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## Infant Mortality in Colorado: Trends, Disparities, and Current Research

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### Introduction

Infant mortality, or deaths among infants under one year of age, is often used as an indicator to determine the health of a population. While U.S. national trends show a general decline in the infant mortality rate since 1958, a minor, though much noted increase in the infant mortality rate was observed in 2002.<sup>1</sup> Although the downward trend in the U.S. infant mortality rate resumed again the following year, this increase has created a renewed interest in the factors behind and causes of infant mortality. An additional topic of continued discussion is the sizeable and persistent disparity in the rates of infant mortality among the Black population, which are presently twice as high as those in the White population. This study was initiated to:

- 1) Compute the current trends of infant mortality among Colorado's infant population;
- 2) Identify disparities in infant mortality among Colorado's race/ethnic sub-populations; and
- 3) Explore perinatal factors associated with increases and disparities in Colorado's infant mortality rates.

### Methods

Infant mortality statistics were computed using Colorado's death certificate/mortality data as well as the linked birth/infant death file, both of which are maintained by the Health Statistics Section at the Colorado Department of Public Health and Environment. The aim of the linked file is to be able to characterize infant deaths using not only death certificate information, but also the maternal and perinatal characteristics found on deceased infants' birth certificates. Statistics computed using the mortality data may differ slightly from those arising from the linked file. This is due primarily to the inability to link all infant deaths to the decedents' birth certificates; however, the linked file provides the unique ability to study infant mortality more comprehensively. Which method used to compute infant mortality statistics—mortality file or linked birth/infant death file—is noted throughout this report as appropriate.

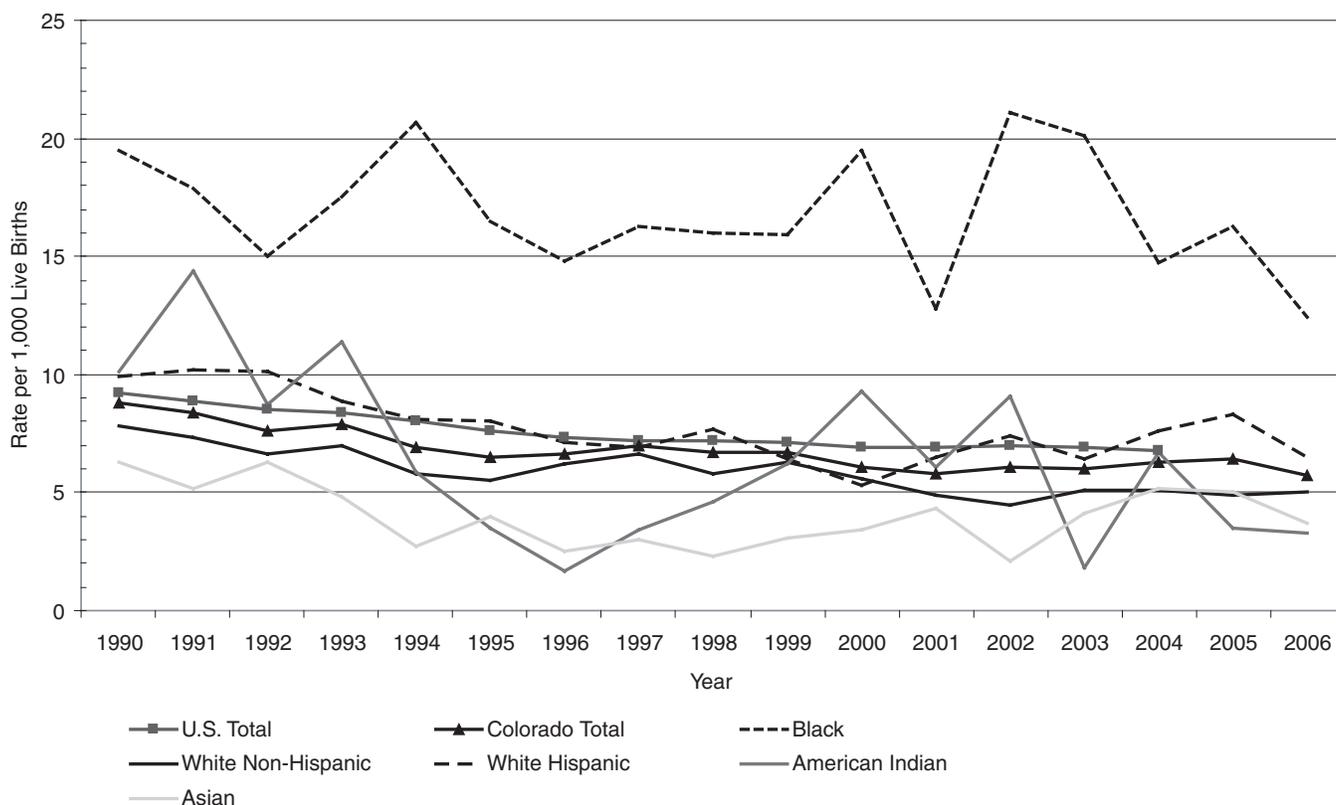
Rates of infant mortality were computed in most cases as the number of infant deaths per 1,000 live births, and were studied in detail for specific race/ethnic populations as well as by birth weight, gestational age, and cause of death. Rates for cause-specific infant mortality were computed as infant deaths per 10,000 live births in order to accommodate the relatively small number of deaths due to some specific causes—this, too, is noted as appropriate in this report. In order to study the independent effects of race/ethnicity on infant mortality, logistic regression was used to compute the odds ratios and to adjust for factors that could influence the racial disparity in infant mortality.

