U.S. Department of Health and Human Services
HRSA
Health Resources and Services Administration

Evidence of Trends, Risk Factors, and Intervention Strategies

U.S. Department of
Health and Human Services
Health Resources and Services Administration
Maternal and Child Health Bureau

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Executive Summary

The rate of infant mortality in the United States declined by 74 percent between 1960 and 2000, but the degree of decline has slowed in the past decade. Experts believe that eliminating racial/ethnic disparities in birth outcomes is key to the continued reduction in the overall rate of infant mortality in the United States. Blacks, American Indian/Alaska Natives, and Puerto Ricans, in descending order, have notably higher rates of infant mortality than other races/ethnicities.

Several programs have been implemented to address racial/ethnic disparities in birth outcomes. Healthy Start, a national initiative begun in 1991 by the Health Resources and Services Administration, Maternal and Child Health Bureau, is the largest of these programs. Healthy Start is a community-based program targeted to eliminating or reducing racial/ethnic disparities in birth outcomes in high-risk communities. The goals of Healthy Start are to improve the quality of the local perinatal system of care, to enhance the cultural competence of providers who work within the system, and to improve women's access to the system of care. These objectives are accomplished through outreach, health education, case management, and enhanced community collaboration within the local perinatal health system. The activities of the Healthy Start program are designed to encourage pregnant and interconceptional women, providers, and other community stakeholders to address the risk factors associated with poor perinatal health outcomes.

In this paper, an evidence base is provided to support the targeted interventions implemented by the national Healthy Start program and other perinatal health initiatives to reduce racial/ethnic disparities in birth outcomes. In light of this objective, the racial/ethnic disparities in birth outcomes are described and the evidence on behavioral, biological, and social risk factors for poor perinatal outcomes in the context of such racial/ethnic disparities is reviewed. The risk factors reviewed are prenatal care, folic acid use, periodontal care, infant sleep position, breastfeeding, well-child care, interconceptional care, maternal smoking, alcohol and other drug use, adolescent pregnancy, perinatal depression, stress, bacterial vaginosis, domestic violence, and maternal birthweight. Key findings are:

- Compared to women of other races/ethnicities, Black women have the lowest rates of preventive behaviors associated with improved birth outcomes. These behaviors include entering prenatal care during the first or second trimester, using folic acid, receiving periodontal care, putting infants to sleep on their back, breastfeeding, completing child vaccinations, and spacing births a year or more apart. Black women also have higher rates of adolescent pregnancies, stress, bacterial vaginosis, and domestic violence during pregnancy. These risk factors are recognized as being associated with preterm birth/low birthweight, the cause of infant mortality for which Blacks are at highest risk.

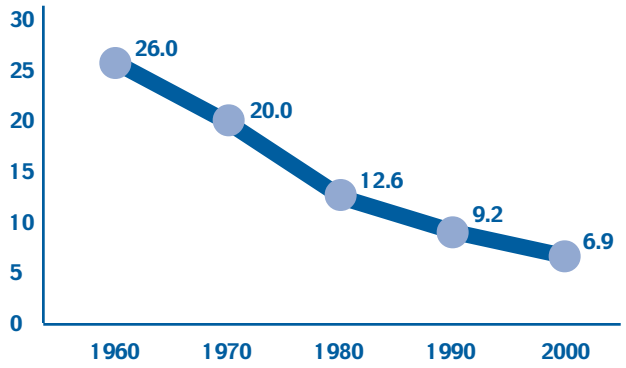
Compared to other races/ethnicities, American Indian/Alaska Natives have the highest prevalence for risk factors associated with sudden infant death syndrome, such as smoking and alcohol use during pregnancy, and putting infants to sleep in the prone position.

These findings provide an evidence base for designing and evaluating initiatives – such as Healthy Start – that are intended to reduce or eliminate disparities in maternal and infant health outcomes.

Chapter I
Introduction

Infant mortality often is used as an international indicator of the health and well-being of a nation. It provides a quick measure of the quality of food and water, housing and clothing, health care, and education available in a population (Reidpath and Allotey 2003). The United States, despite being the largest, most technologically advanced economy in the world, ranks 37th of 191 countries in infant mortality (Appendix A, Table A.1) (World Health Organization 2004). Although the rate of infant mortality in the United States declined by 74 percent over the four decades between 1960 and 2000, to 6.9 infant deaths per 1,000 live births (Figure I.1), the degree of decline has slowed in the past decade (Centers for Disease Control and Prevention 2004b). In the 1990s, the rate of infant mortality decreased by 22 percent, compared to 27 percent and 37 percent in the 1980s and 1970s, respectively (Figure I.1). Much of the decrease in the 1970s and 1980s was due to technological advances in high-risk obstetrics and neonatal intensive care (Wise 2003). More recently, technological strides in neonatal health have slowed, making it more challenging to create the large rates of decline seen previously in the United States.

