The Changing Epidemiology of Multiple Births in the United States

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OBJECTIVE: To describe changes in the epidemiology of multiple births in the United States from 1980 to 1999 by race, maternal age, and region; and to examine the impact of these changes on birth weight-specific infant mortality rates for singleton and multiple births.

METHODS: Retrospective univariate and multivariable analyses were conducted using vital statistics data from the National Center for Health Statistics.

RESULTS: Between 1980 and 1999, the overall multiple birth ratio increased 59% (from 19.3 to 30.7 multiple births per 1000 live births, $P < .001$), with rates among whites increasing more rapidly than among blacks. Women of advanced maternal age, especially those aged 30–34, 35–39, and 40–44 experienced the greatest increases (62%, 81%, and 110%, respectively). Although all regions of the United States experienced increases in multiple birth ratios between 1991 and 1999, the Northeast had the highest twin (33.9 per 1000 live births) and higher order birth ratios (280.5 per 100,000 live births), even after adjusting for maternal age and race. Between 1989 and 1999, multiple births experienced greater declines in infant mortality than singletons in all birth weight categories. Consequently, very low birth weight and moderately low birth weight infant mortality rates among multiples were lower than among singletons.

CONCLUSION: It is important to understand the changing epidemiology of multiple births, especially for women at highest risk (advanced maternal age, white race, Northeast residents). The attribution of infertility management requires further study. The differential birth weight-specific infant mortality for singletons and multiples demonstrates the importance of stratifying by plurality when assessing perinatal outcomes. (Obstet Gynecol 2003;101:129–35.

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For years, health care providers were taught that plural births accounted for about 2% of births and 11% of infant deaths. In the 1990s, these proportions changed because of dramatic increases in multiple births.[1,2] During this time, there was an upsurge in plural births affecting subgroups of the population, leading to unprecedented rates of twins, triplets, and other higher order births. By 1999, multiples accounted for 3% of live births (121,628 of 3,959,417) and 14% of infant deaths (4000 of 27,864).[3] These changes have already had significant impact on many perinatal outcomes, particularly gestational age and birth weight, which are strong predictors of infant morbidity and mortality.[2,4] Regardless of management, overall, at least half of all twins and 90% of higher order (triplet and greater) births are low birth weight (LBW) and preterm.[2] This report describes the changing epidemiology of plural births from 1980 to 1999 for the United States providing national statistics by race, maternal age, and region. Plurality-specific infant mortality rates are also examined. It is necessary to have an understanding of these background statistics to appreciate the story behind the adjusted rates that are presented.

MATERIALS AND METHODS

Analyses were based on National Center for Health Statistics natality data from 1980 to 1999 and linked birth/infant death data from 1989 and 1999. The US natality files contain data from all certificates of live births that were submitted through the Vital Statistics Cooperative Program.[5] All states have participated in the program since 1985. For the study years 1980–1984, data were based on 100% of the participating states and a 50% sample of birth certificates from those states that did not participate. The linked birth infant death data consist of all infant deaths that have been linked to their corresponding birth certificates for 1989 and 1999.[3] A

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weight is applied to the file to account for those deaths that could not be linked, which was 2.3% both in 1989 and in 1999. Descriptions of multiple birth ratios and race from 1980 to 1990 were tabulated using National Center for Health Statistics monthly vital statistics reports. For the remaining years, data were obtained from the electronic data sets released from the National Center for Health Statistics, and descriptive analyses were conducted using SPSS 9.0 (SPSS Inc., Chicago, IL).

For variables concerning multiple births, dichotomous comparisons were made between white and black race. From 1980 through 1988, the National Center for Health Statistics classified race in the natality data by race of child. This classification was replaced by maternal race in 1989, which was used for the rest of the period studied.[6]

Multiple birth ratios were calculated as the number of multiple births divided by the number of live births multiplied by 1000 as is done by the National Center for Health Statistics.[5] Sets of multiples could not be determined from the data, so counts represent individual live births that occur from multiple deliveries. Twin and higher order birth ratios were calculated separately using the number of twins and higher order births, respectively, in the numerator. Higher order birth ratios are reported per 100,000 live births. Race and age-specific multiple birth ratios were calculated using the total number of live births in a given category as the denominator.