## Results

The U.S. infant mortality rate in 1990 was 9.2 deaths per 1,000 live births and fell to 6.8 in 2004, but not before increasing to 7.0 in 2002.<sup>2</sup> In 1990, Colorado's infant mortality rate was 8.8, and dropped to 5.7 in 2006, although some increases were seen between 2002 and 2005 (Figure 1).

The infant mortality disparity seen nationwide among Black infants is observed in Colorado as well, and has been present over time. In 2006, the infant mortality rate among Black infants in Colorado was 12.4 per 1,000 live births to Black mothers, while that among White/non-Hispanic infants was 5.0 (Figure 1). A second smaller, yet equally persistent disparity is the infant mortality rate among White/Hispanic infants (6.5 in 2006.) The rates of infant mortality among Asian/Pacific Islander and American Indian infants were the lowest among the race/ethnic categories studied here (3.7 and 3.3, respectively, in 2006.)

Figure 1. Infant mortality trends by race/ethnicity: Mortality file, Colorado and U.S. residents, 1990-2006



SOURCE: Health Statistics Section, Colorado Department of Public Health and Environment.

Table 1 lists certain characteristics of live births, infant deaths, and infant mortality rates by maternal race/ethnicity in Colorado for the combined years 2002-2006. Infants born to mothers who initiated prenatal care in the first trimester had a much lower infant mortality rate (5.3 per 1,000 live births) than infants born to mothers who had late (6.0) or no prenatal care (38.7). Multiple births experienced higher risk of infant mortality as well, with an infant mortality rate of 23.2 among twins, and 68.8 for multiple births of three or more. Higher risks of infant mortality were seen during the neonatal period (4.4), while infant mortality during the post-neonatal period was lower at 1.6.

Low birth weight and early gestational age are strongly associated with increased infant mortality. Very low birth weight infants—those weighing less than 1,500 grams—have the highest mortality rates (ranging from 50.6-921.6 per 1,000 live births, depending on very low birth weight category). Low-weight births—those between 1,500-2,500 grams—had mortality rates between 8.3-20.4, again depending on specific low birth weight category. Infants born at less than 20 weeks have the highest mortality rate of all gestational age categories at 953.8, while other preterm births experienced higher infant mortality rates than term births, with rates of 5.6-482.5 for births between 20 and 36 weeks gestation (Figure 2).