Figure I.1.
Infant Mortality Rate: United States, 1960 – 2000

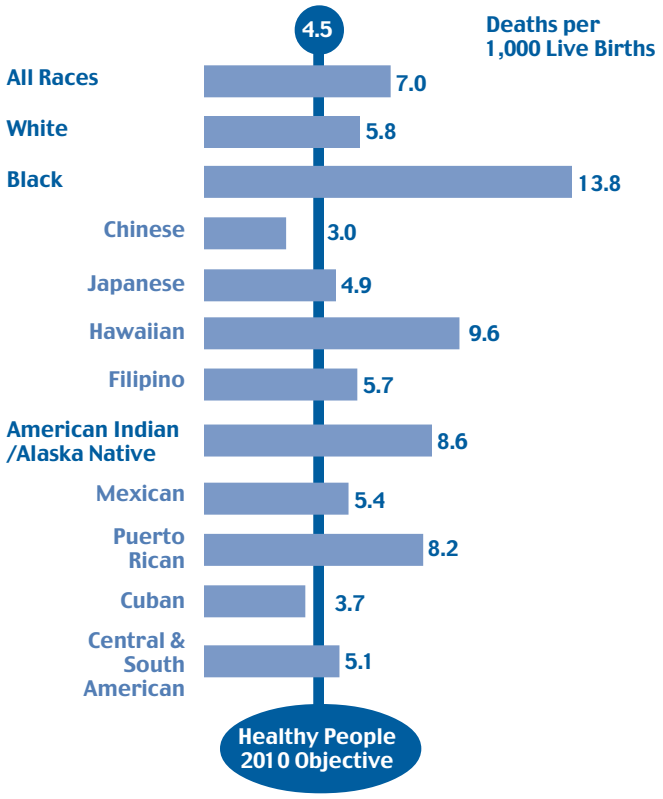


Source: Centers for Disease Control and Prevention 2004b.

Although it is more difficult to achieve the magnitude of decreases in infant mortality today that occurred in previous decades, the United States' world ranking in infant mortality suggests that there is still progress to be made. Experts in neonatal health attribute this ranking to the prevalence of poor birth outcomes among certain racial and ethnic groups in the United States, particularly Black, American Indian/Alaska Native, and Puerto Rican populations. The rate of infant mortality is notably higher among these three racial/ethnic groups than the national average (Figure I.2). For example, in 2002, infants born to Black women were twice as likely to die in their first year than infants overall in the United States. In that same year, American Indian/Alaska Natives and Puerto Ricans had infant mortality rates 15 percent above the national average. Hawaiians also had a rate above the national average. However, as shown in Table II.2, the rate for Hawaiians fluctuates below and above the national average from year to year, likely due to small sample size.

In response to these racial/ethnic disparities, the U.S. Department of Health and Human Services has set a goal to reduce infant mortality to less than 4.5 infant deaths per 1,000 births among all racial/ethnic groups in its Healthy People 2010 objectives (U.S. Department of Health and Human Services 2000a). Although infant mortality rates for people in the United States of Cuban and Chinese ancestry

Figure I.2.
Infant Mortality Rate by Race/Ethnicity: U.S. 2002



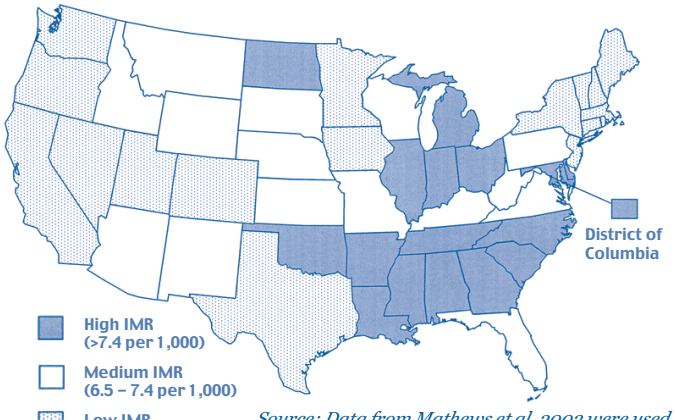
Source: Mathews et al. 2004.

are already below the Healthy People 2010 goal, those who are Black, Puerto Rican, Hawaiian, and American Indian/Alaska Native have a rate of 8.2 infant deaths per 1,000 births or higher (Figure I.2). This relationship holds at the State level as well. For all States in 2001, Blacks and American Indian/Alaska Natives consistently have higher infant mortality rates than Whites, while Asian/Pacific Islanders consistently have lower rates (Appendix A, Table A.2).

High rates of infant mortality tend to be concentrated in the South and North Central regions of the United States (Figure I.3). Those States with higher overall rates of infant mortality also tend to have larger racial/ethnic disparities in infant mortality. For example, when States are divided into thirds by infant mortality rate, States in the lowest tertile (less than 6.5 infant deaths per 1,000 live births) had an average difference in rate between Whites and Blacks of 6.3 infant deaths per 1,000 live births. In comparison, States with rates greater than 7.4 infant deaths per 1,000 live births (highest tertile) had an average difference in rate between Whites and Blacks of 8.4 infant deaths per 1,000 live births (Appendix A, Tables A.2 and A.3).

