OBSTETRICS

The increasing racial disparity in infant mortality rates: Composition and contributors to recent US trends

Greg R. Alexander, MPH, ScD†; Martha S. Wingate, DrPH; Deren Bader, CPM, DrPH; Michael D. Kogan, PhD

OBJECTIVES: We examined trends in birthweight-gestational age distributions and related infant mortality for African American and white women and calculated the estimated excess annual number of African American infant deaths.

STUDY DESIGN: Live births to US-resident mothers with a maternal race of white or African American were selected from the National Center for Health Statistics' linked live birth-infant death cohort files (1985-1988 and 1995-2000).

RESULTS: The racial disparity in infant mortality widened despite an increasing rate of white low-birthweight infants. White preterm infants had relatively greater gains in survival and the white advantage in survival at term increased. Annually, African American women experience approximately 3300 more infant deaths than would be expected.

CONCLUSION: The increasing US racial disparity in infant mortality is largely influenced by changes in birthweight-gestational age–specific mortality, rather than the birthweight-gestational age distribution. Improvement in the survival of white preterm and low-birthweight infants, probably reflecting advances in and changing access to medical technology, contributed appreciably to this trend.

Key words: birthweight, gestational age, infant mortality, race

Cite this article as: Alexander GR, Wingate MS, Bader D, Kogan MD: The increasing racial disparity in infant mortality rates: Composition and contributors to recent US trends. Am J Obstet Gynecol 2008;198:51.e1-51.e9.

In 2002 in the United States, the percent of infants born low birthweight (LBW; the proportion of live births <2500 g) rose to its highest level in nearly 30 years.[1,2] Although LBW rates were increasing over the last few decades, infant mortality rates (IMRs), the number of infant deaths <1 year of age per 1000 live births, continued to decline dramatically.[1-3] In the United States, an approximate 45% decrease in IMRs occurred between 1980-2000 as LBW percentages rose nearly 12%.[2,3]

★ EDITORS' CHOICE ★

IMRs are often used as surrogate measures of a population's general health status, socioeconomic conditions, and availability and access to quality health care. The decrease in the rate of infant death in the United States has been observed for births to both white and African American (AA) mothers.[3] However, in the midst of this general improvement in infant survival, there has been a widening in the racial disparity in IMRs.[2-4]

Racial disparities in rates of infant mortality, LBW and preterm delivery have been an unrelenting feature of US pregnancy statistics.[2-4] Despite the steady decline in infant mortality rates for both US white and AA women over the last 20 years, the risk of an infant death for AA women, relative to white women, actually rose. In 1980, an AA live birth was 2.04 times more likely to die during the first year of life than a white birth; in 2000, the comparative risk of infant death for AA women was 2.46.[2,3] This persistent and growing racial disparity in US IMRs has attracted the concern of policymakers and understanding the contributors to the growing increase in the racial disparity has drawn ongoing research attention.[5]

Downward trends in IMRs are typically assessed by investigating: (1) decreases in the proportion of high-risk births, eg, changes in the percentage of LBW or preterm births; and/or, (2) increases in infant survival, ie, changes in BW or gestational age (GA)-specific IMRs.[6-9] To the extent that LBW or preterm birth rates remain constant or increase, the primary mechanism underlying observed declines in infant mortality is likely to be improved survival for in-

†Deceased.

From the Department of Pediatrics, University of South Florida College of Medicine, Tampa, FL (Dr Alexander); the Department of Health Care Organization and Policy, School of Public Health, University of Alabama at Birmingham (Dr Wingate), and the Midwives Alliance of North America (Dr Bader), Birmingham, AL; and the Maternal and Child Health Bureau, Health Resources and Services Administration, US Department of Health and Human Services, Rockville, MD (Dr Kogan).

Received Jan. 24, 2007; revised April 13, 2007; accepted June 7, 2007

The content of this work is solely the responsibility of the authors and does not necessarily represent the official views of the funding agencies.

Supported in part by DHHS, HRSA, MCHB grant MC00008-16 S21 (G.R.A., M.S.W., and D.B.).

Reprints not available from the authors. Address correspondence to: Martha S. Wingate, DrPH, Assistant Professor, Health Care Organization and Policy, School of Public Health, University of Alabama at Birmingham, RPHB 330, 1530 3rd Ave. S, Birmingham, AL 35294-0022; mslay@uab.edu

0002-9378/$34.00 • • doi: 10.1016/j.ajog.2007.06.006

fants born at higher-risk BWs or GAs.[6-11] As marked racial variation in both the distributions of BW and GA, as well as in BW and GA-specific mortality, have long been recognized, exploring trends in the distribution and survival of high-risk births for each race group is essential to understanding patterns in racial disparities in IMRs.[12-15]

In this study, we examine for the periods 1985-1988 and 1995-2000 temporal changes in BW-GA distributions and BW-GA–specific IMRs for AA and white race groups. Our purpose for examining changes in the proportion of high-risk births and their survival by race group is to better understand how these parameters contribute to the growing racial disparity in overall infant mortality. Within these 2 race groups, we assessed trends in infant survival by BW-GA categories and then examined how relative racial differences in survival had changed. Finally, we calculated the estimated annual number of excess AA infant deaths for the final period to quantify the magnitude of the observed racial disparity.