**Table 1. Live births, infant deaths, and infant mortality rates by maternal race/ethnicity and selected birth characteristics: linked birth/infant death file, Colorado residents, 2002-2006**

Characteristics	Total			White Non-Hispanic			White Hispanic			Black			Asian			American Indian		
	Births	Deaths	Rate	Births	Deaths	Rate	Births	Deaths	Rate	Births	Deaths	Rate	Births	Deaths	Rate	Births	Deaths	Rate
Total	345,858	2,087	6.0	208,902	1,068	5.1	106,474	701	6.6	15,058	222	14.7	12,354	71	5.7	3,002	21	7.0
<b>BIRTH WEIGHT:</b>																		
<500 grams	523	482	921.6	240	217	904.2	186	171	919.4	74	73	986.5	20	18	900.0	3	3	1000.0
500-999	1,632	540	330.9	881	274	311.0	511	189	369.9	175	58	331.4	51	15	294.1	13	4	307.7
1,000-1,499	2,334	118	50.6	1,372	62	45.2	688	40	58.1	167	11	65.9	81	4	49.4	25	*	*
1,500-1,999	5,838	119	20.4	3,477	64	18.4	1,627	43	26.4	456	10	21.9	216	*	*	59	*	*
2,000-2,499	20,991	174	8.3	12,403	87	7.0	6,080	63	10.4	1,416	17	12.0	882	4	4.5	204	3	14.7
2,500+	314,449	616	2.0	190,491	354	1.9	97,356	180	1.8	12,763	46	3.6	11,096	25	2.3	2,696	9	3.3
<b>CLINICAL ESTIMATE OF GESTATIONAL AGE</b>																		
<20 weeks	130	124	953.8	59	55	932.2	40	38	950.0	25	25	1000.0	6	6	1000.0	*	*	*
20-27	1,909	921	482.5	958	438	457.2	653	332	508.4	223	114	511.2	60	31	516.7	15	6	400.0
28-31	2,876	131	45.5	1,647	60	36.4	884	51	57.7	206	11	53.4	105	5	47.6	33	4	121.2
32-35	14,809	181	12.2	8,960	100	11.2	4,299	61	14.2	902	15	16.6	511	3	5.9	135	*	*
36	13,927	78	5.6	8,621	44	5.1	3,950	25	6.3	730	7	9.6	517	*	*	106	*	*
37-39	190,420	436	2.3	115,433	262	2.3	57,963	123	2.1	8,045	33	4.1	7,367	12	1.6	1,594	5	3.1
40+	121,647	211	1.7	73,146	108	1.5	38,664	69	1.8	4,924	17	3.5	3,781	12	3.2	1,117	5	4.5
<b>TRIMESTER CARE BEGAN:</b>																		
1st Trimester	270,866	1,435	5.3	176,770	804	4.5	71,617	414	5.8	10,605	154	14.5	9,894	48	4.9	1,958	15	7.7
2nd & 3rd Trimester	65,295	395	6.0	27,348	162	5.9	31,246	173	5.5	3,724	43	11.5	2,104	12	5.7	866	5	5.8
No Care	3,828	148	38.7	1,551	54	34.8	1,768	69	39.0	309	19	61.5	117	5	42.7	78	*	*
Unknown	5,869	109	18.6	3,233	48	14.8	1,843	45	24.4	420	6	14.3	239	6	25.1	100	*	*
<b>PLURALITY</b>																		
Single	334,541	1,800	5.4	200,801	913	4.5	104,190	613	5.9	14,520	185	12.7	12,028	66	5.5	2,936	19	6.5
Twin	10,779	250	23.2	7,646	132	17.3	2,222	74	33.3	532	37	69.5	311	5	16.1	66	*	*
Triplet or more	538	37	68.8	455	23	50.5	62	14	225.8	6	*	*	15	*	*	*	*	*
<b>AGE AT DEATH</b>																		
Neonatal <sup>1</sup>	-	1,518	4.4	208,902	756	3.6	106,474	532	5.0	15,058	162	10.8	12,354	52	4.2	3,002	13	4.3
Post-neonatal <sup>2</sup>	-	569	1.6	208,902	312	1.5	106,474	169	1.6	15,058	60	4.0	12,354	19	1.5	3,002	8	2.7

\* Indicates one or two events in the category.