Overall infant mortality rates were calculated as the number of infant deaths per 1000 live births. For plurality- and birth weight-specific infant mortality rates, plurality was dichotomized into singleton and multiple, and birth weight was categorized as very low birth weight (VLBW, less than 1500 g), moderately LBW (1500–2499 g), LBW (less than 2500 g), and not LBW (2500 g or more). For analysis of plurality-specific infant mortality rates by race (dichotomized into white and black), LBW was divided into 500-g categories.

Regional analyses were restricted to the time 1991–1999. Region was determined using the National Center for Health Statistics classification used in the natality file (Northeast, Midwest, South, West). Multiple birth ratios in 1999 for white and black infants were directly standardized to the 1980 maternal age distribution to adjust for changes in maternal age distributions over the study period.[7] Regional twin and higher order birth rates were directly standardized to the 1999 maternal age and race distributions to adjust for differences in the distribution of these demographics across regions when comparing rates. Statistical testing of trends and differences were done by applying the χ^2 test of proportions[8] using SPSS 9.0. Statistical significance was conservatively set a priori at $P < .001$ because of the large sample sizes and multiple comparisons.

RESULTS

The number of multiple births by race and maternal age for 1980, 1990, and 1999 are shown in Table 1. Since 1980, the number and proportion of multiple births have increased. Between 1980 and 1999, the percent of multiples increased 58%, from 1.9% to 3.0% of live births. The majority of multiple births are twins, although this proportion has changed over time. Between 1980 and 1990, the percent of multiple births that are twins declined from 98.1% to 96.9%, and then declined further to 94.0% in 1999. This same decreasing trend was seen among births to both white and black mothers.

Between 1980 and 1999, the overall multiple birth ratio increased more than 59% (from 19.3 to 30.7 multiple births per 1000 live births, $P < .001$). Because the majority of multiple births are twins, the profile of all multiple births closely mirrors that of the trends in twin births discussed here. These trends in twin births for all races and dichotomized for black and white infants are presented in Figure 1. Similar to the overall multiple birth ratio, the twin birth ratio increased nearly 53% over the 20-year study period to 28.9 twin births per 1000 live births in 1999. White births accounted for most of this increase. Since 1980, the twin birth ratio increased more than 59% for white births compared with 34% among black births. For the entire period, there was a statistically significant higher ratio of twins among black births, but this gap decreased over time. In 1980, the black twin birth ratio of 23.8 per 1000 live black births was more than 31% higher than the white twin birth ratio of 18.1 ($P < .001$). By 1999, the black twin birth ratio of 32.0 per 1000 live black births was 11% higher than the white twin ratio of 28.8 because of increasing rates of white twin births ($P < .001$).

The most dramatic increases in multiple births have been among higher order births, shown in Figure 2. Between 1980 and 1998, the higher order birth ratio increased almost 423%, from 37.0 to 193.5 higher order births per 100,000 live births ($P < .001$). Most of this increase can be attributed to white higher order multiple birth ratios, which are substantially larger than higher order black birth ratios. The ratio among white infants increased over 484%, from 37.7 in 1980 to 220.3 in 1998 ($P < .001$). The black higher order birth ratio fluctuated somewhat, but steadily increased by nearly 75% between 1993 and 1998, from 49.6 to 86.7 ($P < .001$). Unexpectedly, in 1999 the overall higher order birth ratio declined 4% to 184.9 ($P = .006$), driven by the change among whites from 220.3 in 1998 to 209.2 in 1999 ($P = .003$).