Materials and Methods

The National Center for Health Statistics' (NCHS) linked live birth-infant death cohort files for 1985-1988 and 1995-2000 were used for this study. The files with all personal identifiers removed are public access files and the use of these files for research has been deemed as exempt research by the institutional review board at the University of Alabama at Birmingham. Singleton live births to US-resident mothers with a reported maternal race of white or AA were selected for analysis. We focus on white and AA births as these were the largest racial groups in the United States during these periods. Data on Hispanic births were not nationally available for the 1985-1988 period. After these selections, the study sample contained 10,620,735 live births from the 1985-1988 birth cohort and 21,687,542 live births from the 1995-2000 birth cohort.

Racial differences in the proportions of live births, infant deaths, and the percent change in the proportions of live births between the 1985-1988 and 1995-2000 birth cohorts were compared within commonly used risk categories of BW (<500, 500-749, 750-1499, 1500-2499, 2500-3999 and 4000+ g) and GA (<28, 28-32, 33-36, 37-41, 42+ weeks). BW-specific infant mortality rates were calculated by using 250 g 2-week intervals for each racial group.

The ratios of BW-GA–specific infant mortality rates were calculated both for each race group between birth cohort years, and for each birth cohort year between race groups. To minimize the impact of small number fluctuation, infant mortality rates are only provided for BW-GA intervals that approximately fall above the first percentile and below the 99th percentile for weight in each GA category. Further, mortality rates are not reported for any cell containing less than 25 infant deaths.

GA in completed weeks was computed from the interval between the first day of the last normal menstrual period (LMP) and the date of birth. Records missing date of LMP were imputed on the NCHS file when there was a valid month and year. Clinical estimate of gestation was used in the imputation of GA in cases when no valid month and year of LMP was reported. Approximately 4-5% of the GAs in the 1995-2000 live birth cohort were based on clinical estimate of gestation. We conducted the analyses with and without the cases based on clinical estimate of gestation and found no differences, therefore we decided to use the cases with clinical estimate to improve statistical power. Records with implausible or missing values for BW or GA and records with a BW value inconsistent with the GA were deleted. Procedures for imputing data and determining GA-BW inconsistency have been described in detail elsewhere.[16]

We then calculated a crude estimate of the annual number of excess AA infant deaths on the basis of the assumption that within a given period the expected proportion of AA deaths should be equal to the proportion of AA live births, similar to the proportions in the white population. In 1995-2000, this proportion was 15.4%. Accordingly, the expected number of AA infant deaths was assumed to be 15.4% of the observed number of total infants deaths. This approach was further applied to all BW-GA categories. The estimated number of excess AA infant deaths for the 1995-2000-birth cohort was calculated by subtracting the expected number of deaths from the observed number of deaths for the total and for each BW-GA–specific category. The ratio of the observed to the expected proportion of deaths indicates the magnitude and the direction of the difference between the observed and the expected deaths. Annual estimates were derived by dividing each estimate by 6, the number of years in the 1995-2000 period.

Results

For each race group, part 1 of Table 1 presents the proportion of live births by year and BW-GA categories. The percentage of births for just BW and GA categories are provided in the table margins, labeled "total." Both race groups exhibit increases in the percent of very LBW infants (<1500 g), with white infants increasing from 0.4-0.6% and AA infants increasing from 1.4-1.9% of all births. The proportion of moderate LBW (1500-2499 g) infants increased for white infants, but slightly declined for AA infants. Similarly, the percent of moderately preterm (33-36 weeks) infants increased for white infants from 6.1-7.2%, but declined for AA infants (12.4-11.7%).

The change in the percent of live births (shown as a ratio) in each BW-GA category is provided in part 2 of Table 1. White live births in 1995-2000 were 1.57 times as likely to be <28 weeks gestational age compared with 1985-1988 births. Although white infants exhibited an increase in the birth categories of 28-32 and 33-36 weeks' gestation between the periods, AA infants demonstrated a temporal decline in the proportion of these preterm births (ratios of 0.95 and 0.94, respectively). Complementary findings were observed for LBW categories with white infants evincing a greater increase over time than AA infants for these higher-risk births.

The proportion of infant deaths by BW-GA categories is shown in part 3 of Table 1. For both race groups, over time

TABLE 1

Percent of live births and infant deaths for birth weight and gestational age categories by race of mother: (W) white and (AA) African American 1985-1988 and 1995-2000 single live births to US residents

Part 1: Percent of live births

BW/Gest Race YR	<28 W 85	<28 W 95	<28 AA 85	<28 AA 95	28-32 W 85	28-32 W 95	28-32 AA 85	28-32 AA 95	33-36 W 85	33-36 W 95	33-36 AA 85	33-36 AA 95	37-41 W 85	37-41 W 95	37-41 AA 85	37-41 AA 95	42+ W 85	42+ W 95	42+ AA 85	42+ AA 95	Total W 85	Total W 95	Total AA 85	Total AA 95
4000-8500									0.2	0.2	0.2	0.2	10.1	10.2	4.2	4.8	2.4	1.2	0.9	0.6	12.7	11.6	5.2	5.5
2500-3999					0.2	0.2	0.9	0.6	4.4	5.2	8.7	7.6	68.5	72.4	65.5	69.6	9.9	6.0	9.2	6.1	83.1	83.7	84.3	83.8
1500-2499			0.1	0.1	0.4	0.5	1.2	1.1	1.5	1.8	3.4	3.7	1.8	1.8	4.0	3.7	0.2	0.1	0.4	0.2	3.8	4.1	9.0	8.8
750-1499	0.1	0.1	0.4	0.5	0.2	0.3	0.7	0.8	0.1	0.1	0.2	0.2	0.0	0.0	0.1	0.0			0.0	0.0	0.4	0.5	1.3	1.6
500-749	0.0	0.1	0.1	0.3	0.0	0.0	0.0	0.1													0.0	0.1	0.1	0.3
<500		0.0	0.0	0.0																		0.0	0.0	0.0
Total	0.1	0.2	0.6	0.8	0.9	1.0	2.8	2.6	6.1	7.2	12.4	11.7	80.4	84.2	73.7	77.9	12.5	7.4	10.5	7.0	100.0	100.0	100.0	100.0