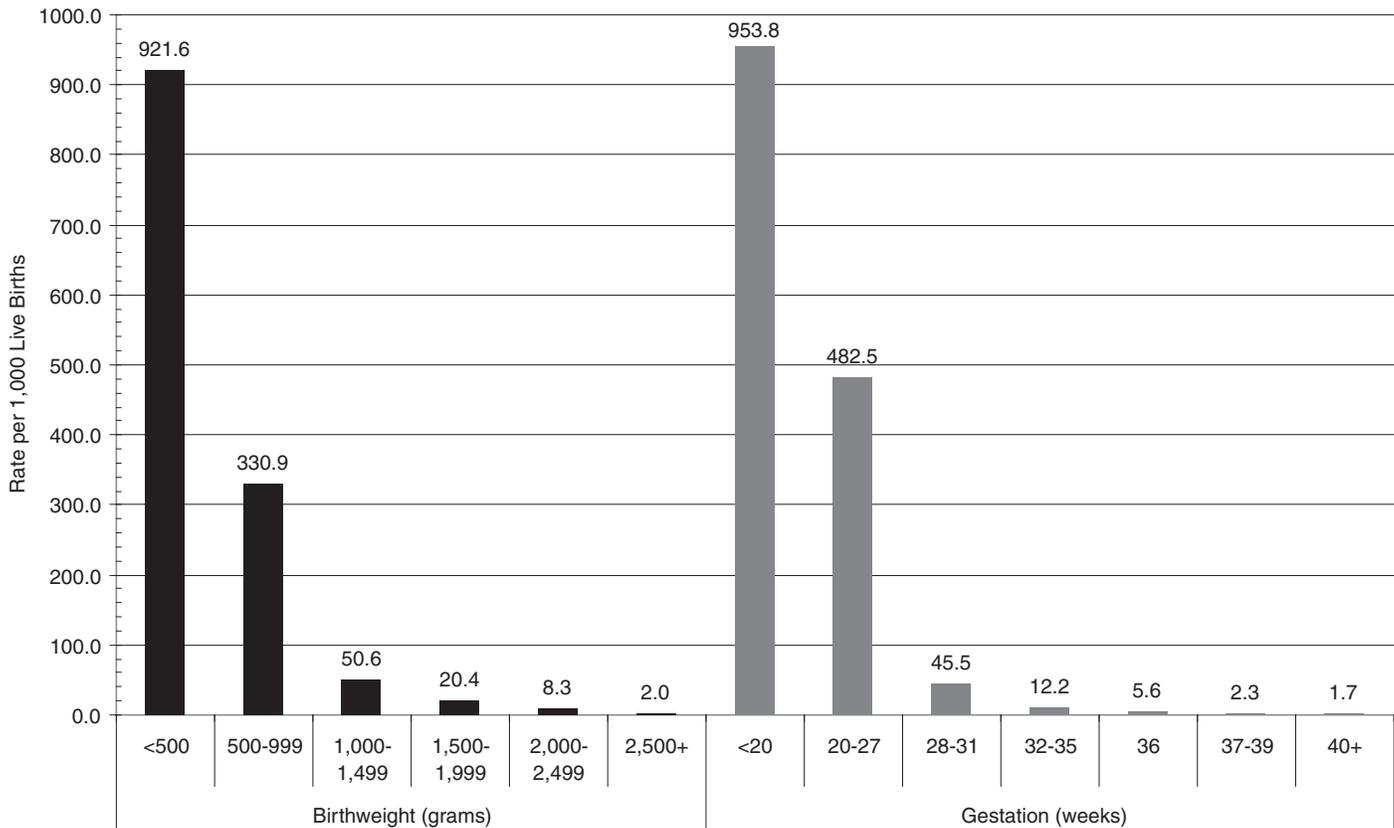
<sup>1</sup> Neonatal death is death prior to the 28th day of life.

<sup>2</sup> Post-neonatal death is death occurring at 28 days to less than 1 year of life.