The Institute of Medicine's (IOM) report, *Unequal Treatment: Confronting Racial and Ethnic Disparities in Healthcare*, offers some insight into the causes of the racial/ethnic disparities in infant mortality (Institute of Medicine 2003). In this report, the IOM attributed the racial/ethnic disparities in health care and, consequently, health to lower health care quality and access for minorities. The IOM reviewed more than 100 studies assessing the health care quality for various minority groups. It consistently found evidence that minorities are less likely than Whites to receive needed services and are more likely to receive less desirable services. The research also showed that disparities are present even when controlling for clinical factors. Although minorities are disproportionately represented among the uninsured and those of lower socioeconomic status, the IOM noted that these factors are not the cause of poorer quality of health care

Figure I.3.
Infant Mortality Rate by Race/Ethnicity: U.S. 2002



Source: Data from Mathews et al. 2003 were used to create State tertiles. Note: Detailed data are shown in Appendix A, Table A.2.

among minorities. Even when minorities have the same health insurance as nonminorities, and similar access to care, minorities still tend to receive a

Table I.1.
Infant Mortality Rate, by Race/Ethnicity and Educational Attainment of Mother: United States, 2002

Race and Ethnicity	Rate per 1,000 Live Births				
	Educational Attainment of Mother				
	0 to 8 years	9 to 11 years	12 years	13 to 15 years	16 years & more
All Races and Ethnicities	6.6	9.6	7.8	6.0	4.2
RACE					
• White	6.1	8.0	6.5	4.9	3.7
• Black	14.7	15.8	13.4	11.7	9.9
• Asian/Pacific Islander	4.0	5.9	5.6	4.7	3.7
• American Indian/Alaska Native	*	8.3	9.1	8.6	*
ETHNICITY					
• All Hispanics	5.3	6.1	5.6	4.9	4.0
–Mexican	5.1	5.7	5.3	5.0	4.1
–Puerto Rican	11.5	9.7	8.8	6.0	3.9
–Cuban	*	*	*	*	*
–Central & South American	5.8	6.0	4.7	4.3	4.4
• White non-Hispanic	9.9	9.9	6.9	4.8	3.7
• Black non-Hispanic	15.2	15.9	13.6	11.9	10.0

Source: Mathews et al. 2004.

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

lower quality of care and have poorer outcomes than Whites (Institute of Medicine 2003). When education is used as a proxy for socioeconomic level, Blacks, American Indian/Alaska Natives, and Puerto Ricans continue to have the highest rates of infant mortality compared to other races/ethnicities, regardless of socioeconomic level (Table I.1).

The IOM proposes that the sources of racial/ethnic disparities in health are "complex, rooted in historic and contemporary inequities, and involve many participants at several levels, including health systems, health professionals, and patients" (Institute of Medicine 2003). Many factors other than socioeconomic and clinical ones contribute to the problem. These factors include minority behavior and attitudes, cultural and language barriers within health systems, and patients' and providers' lack of knowledge. As a result, the IOM promotes a comprehensive, multilevel approach to eliminating disparities that targets patients, providers, and health care systems. This approach includes (1) raising awareness of the problem among the public and health care professionals; (2) employing health systems interventions to equalize and promote high-quality care for all patients; (3) implementing legal, policy, and regulatory improvements to increase minority access to care and reduce cultural barriers to care; and (4) increasing the education of patients and providers.

Healthy Start is a federally-sponsored, commu-

nity-based program that works on many levels to eliminate racial/ethnic disparities in infant mortality. The program recognizes the complex nature of racial/ethnic disparities in health and the need to address other factors besides socioeconomic and clinical ones. The goal of Healthy Start is to improve perinatal system access and knowledge by providing culturally competent services, including outreach, health education, and case management, and by enhancing the local perinatal health system. The activities of the Healthy Start program are designed to encourage pregnant and interconceptional women, providers, and other community stakeholders to address the risk factors associated with poor perinatal health outcomes. Healthy Start relies on community involvement to lead to better access to care and knowledge of perinatal risks for high-risk women, which should in turn bring about improved birth outcomes and ultimately eliminate racial/ethnic disparities in infant mortality.

In this paper, an evidence base for Healthy Start and other perinatal health initiatives is provided by describing in detail the racial/ethnic disparities in birth outcomes and the risk factors that may be the underlying causes of differences in birth outcomes. To gather this information, a literature review of infant mortality trends and risk factors among various racial/ethnic groups was conducted. The National Vital Statistics Reports was used, and Pubmed, Ovid, and the Internet were searched using key words related to racial/ethnic disparities in infant mortality, causes of infant mortality, and its associated risk factors. Data were amassed from many sources, including vital statistics, peer-reviewed journal articles, and press releases and reports from organizations such as the Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH), and the IOM.

