[1]				Fetal deaths				Live births			
	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	6.23	4.94	11.56	5.45	25,653	11,350	6,685	4,970	4,090,007	2,287,572	571,490	906,597
Single	5.86	4.58	11.14	5.13	23,317	10,120	6,210	4,572	3,953,667	2,200,949	551,030	886,450
Twin	16.52	13.67	22.38	18.90	2,161	1,119	454	373	128,670	80,746	19,832	19,366
Triplet or higher order	22.31	18.54	32.36	31.02	175	111	21	25	7,670	5,877	628	781
Sex of fetus	6.23	4.94	11.56	5.45	25,653	11,350	6,685	4,970	4,090,007	2,287,572	571,490	906,597
Male	6.51	5.08	12.22	5.84	13,713	5,991	3,596	2,718	2,093,564	1,173,490	290,755	462,335
Female	5.95	4.79	10.88	5.04	11,940	5,359	3,089	2,252	1,996,443	1,114,082	280,735	444,262
Ratio male to female	1.09	1.06	1.12	1.16	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Marital status, total[4]	6.36	4.93	11.64	5.51	17,613	8,625	5,069	2,097	2,753,054	1,741,278	430,453	378,602
Married	4.99	4.28	10.12	4.99	9,016	5,691	1,345	1,006	1,799,041	1,323,553	131,568	200,559
Unmarried	8.25	6.48	11.82	5.75	7,938	2,724	3,576	1,030	954,013	417,725	298,885	178,043
Ratio unmarried to married	1.65	1.51	1.17	1.15	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

. . . Category not applicable.
[1]Rate per 1,000 live births and fetal deaths in specified group.
[2]Includes races other than white and black.
[3]Excludes data from Okhahoma, 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.

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 (16.52) was nearly three times that for singletons (5.86) (Table D). The fetal mortality rate for triplet or higher order deliveries (22.31) was almost four 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 and cord accidents (28). Also, many multiple pregnancies are the result of assisted reproductive technologies (29), and it is possible that both the underlying infertility problem, and the use of these therapies may increase the risk of adverse outcomes (22,29).



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

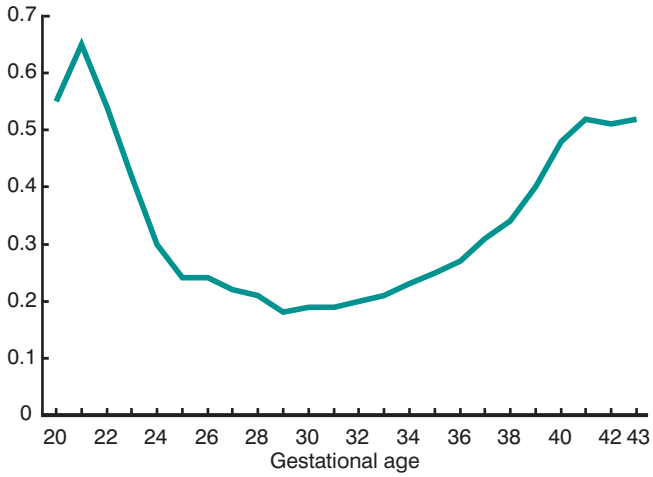
Figure 7. Sex ratios by single weeks of gestation for fetal deaths and live births: United States, 2001–2003

Period of gestation

In general, many more fetal deaths than live births occur early in the pregnancy. In 2003, more than one-third (35.2 percent) of all fetal deaths at 20 weeks of gestation or more occurred between 20–23 weeks of gestation, and over one-half (51.3 percent) 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 the same 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 2003, the fetal mortality rate computed by this method was 509.76 at 20–23 weeks of gestation, declined sharply to a low of 0.89 for 40 weeks of gestation, and then increased to 1.45 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. The rate was highest (0.65) at 21 weeks of gestation, declined to a low of 0.18–0.19 at 29–31 weeks of gestation. The rate remained relatively low until about 36 weeks of gestation, and then increased rapidly to a high of



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, 2003

0.51–0.52 at 41–43 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 24 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 2003, 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 (49 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 I). 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 limited 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. Thus, these states are excluded in the comparison of mortality differences below for fetal mortality and for perinatal definition II (fetal deaths of 20 weeks of gestation or more and infant deaths of less than 28 days), but are included for perinatal definition I (fetal deaths of 28 weeks of gestation or more and infant deaths of less than 7 days).