Sums may not add to total due to cases with certain characteristics unknown. Rates are deaths per 1,000 live births in each category.

SOURCE: Health Statistics Section, Colorado Department of Public Health and Environment.

Figure 2. Infant Mortality Rates by Birthweight & Gestational Age: Linked Birth/Infant Death File, Colorado Residents, 2002-2006



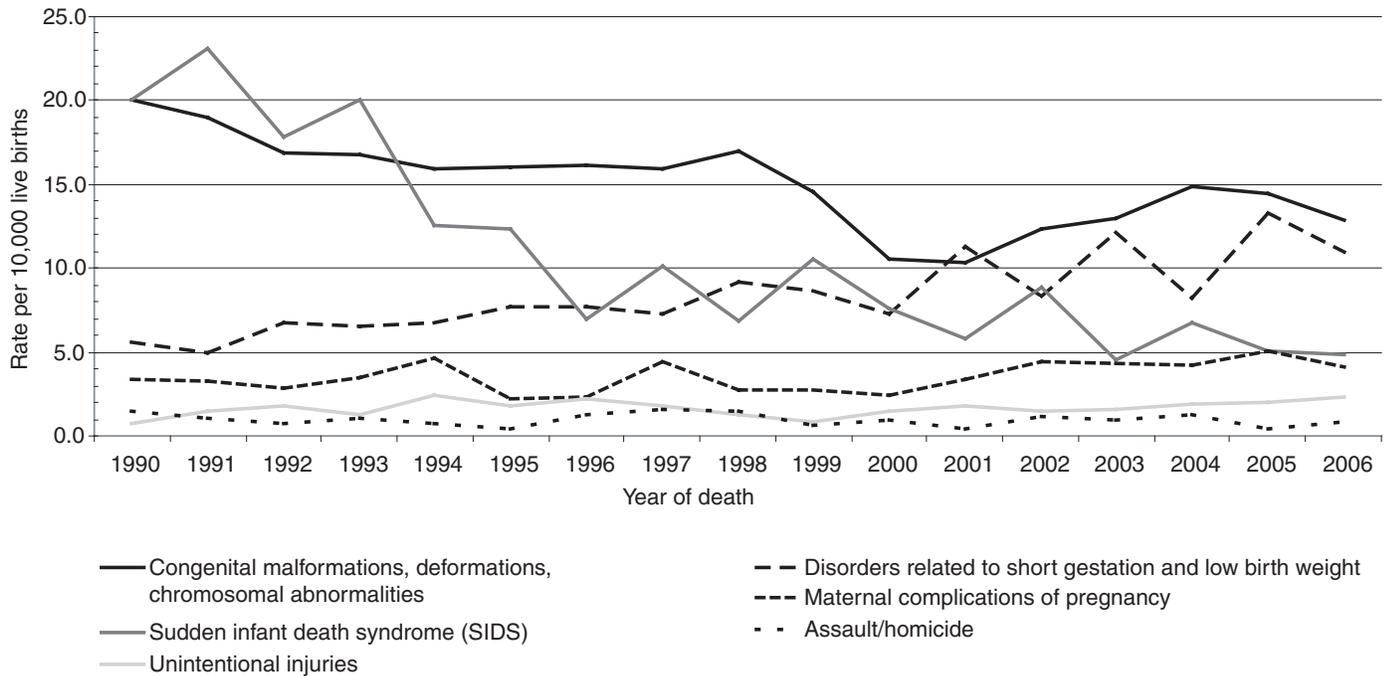
SOURCE: Health Statistics Section, Colorado Department of Public Health and Environment.