Table 1. Distribution of Live Births by Race and Maternal Age, United States, 1980, 1990, and 1999

	1980				1990				1999			
	Total	Singleton	Twin	Higher order	Total	Singleton	Twin	Higher order	Total	Singleton	Twin	Higher order
All live births												
All ages	3,612,258	3,542,582	68,339	1337	4,158,212	4,061,319	93,865	3028	3,959,417	3,837,789	114,307	7321
<20 y	562,330	555,035	7212	83	533,483	525,793	7605	85	485,104	477,685	7353	66
20–24 y	1,226,200	1,204,441	21,374	385	1,093,730	1,072,431	20,945	354	981,929	959,878	21,640	411
25–29 y	1,108,291	1,085,105	22,712	474	1,277,108	1,246,144	30,020	944	1,078,252	1,046,105	30,494	1653
30–34 y	550,354	537,089	12,944	321	886,063	860,478	24,466	1119	892,400	857,548	31,926	2926
35–59 y	140,793	137,167	3559	67	317,583	307,498	9587	498	434,294	413,996	18,485	1813
≥40 y	24,290	23,745	538	7	50,245	48,975	1242	28	87,438	82,577	4409	452
White												
All ages	2,898,732	2,845,243	52,397	1092	3,290,273	3,215,017	72,617	2639	3,132,501	3,035,757	90,191	6553
<20 y	392,229	387,581	4595	53	359,456	354,813	4592	51	342,627	337,888	4698	41
20–24 y	982,526	966,204	16,030	292	837,572	822,451	14,863	258	748,371	733,193	14,880	298
25–29 y	933,159	914,568	18,185	406	1,051,760	1,027,004	23,919	837	873,654	847,912	24,257	1485
30–34 y	459,151	448,413	10,453	285	739,209	717,878	20,315	1016	739,948	710,358	26,903	2687
35–59 y	113,124	110,322	2750	52	261,787	253,431	7904	452	356,959	339,701	15,622	1636
≥40 y	18,543	18,155	384	4	40,489	39,440	1024	25	70,942	66,705	3831	406
Black												
All ages	589,616	575,379	14,026	211	684,336	665,851	18,164	321	605,970	586,027	19,374	569
<20 y	156,146	153,655	2464	27	157,951	155,099	2821	31	125,143	122,692	2426	25
20–24 y	209,596	204,650	4859	87	217,274	211,651	5539	84	193,211	186,985	6125	101
25–29 y	135,680	131,725	3897	58	168,217	162,987	5143	87	138,868	133,700	5022	146
30–34 y	64,369	62,306	2035	28	99,514	96,163	3271	80	91,486	87,831	3502	153
35–59 y	19,631	18,974	649	8	35,592	34,311	1245	36	47,277	45,195	1966	116
≥40 y	4194	4069	122	3	5788	5640	145	3	9985	9624	333	28

Source: National Center for Health Statistics, final natality data.

This important reversal of the increasing trend for higher order multiples did not meet the study's statistical significance criterion ($P < .001$).

Trends in multiple birth ratios varied by maternal age (Figure 3). Between 1980 and 1999, the multiple birth ratio among women aged 20–24 increased more than 27% (17.7–22.5, $P < .001$), and among women aged 25–29 increased by more than 42% (20.9–29.8 multiple births per 1000 live births, $P < .001$). However, the largest increases in multiple birth ratios occurred in the older maternal age groups. These ratios increased more than 62% among women aged 30–34 (24.1–39.1, $P < .001$), more than 81% among women aged 35–39 (25.8–46.7, $P < .001$), and more than 110% among women aged 40–44 (23.2–48.8, $P < .001$).

Dramatic increases were observed in higher order births for women of all ages. Between 1980 and 1998, the higher order birth ratio increased nearly 265% among women aged 25–29 (from 42.8 to 156.2) and more than 518% among women aged 30–34 (from 58.3 to 360.4) ($P < .001$). In 1999, however, the higher order birth ratio declined in all of these age groups.