For the comparable states, fetal mortality rates were highest (above 8.5) in Mississippi, South Carolina, and Alabama, and lowest (below 4) in Maine, Rhode Island, and Vermont. The perinatal mortality rate, definition I, was 6.71 for the United States in 2003. Perinatal definition I is used most often for international comparisons because it is less affected by differences in reporting of fetal deaths of 20–27 weeks of gestation. The highest rates (above 9) were for the District of Columbia and South Carolina, whereas the lowest rates (below 5) were for New Hampshire and New Mexico. The perinatal mortality rate, definition II (the most inclusive perinatal definition), was 10.78 for the United States in 2003. Among the comparable states, the highest rates (above 15) were for the District of Columbia and Mississippi, whereas the lowest rates (below 7.8) were for Maine, New Hampshire, and Vermont. Differences in population characteristics between 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 by state as differences may not be statistically significant.

Discussion

Fetal and perinatal mortality rates have declined slowly but steadily from 1990 to 2003. 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. Fetal mortality rates are elevated for a number of groups, including non-Hispanic black women, teenagers, women aged 35 years and over, unmarried women, and multiple deliveries.

A large amount 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 black infants (31); but the question remains as to

what causes their higher rates of preterm delivery. Factors frequently mentioned as contributing to the black and 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 and white disparity in perinatal mortality remains unexplained (39–42).

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).

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 opportunities for prevention of fetal mortality. The analysis of fetal mortality data presents challenges due to possible underreporting of early fetal deaths, and also due to higher percentages of unknown responses for specific variables in the fetal death file.

Despite these challenges, fetal mortality research is gaining in importance and visibility now, for several reasons. The 2001–2002 increase in the infant mortality rate in the United States led to questions about how possible changes in reporting of fetal or infant deaths may have affected the increase (43). A greater awareness of the magnitude of fetal mortality is also a factor, as well over one-half (58 percent) of all perinatal deaths in the United States in 2003 were fetal deaths (Table B).

Several recent initiatives examine the etiology and prevention of fetal death. The National Institute of Child Health and Human Development (NICHD) is currently sponsoring a major multicenter research effort into fetal mortality called the Stillbirth Research Collaborative Network (44). Beginning in 2006, the Centers for Disease Control and Prevention initiated active surveillance of fetal deaths at the Iowa Department of Public Health, and at the Metropolitan Atlanta Congenital Defects Program (45). Also, a nonprofit coalition of organizations founded by stillbirth parents recently formed the International Stillbirth Alliance (ISA), whose mission is to facilitate research on the causes and prevention of stillbirth, and to raise public awareness of the problem and prevention of fetal mortality (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. It is hoped that this report together with recent research efforts will stimulate a 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, age, and race and Hispanic origin of mother: United States, 2003