Part 2: Change in percent of live births from 1985-1995

	<28 W Ratio	<28 AA Ratio	28-32 W Ratio	28-32 AA Ratio	33-36 W Ratio	33-36 AA Ratio	37-41 W Ratio	37-41 AA Ratio	42+ W Ratio	42+ AA Ratio	Total W Ratio	Total AA Ratio
4000-8500					1.06	0.89	1.01	1.14	0.49	0.66	0.91	1.05
2500-3999			0.95	0.66	1.18	0.87	1.06	1.06	0.60	0.66	1.01	0.99
1500-2499		0.56	1.10	0.91	1.22	1.11	1.00	0.93	0.59	0.59	1.08	0.98
750-1499	1.40	1.29	1.41	1.27	1.00	1.00	0.67	0.13		1.00	1.32	1.20
500-749	2.00	2.36	2.00	2.50							2.67	2.38
<500		2.00										2.00
Total	1.57	1.40	1.15	0.95	1.18	0.94	1.05	1.06	0.59	0.67		

Part 3: Percent of infant deaths

	<28 W 85	<28 W 95	<28 AA 85	<28 AA 95	28-32 W 85	28-32 W 95	28-32 AA 85	28-32 AA 95	33-36 W 85	33-36 W 95	33-36 AA 85	33-36 AA 95	37-41 W 85	37-41 W 95	37-41 AA 85	37-41 AA 95	42+ W 85	42+ W 95	42+ AA 85	42+ AA 95	Total W 85	Total W 95	Total AA 85	Total AA 95
4000-8500										0.1			3.2	3.0	1.3	1.3	0.9	0.4	0.3	0.2	4.2	3.5	1.7	1.5
2500-3999					0.4	0.5	0.6	0.5	4.8	5.2	4.9	4.1	33.7	32.4	24.4	22.3	5.8	3.2	4.0	2.2	44.7	41.3	34.0	29.0
1500-2499	0.2	0.2	0.4	0.2	3.4	3.1	3.2	2.6	5.9	6.2	5.4	5.3	6.4	6.0	5.8	4.5	0.9	0.5	0.7	0.4	16.7	16.1	15.5	13.0
750-1499	7.2	5.7	8.8	6.7	5.8	4.6	5.8	4.6	1.8	1.3	1.5	0.9	0.6	0.5	0.6	0.3					15.5	12.2	16.7	12.5
500-749	10.5	14.2	17.1	21.0	1.3	1.2	2.2	1.6													11.9	15.4	19.4	22.6
<500	6.7	11.3	12.2	20.8	0.2	0.4	0.5	0.6													7.0	11.6	12.7	21.3
Total	24.7	31.3	38.5	48.4	11.2	9.8	12.2	9.9	12.7	12.9	12.0	10.4	43.8	41.9	32.1	28.4	7.6	4.2	5.2	2.9	100.0	100.0	100.0	100.0

Alexander. Increasing racial disparities in infant mortality. Am J Obstet Gynecol 2008.

TABLE 2
Birth weight-gestational age specific infant mortality rates & rate ratios 1995-2000 single live births to white US resident mothers