After controlling for maternal age, education, prenatal care, short gestation and low birth weight, multiple births, medical risk factors, and labor and delivery complications, Black mothers still had 50 percent greater odds of infant death compared to White/non-Hispanic mothers (Odds Ratio: 1.5, 95% Confidence Interval: 1.3-1.8). Prenatal care, maternal education, gestational age and birth weight were also found to be significantly associated with infant mortality when adjusting for all other covariates using logistic regression analysis. In the adjusted analyses, those women who did not receive any prenatal care had twice the odds of infant mortality than those women who received prenatal care in the first trimester (OR: 2.1, 95% CI: 1.7-2.6). Women who had more than a high school education had a 20 percent reduction in the odds of an infant death compared to women who only had a high school diploma or equivalent (OR: 0.8, 95% CI: 0.7-0.9). Infants that were born preterm (<37 weeks gestation) and of

low birth weight (1,500-2,500 grams) had seven times the odds of dying in infancy compared to infants born normal weight at term (OR: 7.0, 95% CI: 5.9-8.3). Even term infants that were of low birth weight, and preterm infants of normal birth weight experienced statistical increases in the risk of infant death.

In 1990, the leading causes of infant mortality in Colorado were congenital malformations/birth defects and sudden infant death syndrome (SIDS) (both had rates of 20.0 per 10,000 live births), followed at a distant third by disorders related to short gestation and low birth weight (5.6 per 10,000). By 2006, the leading causes of infant mortality were congenital malformations (12.9 per 10,000) and short gestation/low birth weight (11.0 per 10,000), with SIDS having dropped to third (4.8 per 10,000) (Figure 3).

**Figure 3. Infant mortality rates by cause of infant death: Mortality file, Colorado residents, 1990-2006**

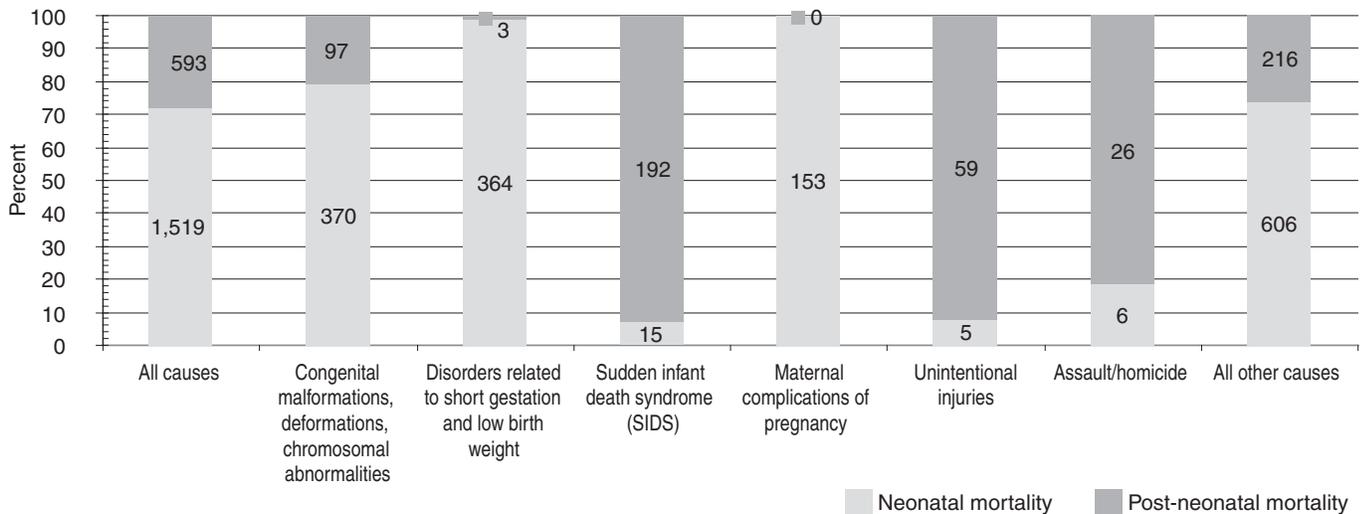


SOURCE: Health Statistics Section, Colorado Department of Public Health and Environment.