Age and 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]	25,653	13,168	12,485	6.23	3.21	3.04
Less than 15 years	89	69	20	13.18	9.52	*
15–19 years	3,043	1,642	1,401	7.29	3.89	3.32
15–17 years	1,080	612	468	7.97	4.44	3.40
18–19 years	1,963	1,031	932	6.96	3.62	3.28
20–24 years	6,347	3,167	3,180	6.11	3.06	3.07
25–29 years	5,983	3,030	2,953	5.48	2.78	2.71
30–34 years	5,597	2,891	2,706	5.70	2.95	2.77
35–39 years	3,408	1,762	1,646	7.23	3.75	3.51
40–44 years	1,098	559	539	10.75	5.50	5.31
45 years and over	88	50	38	14.83	8.43	6.51
Non-Hispanic white[4]	11,350	5,551	5,799	4.94	2.42	2.53
Less than 15 years	23	15	8	16.59	*	*
15–19 years	1,031	527	504	6.08	3.12	2.98
15–17 years	322	164	158	7.00	3.58	3.45
18–19 years	709	363	346	5.74	2.94	2.81
20–24 years	2,584	1,192	1,392	5.03	2.33	2.72
25–29 years	2,638	1,306	1,332	4.25	2.11	2.15
30–34 years	2,806	1,403	1,403	4.51	2.26	2.26
35–39 years	1,679	813	866	5.55	2.69	2.87
40–44 years	548	269	279	8.48	4.19	4.33
45 years and over	41	26	15	10.46	6.56	*
Non-Hispanic black[4]	6,685	3,857	2,828	11.56	6.70	4.92
Less than 15 years	38	35	3	14.28	13.14	*
15–19 years	1,050	596	454	10.75	6.13	4.68
15–17 years	387	235	152	10.87	6.63	4.30
18–19 years	663	361	302	10.68	5.85	4.89
20–24 years	1,930	1,069	861	10.20	5.68	4.57
25–29 years	1,510	862	648	11.24	6.45	4.86
30–34 years	1,129	681	448	12.02	7.29	4.80
35–39 years	775	463	312	16.07	9.67	6.53
40–44 years	232	138	94	20.00	11.97	8.22
45 years and over	21	12	9	33.18	*	*
Hispanic[4,5]	4,970	2,394	2,576	5.45	2.63	2.83
Less than 15 years	20	14	6	8.49	*	*
15–19 years	732	387	345	5.71	3.02	2.70
15–17 years	294	166	128	6.27	3.55	2.74
18–19 years	438	221	217	5.38	2.72	2.67
20–24 years	1,277	618	659	4.68	2.27	2.42
25–29 years	1,202	551	651	4.88	2.25	2.65
30–34 years	990	465	525	5.85	2.76	3.11
35–39 years	574	286	288	7.55	3.78	3.80
40–44 years	158	68	90	9.72	4.20	5.57
45 years and over	17	5	12	*	*	*

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

[3]Includes races other than white or black.