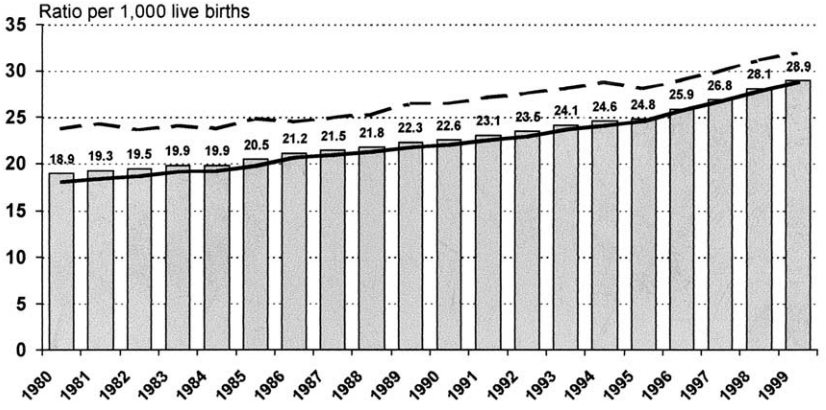

Figure 1. Twin birth ratios among infants of all races *(shaded bars),* white infants *(solid line),* and black infants *(broken line)* in the United States, 1980–1999 (race of child from 1980 to 1988, race of mother from 1989 to 1999). Source: National Center for Health Statistics, final natality data, 1980–1999.

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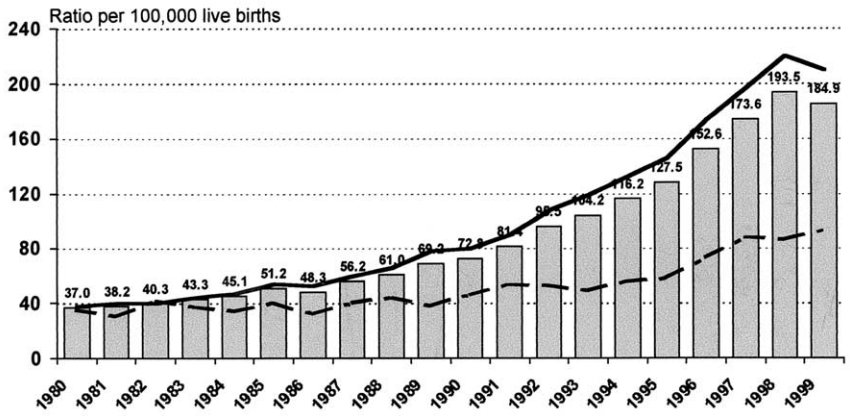

Figure 2. Higher order birth ratios among infants of all races *(shaded bars),* white infants *(solid line),* and black infants *(broken line)* in the United States, 1980–1999 (race of child from 1980 to 1988, race of mother from 1989 to 1999). Source: National Center for Health Statistics, final natality data, 1980–1999.

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After adjusting for the increase in births to women of advanced maternal age, the adjusted multiple birth ratio for whites was 26.9, compared with the observed ratio of 30.9 in 1999 ($P < .001$). Among black women, adjustment for maternal age resulted in a multiple birth ratio of 31.3, compared with the observed ratio of 32.9 in 1999 ($P < .001$).

From 1991 to 1999, all regions had an increase in the multiple birth ratios. During this time period, the twin birth ratio increased nearly 38% in the Northeast (from 24.6 to 33.9 twins per 1000 live births) (Table 2). This increase was nearly double that of the other three regions (Midwest 23%, South 23%, and West 21.6%). In 1999, the Northeast had the largest higher order birth ratio and between 1991 and 1999 had the largest increase in this birth ratio (more than 193%) from 95.6 to 280.5 higher order births per 100,000 live births. Similar to the overall trend in higher order multiples that is seen at the national level, the higher order multiple birth ratio declined between 1998 and 1999 for the Northeast, the South, and the West; however, in the Midwest, this ratio continued to increase.

Because of the large differences between the Northeast and other regions, the ratios of twin and higher order births were adjusted for maternal age and race to reflect the US distribution (Table 3). Adjustment for maternal age and race had a substantial impact on higher order birth ratios, but little impact on twin birth ratios. The Northeast continued to have the largest higher order birth ratio (235.2 per 100,000 live births), followed by the Midwest (212.7), the South (174.5), and the West (128.3).