Because data cited in this paper are from different sources, categorizations of race and ethnicity on the tables and figures vary. While some sources categorized race and ethnicity separately (for example, White and Black, Hispanic and non-Hispanic), others grouped race and ethnicity together (for example, White non-Hispanic, Black non-Hispanic, and Hispanic). Unless explicitly stated as non-Hispanic, White and Black include both Hispanics and non-Hispanics. When possible, race and ethnicity are presented separately. For consistency, African Americans are referred to as Black, and Caucasians are referred to as White.

For comparison and consistency, year 2002 data are presented whenever possible, because, in most cases, 2002 is the most recent year for which data are available. In a few cases, however, data are shown for years before 2002 and are aggregated over several years. Appendix A contains tables with detailed data used to create the figures in the paper. Appendix B provides a glossary defining terms used in the paper that relate to birth outcomes.

Chapter II
Racial/Ethnic Disparities in Birth Outcomes

Racial/ethnic differences in infant mortality are evident in trends over time and in the leading causes of infant death. Investigating these patterns can provide insight into these disparities. This chapter first presents racial/ethnic trends in rates of infant mortality. It then describes infant mortality rates during the neonatal and postneonatal period by race and ethnicity to offer a deeper understanding of how racial/ethnic disparities in birth outcomes show up at different times in an infant's life. Infant mortality trends are examined from 1995 to 2002; 1995 is the earliest year with racial/ethnic infant mortality data publicly available through the National Center for Health Statistics, while 2002 is the latest year with data available by racial/ethnic groups, including White, Black, Asian/Pacific Islander, American Indian/Alaska Native, and Hispanic.

RACIAL/ETHNIC TRENDS IN INFANT MORTALITY

OVERALL TRENDS

Decreases in infant mortality rates were observed for most racial and ethnic groups from 1995 to 2002, but the magnitude of the change varied by group. Significant decreases were observed for White (7.9 percent), Black (5.5 percent), Asian/Pacific Islander (9.4 percent), and Hispanic (11.1 percent) populations (Table II.1). The infant mortality rate decreased among American Indian/Alaska Natives by 4.4 percent during this period, although the change was not statistically significant. The large decrease in infant mortality among the Hispanic population was driven by those of Cuban (30.2 percent) and Mexican (10.0 percent) descent. Although Hispanics as a group had a lower rate of infant mortality than the overall U.S. rate, women of Puerto Rican descent had an infant mortality rate higher than the national average for all years reported.

Despite significant declines in the rate of infant mortality for most racial/ethnic groups, the racial/ethnic disparity in rates did not change between 1995 and 2002 (Table II.1). For each year during this period, the rate of infant mortality for Blacks overall and Black non-Hispanics was 2.3 times that of Whites. In addition, for each year during this period, American Indian/Alaska Natives had an infant mortality rate ranging from 1.4 to 1.7 times that of Whites, while Puerto Ricans had a rate ranging from 1.3 to 1.5 times that of Whites. The ratio between White non-Hispanic and Hispanic infant mortality rates was similar and remained stable for all years.[1]

[1]As shown in Table II.1 (page 10), the infant mortality rate increased slightly from 2001 to 2002. The increase was spread among most race and Hispanic origin groups. The increase is attributed, in large part, to an increase in the number of very low birthweight infants (less than 750 grams). Among the other possible explanations for the slight rise in infant mortality are: (1) increase reporting of early fetal deaths; (2) extent of mothers' medical risk factors (including maternal anemia, diabetes, and chronic hypertension); and (3) changes in the medical management of pregnancy (such as cesarean deliveries) (MacDorman et al. 2005).

Table II.1.
Infant Mortality Rate, by Race/Ethnicity: United States, 1995 – 2002

Race and Ethnicity	Rate per 1,000 Live Births								Percent Change 1995 to 2002
	1995	1996	1997	1998	1999	2000	2001	2002	
All Races and Ethnicities	7.6	7.3	7.2	7.2	7.0	6.9	6.8	7.0	-7.9*
RACE									
• White	6.3	6.1	6.0	6.0	5.8	5.7	5.7	5.8	-7.9*
• Black	14.6	14.1	13.7	13.8	14.0	13.5	13.3	13.8	-5.5*
• Asian/Pacific Islander	5.3	5.2	5.0	5.5	4.8	4.9	4.7	4.8	-9.4*
–Chinese	3.8	3.2	3.1	4.0	2.9	3.5	3.2	3.0	-21.1
–Japanese	5.3	4.2	5.3	3.5	3.4	4.5	4.0	4.9	-7.5
–Hawaiian	6.6	5.6	9.0	10.0	7.1	9.0	7.3	9.6	45.5
–Filipino	5.6	5.8	5.8	6.2	5.8	5.7	5.5	5.7	1.8
• American Indian/ Alaska Native	9.0	10.0	8.7	9.3	9.3	8.3	9.7	8.6	-4.4
ETHNICITY									
• All Hispanics	6.3	6.1	6.0	5.8	5.7	5.6	5.4	5.6	-11.1*
–Mexican	6.0	5.8	5.8	5.6	5.5	5.4	5.2	5.4	-10.0*
–Puerto Rican	8.9	8.6	7.9	7.8	8.3	8.2	8.5	8.2	-7.9
–Cuban	5.3	5.1	5.5	3.6	4.7	4.6	4.2	3.7	-30.2
–Central & South American	5.5	5.0	5.5	5.3	4.7	4.6	5.0	5.1	-7.3
• Non-Hispanic White	6.3	6.0	6.0	6.0	5.8	5.7	5.7	5.8	-7.9*
• Non-Hispanic Black	14.7	14.2	13.7	13.9	14.1	13.6	13.5	13.9	-5.4*