[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, 2003

Birthweight (grams) and race and Hispanic origin of mother	Gestational age											
	Total	20–23	24–27	28–31	32–35	36	37–39	40	41	42 and over	Not stated	Fetal mortality rate[1]
All races[2]	25,653	8,880	4,087	3,115	3,501	1,004	3,218	722	359	375	392	6.23
Less than 500	7,962	5,855	1,436	410	184	27	37	3	4	5	1	530.02
500–749	3,462	1,521	1,213	464	135	13	30	4	3	9	70	231.15
750–999	1,582	180	613	540	163	17	17	1	3	7	41	117.41
1,000–1,249	1,181	63	212	508	281	34	42	6	4	12	19	79.71
1,250–1,499	977	31	86	351	333	55	60	8	8	14	31	56.21
1,500–1,999	1,923	36	82	409	843	161	267	27	13	36	49	29.22
2,000–2,499	1,864	–	21	119	776	220	516	76	39	33	64	9.18
2,500–2,999	1,704	–	20	37	353	239	782	120	61	63	29	2.39
3,000–3,499	1,359	–	–	19	122	103	689	216	86	88	36	0.87
3,500–3,999	742	–	–	13	33	41	370	136	80	55	14	0.66
4,000 or more	414	–	–	–	28	25	189	74	39	27	32	1.14
Not stated	2,483	1,194	404	245	250	69	219	51	19	26	6	. . .
Fetal mortality rate[1]	6.23	509.76	170.07	59.15	14.74	5.39	1.53	0.89	0.93	1.45	. . .	. . .
Non-Hispanic white[3]	11,350	3,657	1,851	1,372	1,572	481	1,608	354	187	181	87	4.94
Less than 500	3,381	2,423	633	182	88	21	28	1	2	2	1	545.06
500–749	1,472	594	568	208	67	5	12	1	3	4	10	238.69
750–999	690	83	273	238	65	7	7	–	3	4	10	114.43
1,000–1,249	504	23	86	229	122	17	18	3	–	3	3	72.39
1,250–1,499	430	15	45	150	136	25	34	3	4	6	12	49.45
1,500–1,999	826	14	36	176	361	76	111	12	7	18	15	24.86
2,000–2,499	828	–	10	42	355	103	240	34	17	16	11	8.09
2,500–2,999	844	–	7	21	187	116	396	51	28	33	5	2.40
3,000–3,499	691	–	–	6	55	52	376	111	43	40	8	0.82
3,500–3,999	380	–	–	8	14	21	190	72	46	26	3	0.55
4,000 or more	190	–	–	–	11	12	74	45	24	15	9	0.80
Not stated	1,114	505	193	112	111	26	122	21	10	14	–	. . .
Fetal mortality rate[1]	4.86	525.20	177.88	54.43	13.01	4.73	1.35	0.76	0.84	1.27	. . .	. . .
Non-Hispanic black[3]	6,685	2,692	1,123	827	875	212	638	129	54	63	72	11.56
Less than 500	2,418	1,834	406	128	42	1	3	2	1	1	–	481.77
500–749	972	446	334	128	34	2	9	–	–	3	16	194.28
750–999	404	45	165	137	42	5	2	–	–	1	7	99.83
1,000–1,249	308	16	60	131	72	8	9	–	1	4	7	74.41
1,250–1,499	250	7	20	93	97	14	9	1	1	4	4	56.84
1,500–1,999	497	9	23	113	229	35	59	7	4	9	9	31.83
2,000–2,499	471	–	9	33	203	55	129	15	11	5	11	10.49
2,500–2,999	342	–	9	6	73	52	151	31	10	7	3	2.48
3,000–3,499	229	–	–	1	30	14	116	40	14	11	3	1.05
3,500–3,999	122	–	–	1	4	10	73	18	6	8	2	1.09
4,000 or more	81	–	–	–	4	3	49	11	3	4	7	2.92
Not stated	591	335	97	56	45	13	29	4	3	6	3	. . .
Fetal mortality rate[1]	11.47	463.58	146.34	62.67	18.40	6.62	2.23	1.28	1.17	1.83	. . .	. . .
Hispanic[3,4]	4,970	1,598	732	616	693	210	656	153	85	94	133	5.45
Less than 500	1,423	1,043	277	57	36	3	5	–	–	2	–	555.86
500–749	662	304	203	92	22	2	6	3	–	2	28	241.17
750–999	330	40	107	116	41	2	6	1	–	2	15	135.36
1,000–1,249	253	15	40	107	61	8	9	3	2	3	5	94.19
1,250–1,499	202	6	19	72	68	11	12	3	3	2	6	64.74
1,500–1,999	401	8	19	76	176	31	68	7	1	6	9	33.41
2,000–2,499	376	–	1	30	134	41	105	22	8	8	27	9.65
2,500–2,999	353	–	3	8	61	52	157	26	17	18	11	2.25
3,000–3,499	288	–	–	10	26	24	133	34	18	27	16	0.79
3,500–3,999	161	–	–	3	12	8	66	31	20	17	4	0.64
4,000 or more	104	–	–	–	9	6	49	13	12	4	11	1.40
Not stated	417	182	63	45	47	22	40	10	4	3	1	. . .
Fetal mortality rate[1]	5.42	510.38	169.09	58.27	13.35	5.43	1.46	0.85	0.98	1.49	. . .	. . .

. . . Category not applicable.

– Quantity zero.

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

[2]Includes races other than white or black.