Between 1989 and 1999, the overall infant mortality rate in the United States declined more than 26%, from 9.5 to 7.0 per 1000 live births.[3,9] The infant mortality rate among singleton births declined 28%, whereas the rate among multiple births declined more than 30% (Figure 4). However, in both 1989 and 1999, the overall rate of infant mortality among multiples was more than five times higher than for singleton births. Plurality-specific infant mortality differed by birth weight category and changed over time. In 1989, moderately LBW multiple infants had lower infant mortality rates than singletons. By 1999, the infant mortality rate for multiples had decreased more than singletons in all three birth weight categories. Mortality for multiple VLBW infants had

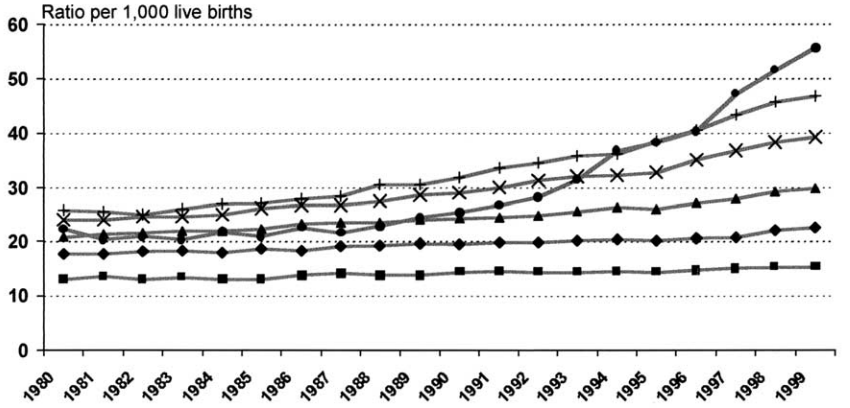

Figure 3. Multiple birth ratios among women aged younger than 20 years *(squares),* 20–24 years *(diamonds),* 25–29 years *(triangles),* 30–34 years *(multiplication signs),* 35–39 years *(plus signs),* and 40 years or older *(circles)* in the United States, 1980–1999. Source: National Center for Health Statistics, final natality data, 1980–1999.

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Table 2. Twin and Higher Order Birth Ratios by United States Region,* 1991–1999

	Twin (per 1000 live births)				Higher order (per 100,000 live births)			
	NE	MW	S	W	NE	MW	S	W
1991	24.6	24.3	22.6	21.3	95.6	104.7	70.6	63.9
1992	25.3	24.6	23.0	21.6	126.3	122.4	78.4	71.3
1993	26.7	25.3	23.5	22.0	141.5	130.4	83.7	80.4
1994	26.8	26.0	23.9	22.5	157.1	154.5	88.5	89.1
1995	27.4	26.1	24.0	22.8	176.5	149.9	105.5	101.7
1996	29.3	26.9	25.1	23.6	213.0	192.0	126.1	110.3
1997	31.3	28.2	25.6	24.1	261.9	195.2	152.7	119.9
1998	32.9	29.0	27.1	25.3	287.5	210.7	171.4	142.1
1999	33.9	29.9	27.8	25.9	280.5	219.0	156.1	128.0
% Change (1991–1999)	37.8	23.0	23.0	21.6	193.4	109.2	121.1	100.3
Ratio of NE increase to other regions		1.64	1.64	1.75		1.77	1.60	1.93

NE = Northeast; MW = Midwest; S = South; W = West.
Source: National Center for Health Statistics, final natality data.
* Based on the National Center for Health Statistics US regions.

declined more than 34% compared with nearly 24% among singletons, making multiple VLBW infants less likely than singleton VLBW infants to die during the first year of life.