Source: Mathews et al. 2004.

**Significant difference at p<0.05. Note: Hispanic includes both White and Black Hispanics.*

NEONATAL AND POSTNEONATAL MORTALITY

Racial/ethnic trends for neonatal and postneonatal death rates are similar to overall rates of infant mortality–Blacks, American Indian/Alaska Natives, and Puerto Ricans continue to have the highest rates of all races and ethnicities (Table II.2). American Indian/Alaska Natives have one of the highest rates of postneonatal mortality while they have a neonatal mortality rate lower than the rates for all races/ethnicities combined. These results indicate that racial/ethnic disparities in infant mortality among American Indian/Alaska Natives are largely driven by infant deaths occurring after the first month of birth. The opposite is true for Puerto Ricans–they have a neonatal infant death rate 23 percent higher than the overall rate for all races and ethnicities and a postneonatal rate only 4 percent above the overall rate. For Blacks, the racial/ethnic disparities in infant mortality are equally attributable to neonatal and postneonatal mortality rates–both neonatal and postneonatal mortality rates for Blacks are nearly twice the rates for all races/ethnicities combined.

Table II.2.
Infant, Neonatal, and Postneonatal Mortality Rate, by Race/Ethnicity: United States, 2002

	Rate per 1,000 Live Births		
	INFANT	NEONATAL	POSTNEONATAL
All Races and Ethnicities	**7.0**	**4.7**	**2.3**
RACE			
• White	5.8	3.9	1.9
• Black	13.8	9.3	4.5
• Asian/Pacific Islander	4.8	3.4	1.4
–Chinese	3.0	2.4	0.7
–Japanese	4.9	3.7	*
–Hawaiian	9.6	5.6	4.0
–Filipino	5.7	4.1	1.7
• American Indian/ Alaska Native	8.6	4.6	4.0
ETHNICITY			
• All Hispanics	5.6	3.8	1.8
–Mexican	5.4	3.6	1.8
–Puerto Rican	8.2	5.8	2.4
–Cuban	3.7	3.2	*
–Central & South American	5.1	3.5	1.6
• Non-Hispanic White	5.8	3.9	1.9
• Non-Hispanic Black	13.9	9.3	4.6

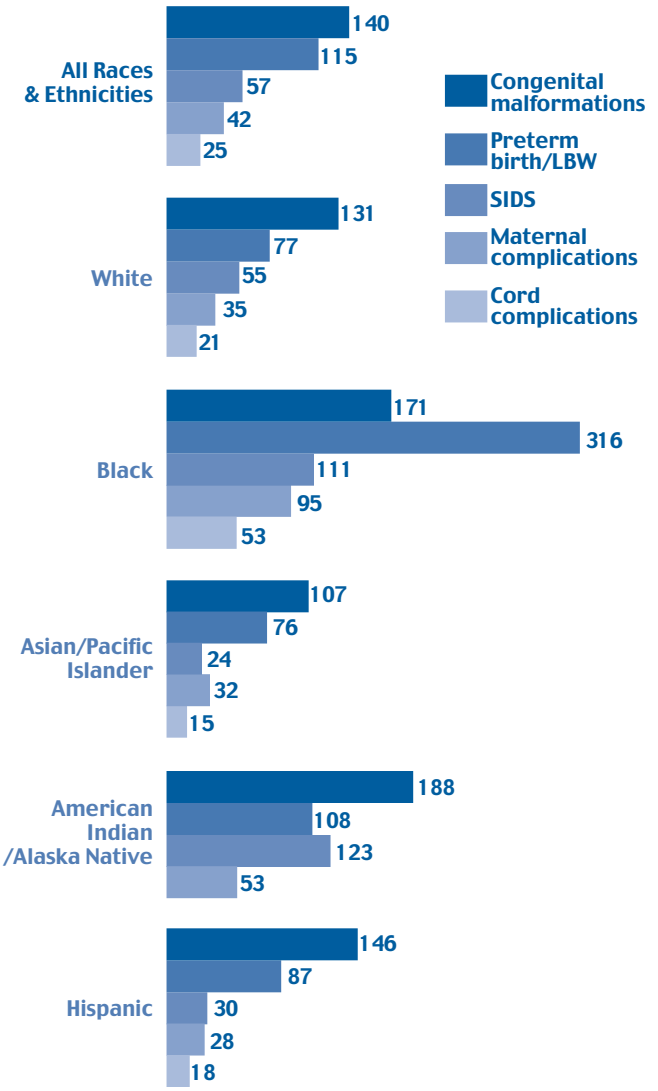
Source: Mathews et al. 2004.