BW/Gest	22-3	24-5	26-7	28-9	30-1	32-3	34-5	36-7	38-9	40-1	42-3	Total
Total	733.3	400.8	178.3	88.6	44.7	20.9	10.3	4.8	2.5	2.1	2.8	4.9
95/85 ratio	0.91	0.7	0.53	0.52	0.59	0.59	0.66	0.61	0.64	0.66	0.68	0.65
5000+								4.4	1.8	1.7	1.6	1.8
95/85 ratio								0.71	0.58	0.74	0.55	0.67
4000-4999							3.8	2.5	1.5	1.3	1.6	1.4
95/85 ratio							0.55	0.64	0.65	0.65	0.7	0.64
3750-3999							3.8	2.6	1.4	1.3	1.7	1.5
95/85 ratio							0.68	0.72	0.67	0.65	0.63	0.68
3500-3749						5.7	3.5	2.3	1.6	1.5	1.9	1.6
95/85 ratio						0.85	0.66	0.55	0.67	0.65	0.63	0.62
3250-3499						5.9	4.3	2.5	1.8	1.8	2.3	2
95/85 ratio						0.98	0.78	0.63	0.64	0.62	0.64	0.65
3000-3249					8.1	6.5	5.7	3.2	2.4	2.5	3.4	2.7
95/85 ratio					0.74	0.64	0.75	0.64	0.65	0.66	0.71	0.66
2750-2999					9.8	11.1	5.8	4.1	3.4	3.7	4.3	3.9
95/85 ratio					0.85	0.77	0.67	0.6	0.65	0.67	0.61	0.65
2500-2749				14.1	16.8	14	8.5	5.9	5.7	6.3	8.2	6.5
95/85 ratio				0.49	0.85	0.81	0.67	0.66	0.71	0.67	0.68	0.68
2250-2499				28	35.5	15.7	10.9	9.4	10.3	13.3	14.7	11.2
95/85 ratio				0.62	1.03	0.58	0.68	0.64	0.72	0.72	0.66	0.66
2000-2249			47.2	58.3	37.1	18.4	15.5	18.2	21.3	30.3	33.3	20.1
95/85 ratio			0.94	1.16	0.8	0.61	0.63	0.67	0.72	0.86	0.67	0.67
1750-1999			76.2	55.3	34.7	23.7	26.4	31.7	45.8	53	44.5	31.5
95/85 ratio			0.83	0.65	0.67	0.59	0.63	0.62	0.72	0.73	0.64	0.62
1500-1749		80	98.5	62	34.8	34.3	45	64.6	74.2	71.3	70.1	45.9
95/85 ratio		0.79	0.92	0.61	0.5	0.53	0.61	0.75	0.78	0.71	0.88	0.59
1250-1499	119.5	114.3	90.8	54	46.3	52.6	64.5	107	93.4	64.4	36.3	59.1
95/85 ratio	0.67	0.63	0.51	0.43	0.52	0.53	0.57	0.78	0.86	0.47	0.36	0.52
1000-1249	196	143.4	102.6	70	63.7	76	107.3	124.2	83.7	75.9	55	83.1
95/85 ratio	0.76	0.51	0.45	0.42	0.39	0.49	0.59	0.63	0.49	0.65	0.38	0.45
750-999	344	265.2	150.7	116.4	124.6	149.1	204					173
95/85 ratio	0.66	0.56	0.42	0.39	0.43	0.48	0.62					0.47
500-749	741.1	473.8	324.2	271.4	281.6	305.1						498.1
95/85 ratio	0.87	0.68	0.51	0.46	0.52	0.48						0.69
250-749	890.7	757.7	633.8	637.9								847.1
95/85 ratio	0.95	0.86	0.73	0.78								0.92

Alexander. Increasing racial disparities in infant mortality. Am J Obstet Gynecol 2008.

a greater proportion of infant deaths occurred among births <28 weeks or <1500 g. For example, in 1995-2000 for white and AA women, respectively, 0.2% and 0.8% of their births were less than 28 weeks' gestation (from part 1), but 31.3% and 48.4% of their infant deaths were in this gestational age group compared with 24.7% for white women in 1985-1988, and 38.5% for AA women.

Tables 2 and 3 present the BW-GA–specific IMRs and between period rate

TABLE 3

Birth weight-gestational age specific infant mortality rates & rate ratios 1995-2000 single live births to African American US resident mothers

BW/Gest	22-3	24-5	26-7	28-9	30-1	32-3	34-5	36-7	38-9	40-1	42-3	Total
Total	662.9	335.9	166	80.1	38.7	18.3	10.7	6.6	4.2	3.8	4.7	11.4
95/85 Ratio	0.95	0.69	0.63	0.67	0.71	0.74	0.78	0.7	0.69	0.67	0.67	0.69
5000+								6.9	4.2	3.1	4.1	3.9
95/85 Ratio								0.88	0.56	0.62	0.51	0.61
4000-4999								4	2.8	2.9	3.1	3
95/85 Ratio								0.67	0.65	0.76	0.67	0.71
3750-3999							4.1	5	2.8	2.4	2.9	2.8
95/85 Ratio							0.95	1.06	0.72	0.6	0.73	0.7
3500-3749						4.7	4.9	4	3	2.8	2.9	3
95/85 Ratio						0.73	0.86	0.8	0.73	0.7	0.59	0.7
3250-3499						6.3	4.9	4.2	3.1	3.1	3.5	3.3
95/85 Ratio						1.07	0.71	0.79	0.74	0.74	0.66	0.73
3000-3249					9.7	6.6	5.7	4.5	3.3	3.8	4.2	3.8
95/85 Ratio					1.41	0.88	1.04	0.71	0.65	0.76	0.67	0.7
2750-2999					9.3	6.5	7	4.9	4.8	4.8	6	5.1
95/85 Ratio					0.89	0.71	0.79	0.64	0.77	0.67	0.69	0.71
2500-2749				12.2	12.1	12.4	9	7.1	5.7	6.2	8.5	6.9
95/85 Ratio				0.64	0.78	1.04	0.71	0.71	0.63	0.58	0.75	0.67
2250-2499				15.3	18.4	15.1	12	9.1	9.9	10.9	13.5	10.8
95/85 Ratio				0.81	0.88	0.75	0.77	0.61	0.66	0.65	0.71	0.68
2000-2249			33.3	29.8	27.8	19	14.4	15.8	16.7	24.8	28	17.6
95/85 Ratio			0.97	0.83	1	0.76	0.72	0.78	0.78	0.89	1	0.77
1750-1999			41.9	32.8	26.5	19.7	22	27.5	32.7	42.3	47.5	25.5
95/85 Ratio			0.9	0.94	0.62	0.64	0.73	0.76	0.9	0.83	0.82	0.71
1500-1749		71.7	57.1	44.3	36	27.2	29.9	43.2	64.8	56	68.5	36.5
95/85 Ratio		0.69	0.84	0.7	0.64	0.68	0.63	0.72	0.81	0.74	0.8	0.65
1250-1499	86.2	79	71	48.1	38.6	35.5	43	63.1	55.8	66.3	63.6	45.7
95/85 Ratio	0.64	0.78	0.81	0.68	0.58	0.56	0.59	0.83	0.79	0.72	0.98	0.63
1000-1249	145.2	113.1	81.7	62.9	58.9	72.3	59.9	74.2	59.5	60.5		71.5
95/85 Ratio	0.74	0.6	0.53	0.51	0.62	0.64	0.47	0.53	0.53	0.54		0.55
750-999	245.8	193.5	128	96.8	87.9	121.8	88.2					140.2
95/85 Ratio	0.62	0.56	0.47	0.43	0.4	0.6	0.43					0.49
500-749	659.9	391.4	322.6	280.4	315.9							457.8
95/85 Ratio	0.85	0.59	0.55	0.5	0.57							0.68
250-749	865	749.8	686.1	610.9								842.1
95/85 Ratio	0.98	0.83	0.82	0.76								0.95