Table 4 shows the 1999 infant mortality rates for infants by plurality and race with the LBW rates divided into 500-g birth weight categories. Among infants of all races, there were no significant differences in infant mortality among infants weighing less than 1000 g. For infants between 1000 and 2499 g, singleton infant mortality rates were significantly higher than for multiples ($P < .001$). Although it is widely recognized that black infant mortality rates are twice as high as the rates among white infants, this does not hold true when examining rates by categories of plurality and birth weight. The rates for black singleton infants were found to be significantly lower than the rates for singleton whites for infants 1000–1499 and 1500–1999 g ($P < .001$).

DISCUSSION

Our findings underscore the importance of epidemiologic analyses of key perinatal outcomes over time to inform clinicians of changing risks. Specifically, although rates of multiple births continue to be higher for black compared with white women, the dramatic increase in multiple births over the past two decades in the United States (particularly for higher order multiples) is largely attributable to increases for white women. This has resulted in a significant diminution of the historical racial gap in multiple births. In fact, since 1981 among higher order births, there was a reversal of the phenomenon that is expected, with multiple birth ratios for white women being substantially higher than for black women. However, in 1999, there was an unanticipated decline in the overall ratios for higher order multiples, which reversed the increasing trend observed since the 1980s. This suggests changes associated with infertility management and requires prospective monitoring and ongoing analysis.

Table 3. Unadjusted and Adjusted* Twin (per 1000) and Higher Order (per 100,000) Birth Ratios, by Region, United States, 1999

	Twin birth ratios		Higher order birth ratios	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Northeast	33.9	31.2	280.5	235.2
Midwest	29.9	29.8	219.0	212.7
South	27.8	28.0	156.1	174.5
West	25.9	27.2	128.0	128.3

Source: National Center for Health Statistics, 1999 final natality data.
* Adjusted for maternal race and age.

The number of plural births has far exceeded estimates of natural occurrence,[10] even when taking into account the shift in the distribution of births to women of advanced maternal age, a group with a higher occurrence of spontaneous multiple births. This is illustrated by the impact of direct age standardization of the multiple birth ratios for white and black women. If the maternal age distribution had not changed for white women between 1980 and 1999, there would have been an estimated 45% increase in multiple births compared with the observed increase of 67%. In contrast, direct age adjustments for multiple birth ratios among black women revealed much less of an effect of age with the adjusted increase being 30% compared with a 37% observed increase. Earlier publications using age standardization demonstrated the value of this technique for assessing changes in multiple birth ratios.[10]

Increased use of fertility management, including as-

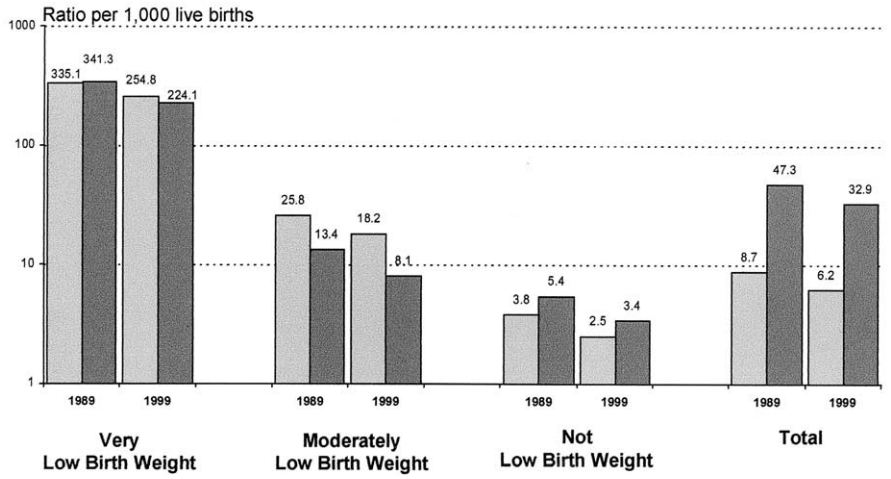

Figure 4. Infant mortality rates by birth weight among singletons *(lighter bars)* and multiples *(darker bars)* in the United States, 1989 and 1999. Graph is shown using a log scale. Source: National Center for Health Statistics, final linked birth/infant death data.