**The figure does not meet standard of reliability or precision, based on fewer than 20 deaths in the numerator.*

CAUSES OF INFANT DEATH

In 2002, the five principal causes of infant mortality accounted for 55 percent of all infant deaths (Mathews et al. 2004). The five leading causes, in descending order, are: (1) congenital malformations, (2) preterm birth/low birthweight, (3) sudden infant death syndrome, (4) maternal complications, and (5) cord complications. Congenital malformations, the leading cause of infant mortality, contributed to 20 percent of all deaths. The second largest cause, disorders relating to short gestation (less than 37 weeks) and low birthweight (less than 2500 grams), accounted for another 17 percent of mortality. Eight percent of deaths were attributable to sudden infant death syndrome (SIDS). Newborns affected by maternal complications of pregnancy and complications of placenta, cord, and membrane explained another six and four percent of infant deaths, respectively.

Figure II.1.
Infant Mortality Rate for the Five Leading Causes of Infant Death, by Race/Ethnicity: U.S. 2002



Source: Mathews et al. 2004.

Notes: For American Indian/Alaska Natives, infant mortality rates due to cord complications were not reported because there were fewer than 20 deaths in the numerator. "Black" and "White" categories exclude women of Hispanic origin. Detailed data are shown in Appendix A, Table A.5.

Cause of death varied by race/ethnicity. Congenital malformations were the leading cause of death for White, Hispanic, Asian/Pacific Islander, and American Indian/Alaska Native populations in 2002, but preterm birth/low birthweight was the leading cause among the Black population (Figure II.1). Unlike other races/ethnicities, American Indian/Alaska Natives had SIDS as the second leading cause of infant mortality.

The variability in cause of infant death across racial/ethnic groups may help identify the areas where interventions to reduce disparities and improve birth outcomes would be most effective. For example, although Black women had higher infant mortality rates than White women for all five leading causes of infant mortality, the largest difference in rates between the two groups was for preterm birth/low birthweight infants–infants born to Black women had an infant death rate due to preterm birth/low birthweight four times higher than those born to White women (Figure II.1). This infant mortality pattern is consistent with the prevalence of preterm birth/low birthweight among the two races; Black infants are almost two times more likely than White ones to be born preterm/low birthweight (Martin et al. 2002b) (Appendix Table A.6). Preterm birth/low birthweight accounted for 30 percent of the disparity in infant mortality rates between White and Black infants, while SIDS and maternal complications accounted for seven percent each

(Mathews et al. 2004). In addition, although the rate of infant mortality decreased for Blacks between 1995 and 2002, the rate of low birthweight births among Blacks remained stable during this period (Table II.3), as did deaths attributable to low birthweight/preterm births (data not shown).