Alexander. Increasing racial disparities in infant mortality. Am J Obstet Gynecol 2008.

ratios for white infants (Table 2) and AA infants (Table 3). As presented in Table 2, the total IMR for white infants in 1995-2000 was 4.9 and the 0.65 period ratio reveals a 35% reduction from the 1985-1988 rate. Between the periods, there was approximately a 50% reduction in the IMR for infants 26-29 weeks and 1000-1499 g. Less dramatic reductions were evident for term and normal BW infants, but even among these births, the decline in IMR exceeded 30%.

TABLE 4

U.S. birth weight-gestational age specific infant mortality African American/white rate ratios by year (1985-88 and 1995-2000)

BW		22-3	24-5	26-7	28-9	30-1	32-3	34-5	36-7	38-9	40-1	42-3	TOTAL 95-00	TOTAL 85-88
Total	85-88	0.87	0.85	0.78	0.71	0.72	0.7	0.88	1.19	1.56	1.78	1.71		
Total	95-00	0.9	0.84	0.93	0.9	0.87	0.88	1.04	1.38	1.68	1.81	1.68	2.32	2.06
5000+	95-00								1.57	2.33	1.82	2.56	2.17	2.17
4000-4999	95-00								1.6	1.87	2.23	1.94	2.14	1.91
3750-3999	95-00							1.08	1.92	2	1.85	1.71	1.87	1.82
3500-3749	95-00						0.82	1.4	1.74	1.88	1.87	1.53	1.88	1.65
3250-3499	95-00						1.07	1.14	1.68	1.72	1.72	1.52	1.65	1.45
3000-3249	95-00					1.2	1.02	1	1.41	1.38	1.52	1.24	1.41	1.31
2750-2999	95-00					0.95	0.59	1.21	1.2	1.41	1.3	1.4	1.31	1.2
2500-2749	95-00				0.87	0.72	0.89	1.06	1.2	1	0.98	1.04	1.06	1.08
2250-2499	95-00				0.55	0.52	0.96	1.1	0.97	0.96	0.82	0.92	0.96	0.95
2000-2249	95-00			0.71	0.51	0.75	1.03	0.93	0.87	0.78	0.82	0.84	0.88	0.76
1750-1999	95-00			0.55	0.59	0.76	0.83	0.83	0.87	0.71	0.8	1.07	0.81	0.71
1500-1749	95-00		0.9	0.58	0.71	1.03	0.79	0.66	0.67	0.87	0.79	0.98	0.8	0.72
1250-1499	95-00	0.72	0.69	0.78	0.89	0.83	0.67	0.67	0.59	0.6	1.03	1.75	0.77	0.64
1000-1249	95-00	0.78	0.79	0.8	0.9	0.92	0.95	0.56	0.6	0.71	0.8		0.86	0.71
750-999	95-00	0.73	0.73	0.85	0.83	0.71	0.82	0.43					0.81	0.77
500-749	95-00	0.89	0.83	1	1.03	1.12							0.92	0.94
<500	95-00	0.97	0.99	1.08	0.96								0.99	0.96

Alexander. Increasing racial disparities in infant mortality. Am J Obstet Gynecol 2008.

The total IMR for AA infants in 1995-2000 was 11.4 (Table 3). The 0.69 period ratio indicated a 31% reduction from the 1985-1988 rate, which was slightly less than that observed for white infants. BW and GA-specific mortality improved over time in every BW and GA category with the greater improvements evident for preterm and LBW infants.

Table 4 shows the ratio of AA/white IMRs for 1995-2000 by BW-GA–specific categories. For comparison, the rate ratios for separate BW and GA categories for 1985-1988 are also provided. Overall, in 1995-2000 the IMR for AA infants was 2.32 times greater than that of white infants and was higher than the rate ratio observed for 1985-1988 (2.06). For LBW infants, AA infants are still more likely to survive than white infants, but the survival advantage decreased, which reduced the racial disparity in infant mortality risk for these infants. For normal-weight infants, the racial disparity in IMRs is growing with white infants demonstrating an increasing survival advantage. These findings for GA are displayed graphically in the Figure, which depicts AA/white GA-specific IMR ratios. This Figure highlights the reduction in the racial disparity for both preterm infants, while indicating the increasing disparity in IMRs for term infants.