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sisted reproductive technology (ART), may largely account for the dramatic increases in higher order births among white women. One study estimated that 38% of the increase in triplet births from the 1970s through the early 1990s could be attributed to ART.[11] Another attributed more than 40% of the triplet and higher order births in 1997 to ART and another 40% to ovulation-inducing drugs.[12] Other studies have estimated the contribution of ART to higher order births to be as high as 50–80%.[13,14] In 1998, 56% of live births resulting from ART procedures were multiple births, and 12.8% were triplet and higher order births.[15] The demographic group most likely to use these treatments closely parallels those with the greatest increase in multiple births.[16,17] Another study that linked data reported from ART patients to the respective birth certificate data of a resulting live birth concluded that in addition to contributing to the increase in multiple births, ART resulted in increased rates of LBW among singletons.[18]

The differences in multiple births among regions in the United States were of interest. With the majority of ART clinics in the eastern and midwestern United States,[19] the larger variations in twin and higher order ratios in the Northeast (before and after age and race adjustment) might reflect differences in health care services, infertility resources, and demographics when compared with the rest of the nation. Although most states have shown increases in the number of ART procedures performed in recent years, one study reported that three of the five states reporting the greatest number of ART procedures in 1998 were in the Northeast, including New York, Massachusetts, and New Jersey.[15]

The differential birth weight-specific infant mortality rates for singletons and multiples, which show lower rates among smaller multiple births, are similar to results for singletons and twins reported by Parker et al for earlier years.[20] These differences, along with the larger decreases in infant mortality over the past 10 years among multiples, demonstrate the importance of stratifying by plurality when assessing perinatal outcomes and suggest potential disparities in the management and risk factors for multiple and singleton births. The racial disparities found in these birth weight-specific infant mortality rates are of interest because of the significantly lower infant mortality rates found among 1000–1999-g black singletons compared with white singletons.

Table 4. Infant Mortality Rates (per 1000 Live Births) by Birth Weight, Plurality, and Maternal Race, United States, 1999

	All races			White			Black		
Birth weight	Singleton	Multiple	Percent difference	Singleton	Multiple	Percent difference	Singleton	Multiple	Percent difference
<500	848.0	879.1	−3.7	844.3	890.9	−5.5*	852.6	863.0	−1.2
500–999	319.3	303.5	4.9	326.9	297.7	8.9	307.6	315.1	−2.4
1000–1499	66.2	38.2	42.3*	71.4	39.6	44.5*	57.9	37.3	35.6*
1500–1999	35.6	12.9	63.8*	38.0	11.4	70.0*	30.0	18.9	37.0*
2000–2499	13.3	5.7	57.1*	13.6	5.2	61.8*	13.3	8.2	38.3
≥2500	2.5	3.4	−36.0*	2.3	3.0	−30.4	4.0	6.3	−57.5
Total	6.2	32.9	−430.6*	5.1	27.7	−443.1*	12.4	59.7	−381.5*

Source: National Center for Health Statistics, 1999 period linked birth/infant death data.
* $P < .001$.

There are several limitations of our analyses. First, this study of live births reflects only changes in multiple births, not multiple pregnancies, over time, as fetal deaths and early spontaneous losses that are multiples were not included. Second, there were constraints in ascertaining the impact of infertility and subfertility management on the rates of multiples and associated perinatal outcomes. Until there is a way to capture the cohort of all pregnancies in the United States and their outcomes resulting from these interventions, researchers will continue to extrapolate from associations.

The recent recommended revision to the US Standard Birth Certificate to add an option under a variable about pregnancy complications identifying pregnancies resulting from infertility management moves us closer to meaningful surveillance,[21] but the degree of completeness remains to be seen. An independent variable for mode of conception on live birth, fetal death, and induced termination certificates would increase the likelihood that these important data would be reported and available for analysis. Well-informed policies could then be implemented to deal with the changing profile of US births including the dramatic rise in higher order multiples now even occurring in relatively young women. In the interim, perinatal outcome analyses must be stratified by plurality in addition to race and maternal age to provide more meaningful information. Providers need to recognize the impact of increasing multiples in this nation, especially on the increasing rates of LBW and preterm birth, two potent predictors of infant morbidity, disability, and survival.