[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, each state and territory, 2003

	Fetal[1]		Perinatal Definition I[2]		Perinatal Definition II[3]	
	Number of deaths	Mortality rate[4]	Number of deaths	Mortality rate[4]	Number of deaths	Mortality rate[4]
United States	25,653	6.23	27,637	6.71	44,588	10.78
Alabama	516	8.59	476	7.93	828	13.71
Alaska	60	5.91	56	5.52	93	9.14
Arizona	568	6.21	589	6.43	960	10.44
Arkansas	259	6.81	298	7.83	463	12.11
California	2,862	5.26	3,083	5.67	4,757	8.72
Colorado	394	5.65	479	6.86	705	10.07
Connecticut	241	5.59	247	5.73	402	9.29
Delaware	63	5.53	93	8.14	139	12.12
District of Columbia	65	8.46	74	9.62	118	15.25
Florida	1,549	7.25	1,529	7.15	2,580	12.01
Georgia	1,138	8.30	1,082	7.89	1,918	13.91
Hawaii	131	7.19	118	6.48	228	12.44
Idaho	113	5.16	134	6.11	195	8.87
Illinois	1,148	6.25	1,331	7.24	2,136	11.57
Indiana	496	5.71	598	6.87	930	10.65
Iowa	201	5.24	200	5.21	335	8.70
Kansas	208	5.24	261	6.57	384	9.63
Kentucky	338	6.08	336	6.05	561	10.05
Louisiana	463	7.07	502	7.66	836	12.69
Maine	50	3.60	76	5.46	106	7.59
Maryland	629	8.32	635	8.40	1,076	14.16
Massachusetts	457	5.67	479	5.94	741	9.16
Michigan	730	5.54	988	7.48	1,511	11.39
Minnesota	337	4.79	359	5.10	553	7.83
Mississippi	403	9.42	374	8.75	651	15.13
Missouri	488	6.29	651	8.38	930	11.93
Montana	55	4.79	67	5.83	98	8.51
Nebraska	151	5.79	168	6.44	247	9.44
Nevada	239	7.05	210	6.20	354	10.41
New Hampshire	68	4.70	60	4.15	109	7.52
New Jersey	768	6.52	733	6.23	1,241	10.50
New Mexico[5]	85	3.05	133	4.76	178	6.36
New York	2,146	8.39	1,711	6.70	3,245	12.63
North Carolina	832	6.98	943	7.91	1,505	12.56
North Dakota	41	5.12	58	7.22	86	10.67
Ohio	929	6.17	1,117	7.41	1,735	11.46
Oklahoma	247	4.82	306	5.97	470	9.13
Oregon	203	4.40	260	5.63	375	8.09
Pennsylvania	956	6.51	1,108	7.53	1,745	11.81
Rhode Island	52	3.92	76	5.72	118	8.85
South Carolina	517	9.20	506	9.01	847	14.99
South Dakota[5]	39	3.52	61	5.50	75	6.76
Tennessee[5]	373	4.71	639	8.03	843	10.57
Texas	2,063	5.44	2,313	6.09	3,706	9.72
Utah	241	4.81	264	5.27	424	8.43
Vermont	21	3.18	39	5.88	51	7.68
Virginia	687	6.74	726	7.12	1,229	11.99
Washington	503	6.21	467	5.77	808	9.94
West Virginia	143	6.78	148	7.02	239	11.29
Wisconsin	356	5.06	447	6.34	669	9.46
Wyoming	31	4.61	42	6.23	53	7.85
Puerto Rico	544	10.62	446	8.72	901	17.46
Virgin Islands	15	*	17	*	25	16.16
Guam	36	10.74	43	12.81	64	18.94

* 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 week and 28 week 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]State reports only fetal deaths of 500 grams or more; data for fetal and perinatal definition II are not comparable with 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 (47).

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 (11,48). 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 or more of gestation, 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. And 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 U.S. fetal mortality rate. For example, when data for these three states were excluded, the fetal mortality rate was 6.33 in 2003.

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, 59 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 27.1 percent were at 20–27 weeks, thus indicating substantial underreporting of early fetal deaths.