Additionally, causes of infant death vary by the age, or period of infancy after birth. Specifically, from 2002-2006, 71.9% of infant deaths occurred during the neonatal period (before 28 days after birth); while 28.1 percent of infant deaths occurred during the post-neonatal period (28 days-1 year after birth). Among deaths due to congenital malformations, 79.2 percent

occurred among neonates, while more than 99 percent of deaths due to short gestation and low birth weight occurred during the neonatal period. Alternatively, the majority of deaths due to SIDS (92.8%), unintentional injuries (92.2%), and assault/homicide (81.3%) occurred during the post-neonatal period (Figure 4).

**Figure 4. Neonatal (<28 days after birth) vs. post-neonatal infant deaths by cause of infant death: Mortality file, Colorado residents, 2002-2006**



SOURCE: Health Statistics Section, Colorado Department of Public Health and Environment.

## Discussion

In 2002, mortality rates among U.S. infants increased for the first time since 1958, renewing concern about the causes of infant death and persistent disparities, particularly across different race/ethnic populations. The study of the causes of infant mortality frequently begins with discussions about the rising issue of low birth weight in the U.S. In 2005, 8.2 percent of infants born in the U.S. were of low birth weight (less than 2,500 grams), marking its highest level in 30 years.<sup>3</sup> Because low weight birth infants are at greater risk of infant death, perhaps some of the 2002 increase in infant mortality, and even the slowed decline in infant mortality over the past decade, may be in part attributed to this increase in low-weight births.

In addition to the disparity in mortality observed in Black infants, there continues to be a greater percentage of low birth weight in Black infants than among White/non-Hispanic infants, both in Colorado and across the nation.<sup>4</sup> In 2005, the U.S. percentage of White/non-Hispanic low-weight births was 7.3 percent compared to 14.0 percent among Black/non-Hispanic births. That same year, the Colorado percentages of low-weight births for White/non-Hispanic and Black/non-Hispanic births were 9.2 percent and 15.3 percent, respectively. The U.S. percentage of very low birth weight (less than 1,500 grams) among White/non-Hispanic births was 1.2 percent in 2005, while that in Black/non-Hispanic births was 3.3 percent. The Colorado percentage in 2005 of very low birth weight among White/Non-Hispanic infants was 1.2 percent compared to 2.5 percent for Black/Non-Hispanic births.<sup>2</sup>

Studies have found racial/ethnic differences in diet, including folic acid intake, and in the living environment, such as infant sleep position, which may lead to the racial/ethnic disparities in infant mortality.<sup>5</sup> Other factors that have been suggested as contributing to the disparities in both low birth weight and infant mortality include racial/ethnic differences in maternal medical conditions and socio-economic factors that may prevent adequate prenatal care.<sup>6</sup> In addition to promoting early prenatal care, it has been suggested that the health of women in general over their lifetimes, not just during pregnancy, should be addressed to improve perinatal outcomes.<sup>7</sup> Other researchers have demonstrated that improvements in maternal socio-economic status and education do not result in the same improvements in infant mortality and low birth weight in Black infants compared to White infants. Put another way, income and education do not appear to offer the same protection for Black women as they do White women. These researchers conclude that traditional

risk factors commonly associated with low birth weight do not explain the entire Black/White disparity, and that other risk factors or stressors may explain the disparity, including racism and lifetime stress.<sup>8,9</sup>

Among the myriad possible explanations for the increase in low-weight births are the use of fertility treatments and the increasing rates of multiple births (twins, triplets, etc.) Research has shown that both multiple births and singleton births from assisted reproductive technologies (ART) have higher risks of low birth weight and prematurity compared to infants born without ART.<sup>10,11</sup> Colorado's birth certificate included information about ART for the first time in 2007, which will allow for further study of this issue both in Colorado and nationwide.

The Healthy People 2010 objective for infant mortality is less than 4.5 infant deaths per 1,000 live births across all race/ethnic groups.<sup>12</sup> Given observed increases in the percentage of births that are of low and very low weight, disparities in low birth weight across race/ethnic groups, and increases in both the rate and proportion of deaths due to low birth weight and short gestation, a necessary step in reducing infant mortality must be a continued emphasis on reducing low weight and preterm births. Additionally, strategies specific for different race/ethnic populations may be needed to reduce the disparity in negative perinatal outcomes like low birth weight and infant mortality.

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