Table II.3.
Low Birthweight, by Race/Ethnicity: United States, 1995 – 2002

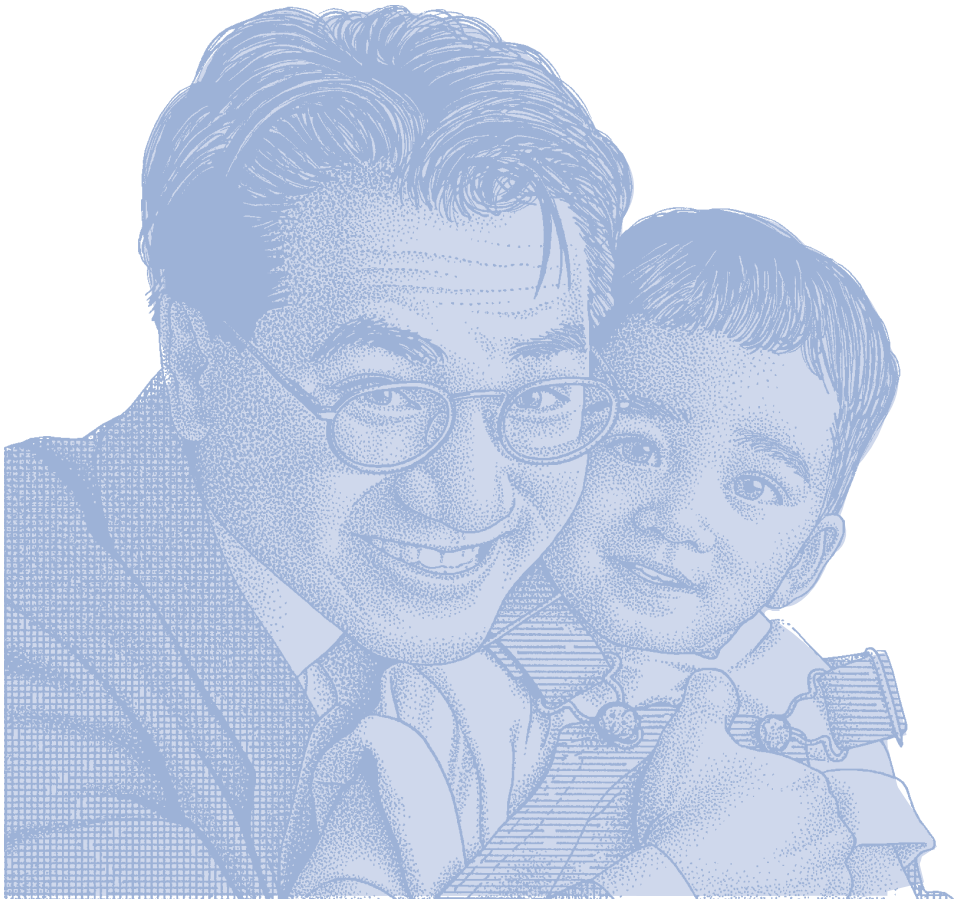
	Percent of Live Births								
Race and Ethnicity	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**Percent Change 1995 to 2002**
All Races and Ethnicities	7.3	7.4	7.5	7.6	7.6	7.6	7.7	7.8	6.8
RACE									
• White	6.2	6.3	6.5	6.5	6.6	6.5	6.7	6.8	9.7
• Black	13.1	13.0	13.0	13.0	13.1	13.0	13.0	13.3	1.5
• Asian/Pacific Islander	6.9	7.1	7.2	7.4	7.4	7.3	7.5	7.8	13.0
–Chinese	5.3	5.0	5.1	5.3	5.2	5.1	5.3	5.5	3.8
–Japanese	7.3	7.3	6.8	7.5	7.9	7.1	7.3	7.6	4.1
–Hawaiian	6.8	6.8	7.2	7.2	7.7	6.8	7.9	8.1	19.1
–Filipino	7.8	7.9	8.3	8.2	8.3	8.5	8.7	8.6	10.3
• American Indian/ Alaska Native	6.6	6.5	6.8	6.8	7.1	6.8	7.3	7.2	9.1
ETHNICITY									
• All Hispanics	6.3	6.3	6.4	6.4	6.4	6.4	6.5	6.5	3.1
–Mexican	5.8	5.9	6.0	6.0	5.9	6.0	6.1	6.2	6.9
–Puerto Rican	9.4	9.2	9.4	9.7	9.3	9.3	9.3	9.7	3.2
–Cuban	6.5	6.5	6.8	6.5	6.8	6.5	6.5	6.5	0.0
–Central & South American	6.2	6.0	6.3	6.5	6.4	6.3	6.5	6.5	4.8
• Non-Hispanic White	6.2	6.4	6.5	6.6	6.6	6.6	6.8	6.9	11.2
• Non-Hispanic Black	13.2	13.1	13.1	13.2	13.2	13.1	13.1	13.4	1.5

Source: MacDorman et al. 1998a, MacDorman et al. 1998b, Ventura et al. 1999, Ventura et al. 2000, Ventura et al. 2001, Martin et al. 2002a, Martin et al. 2002b, Martin et al. 2003.

Note: See Appendix A, Table A.7 and A.8 for trends in preterm birth and very low birthweight by race and ethnicity.

This pattern suggests that focusing on the prevention of preterm birth/low birthweight among Black infants could have a large impact on reducing racial/ethnic disparities in infant mortality.

Similarly, American Indian/Alaska Natives had the highest proportion of infant deaths attributable to SIDS; the infant death rate among this group was 2.2 times that of Whites (Figure II.1). This implies that concentrating on the reduction of SIDS among American Indian/Alaska Natives could decrease the disparity in infant mortality between the two groups by 24 percent (Mathews et al. 2004). Likewise, if Puerto Rican infant deaths due to congenital malformations, preterm birth/low birthweight, and maternal complications were reduced to the levels of White infants, the difference in their infant mortality rates would be cut in half (data not shown). In Chapter III the risk factors underlying poor birth outcomes, and the racial/ethnic disparities in these risk factors, are discussed.