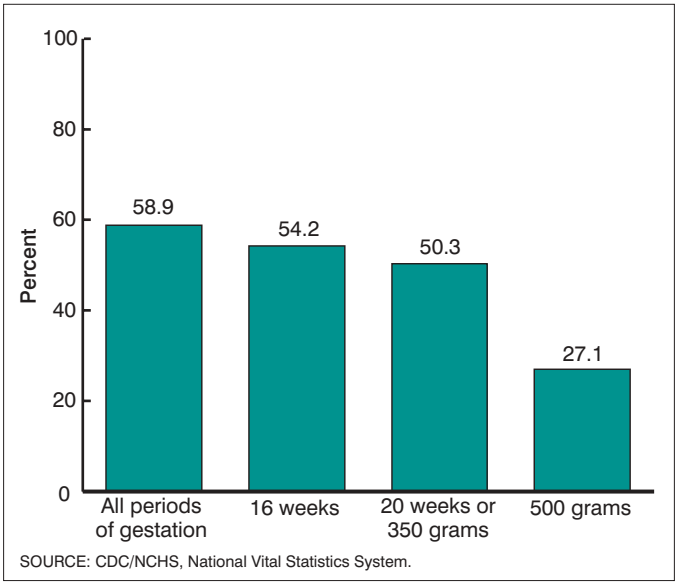

Figure I. Percentage of fetal deaths at 20–27 weeks of all fetal deaths 20 weeks or more according to state reporting requirements, 2003

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 the U.S. natality file. 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 percentage 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, 2003

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.

2003 revision of the U.S. Standard Certificates and Reports

This report includes data for two states, Michigan (partial year revision) and Washington, which implemented the 2003 revision of the U.S. Standard Report of Fetal Death in 2003 (revised). Data from all other areas are based on the 1989 revision (unrevised). For live births, two states (Pennsylvania and Washington) implemented the 2003 revision of the U.S. Standard Certificate of Birth in 2003; data from all other areas are based on the 1989 revision. For infant deaths, four states (California, Idaho, Montana, and New York) implemented the 2003 revision of the U.S. Standard Certificate of Death in 2003; 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 (49). Because the variables included in this report are comparable between the 1989 and 2003 revisions, this change has little or no 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.

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

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

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

A previous NCHS report contains information on the historical development of various perinatal measures (50).

Table II. Percentage of unknown responses for selected variables for fetal deaths and live births, United States, 2003

	Fetal deaths			
	Total[1]	20–27 weeks	28 weeks or more	Live births
Marital status[2]	3.52	3.86	2.98	0.04
Hispanic origin	**4.63	**5.20	**3.85	0.70
Period of gestation	1.53	. . .	. . .	1.07
Birthweight	9.68	12.32	7.15	0.02

**Excludes data from Oklahoma, which did not report Hispanic origin for fetal deaths.
. . . Category not applicable.
[1]Includes fetal deaths with stated or presumed period of gestation of 20 weeks or more.
[2]For fetal deaths, excludes data from 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 nonreporting states and not stated marital status was imputed in reporting states, see reference 31.

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 current Office of Management and Budget (OMB) standards (51). States reporting multiple race data in 2003 were Michigan and Washington for fetal deaths, and California, Hawaii, Ohio (December only), Pennsylvania, Utah, and Washington for live births. 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, 52–55). 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. 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 gestation is inconsistent with birthweight, the "Clinical estimate of gestation" is used (5 percent of records in 2003). These procedures are described in more detail elsewhere (31,56).

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

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

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

where D is the number of deaths and

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

where B is the number of births.

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

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

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

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

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

The RSE of the FMR for the example above

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

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

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

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

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.

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

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

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}.

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) =

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

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

Comparison of two fetal or perinatal mortality rates—If either of the two rates to be compared is based on fewer than 100 deaths, compute the confidence intervals for both rates and check to see if they overlap. If so, the difference is not statistically significant at the 95 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:

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

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

Availability of 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. Additional information on fetal and perinatal mortality is available from: http://www.cdc.gov/nchs.

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			

Contents

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