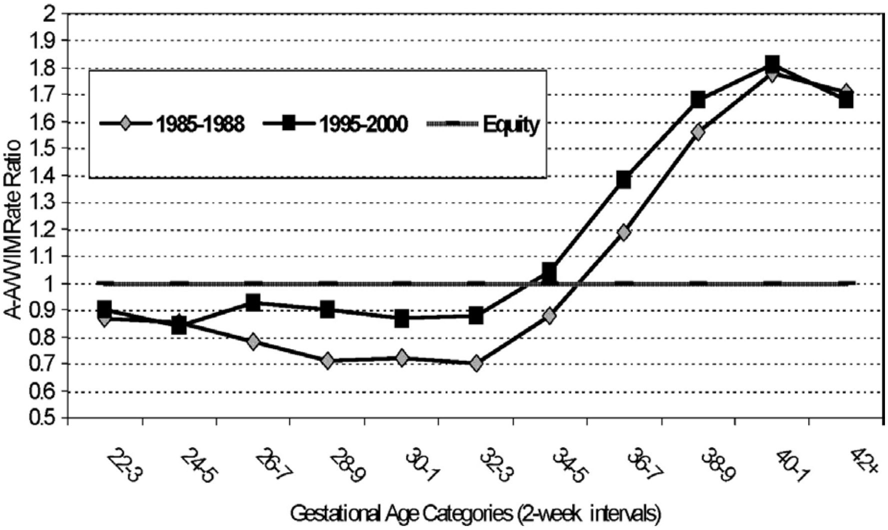
Table 5 presents the estimated annual excess number of AA infant deaths by total and BW-GA categories. It is estimated that 3303 excess AA infant deaths occurred annually during the 1995-2000 period. Slightly more than 20% of the excess deaths occurred to infants who were 2500 g or greater or at term or beyond. More than two-thirds of the estimated excess deaths were among very LBW (and very preterm) infants.

COMMENT

For this study population, IMRs declined over time for both race groups. AA women continue to have higher proportions for preterm and LBW births compared with white women. However, this disparity is decreasing as white infants exhibit greater increases in the LBW rates. At the same time, AA infants continue to experience lower risks of infant mortality for preterm and LBW infants, while having higher risks of mortality among term, post-term, normal BW, and macrosomic births. However, the AA advantage in the survival of higher-risk LBW and preterm infants is diminishing, whereas the survival advantage for white infants at term and beyond is increasing. These factors underlie the overall increasing AA/white disparity in infant mortality and represent a matter of serious concern, particularly as the AA/white disparity in infant mortality appears to be growing despite ongoing reduction efforts.

FIGURE

African American/white gestational age–specific infant mortality rate ratios 1985-1988 and 1995-2000 (US resident births)



Alexander. Increasing racial disparities in infant mortality. Am J Obstet Gynecol 2008.

We found that the rising racial disparity in infant mortality rates is being largely driven by differential improvements in BW and GA-specific survival. Although racial differences in the proportion of very LBW (VLBW) and very preterm births continue to play a major role in the existing racial disparity in infant mortality, changes in BW and GA distributions for each race group are not the major underlying determinants of the increasing racial disparity in US infant death rates. The ongoing increase in the mortality disparity is fueled by better improvements in the survival of white high-risk infants.

There are several possible explanations for the increasing proportions of LBW and preterm births observed in these data. These include changes in vital record reporting, (ie, very small infants once reported as fetal deaths now being registered as live births), in sociodemographic risks disparities, and in the incidence of multiple births (although our analysis was limited to singletons).[3,17-20]

It has also been proposed that earlier therapeutic delivery or induction of labor may also play a major role in increasing LBW and preterm percentages.[3,7,8,20,21] Early and adequate use of prenatal care, combined with advances in medical care (eg, steroids and surfactant) may lead to an early therapeutic delivery for women with identified high-risk conditions. This early identification allows for the lifesaving use of newly developed medical interventions and technologic tools in high-risk obstetric, perinatal, and neonatal care.[3,7,8,22-24] In the obstetric arena, prenatal corticosteroids and intrapartum antibiotics have been linked to reductions in neonatal morbidity and mortality.[25-28] Advances in neonatal care include high-frequency ventilation, surfactant, and the use of postnatal steroids.[26,29-31] Some researchers have suggested that certain therapies, such as surfactant, have differentially benefited LBW white infants who may be relatively more immature and are known to be at greater risk of mortality.[5,6,37,33] At the same time, racial variations in access to tertiary perinatal hospital care may be a factor, although clear evidence has not emerged from investigations of this theory.[34]

In some parts of the country, AA women may be more likely to deliver in a tertiary care center than white women,[34] but further investigation will be needed to establish the extent to which racial

TABLE 5

Estimated annual excess African American infant deaths single live births to US resident mothers 1995-2000

	<28			28-32			33-36			37-41			42-44			Total		
BW-GA groups	% deaths	O/E ratio	# (%)	% deaths	O/E ratio	# (%)	% deaths	O/E ratio	# (%)	% deaths	O/E ratio	# (%)	% deaths	O/E ratio	# (%)	% deaths	O/E ratio	# (%)
4000-8500										16	1.04	3 (0.1)	16.4	1.07	1 (0.02)	16.1	1.04	4 (0.1)
2500-3999				30.5	1.98	15 (0.5)	26.3	1.71	112 (3.4)	23.6	1.53	509 (15.4)	23.6	1.53	50 (1.5)	24.1	1.56	686 (20.8)
1500-2499	33.3	2.16	8 (0.2)	27.4	1.78	75 (2.3)	27.5	1.79	152 (4.6)	25.2	1.63	115 (3.5)	28.5	1.85	13 (0.4)	26.7	1.74	362 (11.0)
750-1499	34.4	2.24	242 (7.3)	30.9	2	151 (4.6)	24.1	1.56	22 (0.7)	23.4	1.52	7 (0.2)				31.7	2.06	423 (12.8)
500-749	39.7	2.58	840 (25.4)	37.5	2.44	63 (1.9)										39.5	2.57	903 (27.3)
<500	45.2	2.94	898 (27.2)	41.7	2.71	27 (0.8)										45.1	2.93	925 (30)
Total	41	2.7	1988 (60.2)	31.3	2	331 (10.0)	26.6	1.7	286 (8.7)	23.4	1.5	634 (19.2)	23.8	1.6	64 (1.9)	31	2	3303 (100)