REFERENCES

1. Mushinski M. Trends in multiple births. Stat Bull 1994; 75:28–35.
2. Martin JA, Taffel SM. Current and future impact of rising multiple birth ratios on low birthweight. Stat Bull 1995;76: 10–8.
3. Mathews TJ, MacDorman MF, Menacker F. Infant mortality statistics from the 1999 period linked birth/infant death data set. Nat Vital Stat Reports 2002;50:11–3.
4. Spellacy WN. Multiple pregnancies. In: Scott JR, DiSaia PJ, Hammond CB, Spellacy WN, eds. Danforth's obstetrics and gynecology. 7th ed. Philadelphia: JB Lippincott, 1994:333–43.
5. Ventura SJ, Martin JA, Curtin SC, Menacker F, Hamilton BE. Births: Final data from 1999. Nat Vital Stat Reports 2001;49:85–6.
6. Ventura SJ, Martin JA, Taffel SM, Mathews TJ, Clarke SC. Advance report of final natality statistics, 1992. Monthly Vital Stat Reports 1994;43 Suppl 5:83.
7. Mausner JS, Bahn AK. Epidemiology: An introductory text. Philadelphia: WB Saunders, 1974:147–8.
8. Freund JE. Modern elementary statistics. 6th ed. Englewood Cliffs, New Jersey: Prentice Hall, 1984:339–41.
9. National Center for Health Statistics. Health, United States, 2001 with urban and rural health chartbook. Hyattsville, Maryland: National Center for Health Statistics, 2001:155.
10. Martin JA, MacDorman MF, Mathews TJ. Triplet births: Trends and outcomes, 1971–94. Vital Health Stat 1997; 21:1–7.
11. Wilcox LS, Kiely JL, Melvin CL, Martin MC. Assisted reproductive technologies: Estimates of their contribution to multiple births and newborn hospital days in the United States. Fertil Steril 1996;65:361–6.
12. Contribution of assisted reproductive technology and ovulation-inducing drugs to triplet and higher-order multiple births—United States, 1980–1997. MMWR 2000;49: 535–8.
13. Elster AD, Bleyl JL, Craven TE. Birthweight standards for triplets under modern obstetrical care in the United States, 1984–1989. Obstet Gynecol 1991;77:387–93.
14. Callahan TL, Hall JE, Ettner SL, Christiansen CL, Green MF, Crowley WF. The economic impact of multiple-gestation pregnancies and the contribution of assisted-reproduction techniques to their incidence. N Engl J Med 1994;331:244–9.
15. Use of assisted reproductive technology—United States, 1996 and 1998. MMWR 2002;51:97–101.
16. Wilcox LS, Mosher WD. Use of infertility services in the United States. Obstet Gynecol 1993;82:122–7.
17. Wysowski DK. Use of fertility drugs in the United States, 1973 through 1991. Fertil Steril 1993;60:1096–8.
18. Schieve LA, Meikle SF, Ferre C, Peterson HB, Jeng G, Wilcox LS. Low and very low birth weight in infants conceived with use of assisted reproductive technology. N Engl J Med 2002;346:731–7.
19. Centers for Disease Control and Prevention (CDC), American Society for Reproductive Medicine, Society for Assisted Reproductive Technology, RESOLVE. 1998 assisted reproductive technology success rates: National summary and fertility clinic reports. Atlanta: US Department of Health and Human Services, CDC, 2000.
20. Parker JD, Schoendorf KC, Kiely JL. A comparison of recent trends in infant mortality among twins and singletons. Paediatr Perinat Epidemiol 2001;15:12–8.
21. National Center for Health Statistics. US standard certificate of live birth (draft November 9, 2001). Hyattsville, Maryland: National Center for Health Statistics, 2001.

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