The expected # of AA infant deaths is based on an assumption of AA infant deaths representing 15.4% of the total # of US infant deaths in each birth weight-gestational age category. *% deaths*, the # of AA infant deaths/the # of total U.S. > infant deaths; *O/E Ratio*, % deaths [observed]/% expected deaths [15.4%: based on the % of total U.S. live births to AA mothers]; *#*, the estimate annual excess # of AA infant deaths [annual observed # deaths − annual expected # deaths]; *%*, the % of the total estimated annual excess AA infant deaths within each birthweight-gestational age category.

Alexander. Increasing racial disparities in infant mortality. Am J Obstet Gynecol 2008.

variations in access to high-risk obstetric and neonatal care exists, has changed over time, and the extent to which this has influenced trends in infant mortality. A recent investigation of prenatal care use by race groups in the United States revealed that racial disparities in early, adequate and intensive use of prenatal care were reduced during the 1990s.[36] Although standard prenatal care alone is no longer widely advocated as an effective means to reduce very preterm birth,[37-39] it may play a very important role in assuring access to a risk-appropriate level of medical care, thereby helping to improve infant survival for all racial groups.

The accuracy, completeness, and limitations of reporting GA on US vital records and linking live birth and infant death certificates have been well documented.[40-42] This previous research has indicated that the reporting of GA on birth certificates may be subject to increasingly greater inaccuracies at GAs <37 weeks. In this study, we have attempted to eliminate some of these potentially inaccurate values by removing cases with inconsistent GA-BW values. Nevertheless, there is the possibility that there are some preterm cases in which the GA value is incorrect. As a result, the BW-GA–specific IMRs may be underestimated for large-for-GA preterm newborn infants.

Further, it should be emphasized that the BW-GA–specific IMRs provided in this report are based on crude mortality rates for each race group and have not been standardized to control for group variations in maternal risk characteristics. Although beyond the scope of this investigation, similar analyses of trends in racial disparities in mortality by BW and GA categories are needed that take into account sociodemographic, behavior, and other risk factors.

What also remains unresolved by these data is what allows racial disparities in infant mortality to persist and increase for *normal* BW and term infants. The reasons underlying these marked and growing disparities are unclear, but a proportion of these deaths may be avoidable. Part of the reason may be explained by the higher comorbidities that complicate AA women, such as hypertension and obesity. Attention needs to be directed to this area as it involves nearly 20% of the total racial disparity in IMRs. Moreover, an added focus on addressing racial disparities in infant mortality in normal and macrosomic BW infants may yield new and important insights regarding the role of environmental stressors and health care delivery characteristics.

Finally, a continued focus on the causes and prevention of very preterm births is necessary; although, the slow advance of research in providing definitive answers is frustrating. States, communities, and providers must remain vigilant in their efforts to assure timely access to high-quality, risk-appropriate prenatal services. But, until effective preterm prevention strategies emerge, dramatic reductions in these racial disparities should not be expected in the near future. Indeed, racial disparities in infant mortality may continue to increase in the short term.[32,35] ■

REFERENCES

1. Hamilton BE, Martin JA, Sutton PD. Births: Preliminary Data for 2002. Hyattsville (MD): National Center for Health Statistics; 2003.
2. Centers for Disease Control and Prevention. Infant mortality and low birth weight among black and white infants—United States, 1980-2000. MMWR 2002;51:589-52.
3. Alexander GR, Slay M. Prematurity at birth: trends, racial disparities, and epidemiology. MRDD Res Rev 2002;8:215-20.
4. Carmicheal SL, Iyasy S. Changes in the black-white infant mortality gap from 19383-1991 in the United States. Am J Prev Med 1998;15:220-7.
5. Hogan VK, Richardson JL, Ferre CD, Durant T, Boisseau M. A public health framework for addressing blank and white disparities in preterm delivery. J Am Med Womens Assoc 2000;56:1780.
6. Lee KS, Paneth N, Gartner LM, et al. Neonatal mortality: an analysis of the recent improvement in the United States. Am J Public Health 1980;70:15-21.
7. Alexander GR, Tompkins ME, Allen MC, et al. Trends and racial differences in birth weight and related survival. Matern Child Health J 1999;3:71-9.
8. Allen MC, Alexander GR, Tompkins ME, et al. Racial differences in temporal changes in newborn viability and survival by gestational age. Paediatr Perinat Epidemiol 2000;14:152-8.
9. Alexander, GR, Kogan M, Bader D, Carlo W, Allen MC, Mor J. U.S. birth weight-gestational age-specific neonatal mortality: 1995-7 rates for whites, Hispanics and African-Americans. Pediatrics 2003;111:e61-6.
10. Paneth NS. The problem of low birth weight. Future of Child 1995;5:19-34.
11. Paneth NS. Technology at birth. Am J Public Health 1990;80:791-2.
12. Alexander GR, Tompkins ME, Altekruse JM, Hornung CA. Racial differences in the relation of birth weight and gestational age to neonatal mortality. Public Health Rep 1985; 100:539-47.
13. Sappenfield WM, Buehler JW, Binkin NJ, Hogue CJ, Strauss LT, Smith JC. Differences in neonatal and postneonatal mortality by race, birth weight, and gestational age. Public Health Rep 1987;102:182-92.
14. Collins JW Jr, David RJ. Differential survival rates among low-birth-weight black and white infants in a tertiary care hospital. Epidemiol 1990;1:16-20.
15. Alexander GR, Kogan MD, Himes JH, Mor JM, Goldenberg R. Racial differences in birthweight for gestational age and infant mortality in extremely-low-risk US populations. Paediatr Perinat Epidemiol 1999;13:205-17.
16. Alexander GR, Himes JH, Kaufman RB, Mor J, Kogan M. A United States national reference for fetal growth. Obstet Gynecol 1996;87:163-8.
17. Phelan ST, Goldenberg R, Alexander G, Cliver SP. Perinatal mortality and its relationship to the reporting of low-birth weight infants. Am J Public Health 1998;88:1236-9.
18. Blondel B, Kogan, MD, Alexander GR, et al. The impact of the increasing number of multiple births on the rates of preterm birth and low birth weight: an international study. Am J Public Health 2002;92:1323-30.
19. Kramer MS. Preventing preterm births: are we making progress? Prenatal Neonatal Med 1998;3:10-2.
20. MacDroman MF, Martin JA, Matthews TJ, Hoyert DL, Ventura SJ. Explaining the 2001-02 infant mortality increase: data from the Linked Birth/Infant Death Data Set. Natl Vital Stat Rep 2005;53:1-24.
21. Kogan MD, Alexander GR, Kotelchuck M, et al. Trends in twin birth outcomes and intensive prenatal care utilization in the United States, 1981-1997. JAMA 2000;284:335-41.
22. Muraskas J, Bhola M, Tomich P, Thomasma D. Neonatal viability: pushing the envelope. Pediatrics 1998;101:1095-96.
23. Allen MC, Donohue PK, Dusman AE. The limit of viability--neonatal outcome of infants born at 22 to 25 weeks' gestation. N Engl J Med 1993;329:1597-601.
24. Alexander GR, Petersen DJ, Allen MC. Life on the edge: preterm births at the limit of viability—committed to their survival, are we equally committed to their prevention and long-term care? Medicolegal Ob/Gyn Newsletter 2000;8:1,18-21.
25. Thorp JM, Hartmann KE, Berkman ND, et al. Antibiotic therapy for the treatment of preterm labor: a review of the evidence. Am J Obstet Gynecol 2002;186:587-92.

26. Morse SB, Haywood JL, Goldenberg RL, Bronstein J, Nelson KG, Carlo WA. Estimation of neonatal outcome and perinatal therapy use. Pediatrics 2000;105:1046-50.

27. Ballard PL. Scientific rationale for the use of antenatal glucocorticoids to promote fetal development. Pediatr Rev 2000;1: E83-90.

28. Curley AE, Halliday HL. The present status of exogenous surfactant for the newborn. Early Human Develop 2001;61:67-83.

29. Eichenwald EC, Stark AR. High-frequency ventilation: current status. Pediatr Rev 1999;20: e127-33.

30. Schwartz RM, Luby AM, Scanlon JW, et al. Effects of surfactant on morbidity, mortality, and resource use in newborn infants weighing 500 to 1500 g. N Engl J Med 1994;330:1476-80.

31. Howell EM, Vert P. Neonatal intensive care and birth weight-specific perinatal mortality in Michigan and Lorraine. Pediatrics 1993;91:464-70.

32. Hamvas A, Wise PH, Yang RK, et al. The influence of the wider use of surfactant therapy on neonatal mortality among blacks and whites. N Engl J Med 1996;334:1635-40.

33. Papiernik É, Alexander GR. Discrepancy between gestational age and fetal maturity among ethnic groups. In: Chervenak F, editor. Fetus as a patient. Canforth, UK: Parthenon Publish; 1999.96-103.

34. Langkamp DL, Foye HR, Roghmann KJ. Does limited access to NICU services account for higher neonatal mortality rates among blacks? Am J Perinatol 1990;7:227-31.

35. Region IV Network for Data Management and Utilization (RNDMU). Consensus in Region IV: Women and Infant Health Indicators for Planning and Assessment. 2000

36. Alexander GR, Kogan MD, Nabukera S. Racial differences in prenatal care use in the United States: are the disparities decreasing? Am J Public Health 2002;92:1970-5.

37. Alexander GR, Korenbrot C. The role of prenatal care in preventing low birth weight. Future of Child 1995;5:103-20.

38. Alexander GR, Howell E. Preventing preterm birth and increasing access to prenatal care: two important but distinct national goals. Am J Prevent Med 1997;13:290-1.

39. Goldenberg RL, Rouse DJ. Prevention of premature birth. N Engl J Med 1998;339:313-20.

40. Alexander GR, Tompkins ME, Cornely DA. Gestational age reporting and preterm delivery. Public Health Rep 1990;105:267-75.

41. Kramer MS, McLean FH, Boyd ME, et al. The validity of gestational age estimation by menstrual dating in term, preterm, and postterm gestations. JAMA 1998;260:3306-8.

42. Alexander GR, Allen MC. Conceptualization, measurement, and use of gestational age: I, clinical and public health practice. J Perinatol 1996;16:53-9.