Chapter III
Risk Factors for Poor Birth Outcomes

Eliminating racial/ethnic disparities in perinatal outcomes requires thorough knowledge of their causes. Researchers suggest that several factors contribute to racial/ethnic disparities in perinatal health: stress, environment, genetics, economic resources and socioeconomic status, health behavior, access to and availability of health care services, and quality of health care (Hogan et al. 2001). In this chapter, evidence on the behavioral, biological, and social risk factors for poor perinatal outcomes in the context of racial/ethnic disparities is presented. Table III.1 lists the risk factors discussed. In categorizing risk factors as behavioral, biological, and social, the interdependent nature of risk factors between and within categories is recognized. For example, a biological risk factor such as depression can lead to behavioral risk factors, such as alcohol use and smoking during pregnancy. As a result, the risk factors in relationship to each other are discussed whenever possible. The inter-related quality of these risk factors also makes it challenging to pinpoint the direct contribution of each factor to poor birth outcomes. Adding to this challenge is women's possible self-selection to certain risk groups (such as those receiving late or no prenatal care). Therefore, no attempt is made to draw direct causal relationships between risk factors and adverse birth outcomes, but a link between the two, acknowledging the influence of other factors is illustrated.

This chapter provides insight into areas where targeted maternal and child health interventions through programs, such as Healthy Start, could help reduce racial/ethnic disparities in birth outcomes. Therefore, issues related to socioeconomics, clinical practice, genetics, and access to health care are not directly discussed. However, these issues in relation to the risk factors presented in the chapter is acknowledged. For example, some behavioral factors, such as getting early prenatal care and obtaining well child visits, can be influenced by a woman's ability to access this care and her knowledge about such care. Despite these multiple influences on a

Table III.1.
Behavioral and Biological/Social Risk Factors for Poor Birth Outcomes

Behavioral Risk Factors		Biological/Social Risk Factors
PREVENTIVE BEHAVIORS	**RISKY BEHAVIORS**	
Prenatal Care	Maternal Smoking	Perinatal Depression
Folic Acid Use	Alcohol & Other Drug Use	Stress
Periodontal Care	Adolescent Pregnancy	Bacterial Vaginosis
Infant Sleep Position		Domestic Violence
Breastfeeding		Maternal Birthweight
Well-Child Care		
Interconceptional Care		

woman's ultimate behavior, this discussion emphasizes the need for interventions and systems to encourage, support, and reinforce positive perinatal behaviors.

BEHAVIORAL RISK FACTORS

PREVENTIVE BEHAVIORS

Prenatal Care

The American College of Obstetricians and Gynecologists recommends that all pregnant women initiate prenatal care in the first trimester and continue care at specified intervals throughout pregnancy (Beck et al. 2002). Lack of prenatal care is associated with an increased risk of preterm birth, low birthweight, and infant death (Beck et al. 2002). From 1995 to 2002, women who had no prenatal care consistently had approximately five times the risk of infant death of women who received prenatal care during any trimester (Table III.2).

The link between prenatal care and adverse birth outcomes is not fully understood, but research indicates that early, regular prenatal care is associated with a decreased risk of poor birth outcomes (Vintzileos et al. 2002a, 2002b). Examination of trimester when prenatal care began by race/ethnicity demonstrates that Whites and Asian/Pacific Islanders had the highest percentages of women who initiated prenatal care in the first trimester; American Indian/Alaska Natives and Blacks had the highest proportions of women who received late or no prenatal care in 2002 (Table III.3).

The racial/ethnic pattern of late or no prenatal care parallels infant mortality rates; Blacks and American Indian/Alaska Natives have both the highest rates of late or no prenatal care and the highest rates of infant mortality. When infant mortality is stratified by when trimester of pregnancy when prenatal care began, however, Blacks and American Indian/Alaska Natives have higher rates of infant mortality, regardless of timing of prenatal care (Table III.4). This suggests that differences in prenatal care only partially explain differences in infant mortality. Regardless of the causal link, prenatal care offers an opportunity for early risk assessment, intervention, and monitoring among those at risk for adverse birth outcomes.

Folic Acid Use

Neural tube defects (NTD) occur in approximately one per 1,000 births in the United States. It is estimated that adequate levels of folic acid one month before conception and through the first trimester of pregnancy could prevent 50 to 70 percent of these defects (Centers for Disease Control and

Table III.2.
Infant Mortality Rate, by Trimester Prenatal Care Began: United States, 2002

	Infant Death Rate per 1,000 Live Births							
	1995	1996	1997	1998	1999	2000	2001	2002
• First Trimester	6.6	6.5	6.3	6.3	6.2	6.1	6.2	6.2
• Second Trimester	8.0	7.7	7.6	7.7	7.2	7.2	6.9	7.3
• Third Trimester	7.5	6.7	6.6	6.1	6.2	6.1	6.0	6.0
• No Prenatal Care	37.9	35.2	35.6	35.2	34.6	33.8	34.8	38.4

Source: MacDorman and Atkinson 1998a, MacDorman and Atkinson 1998b, MacDorman and Atkinson 1999, Mathews et al. 2000, Mathews et al. 2002a, Mathews et al. 2002b, Mathews et al. 2003, Mathews et al. 2004.

Table III.3.
Women Beginning Prenatal Care in the First Trimester and with Late or No Prenatal Care, by Race/Ethnicity: United States, 2002

	PERCENT							
	RACE					ETHNICITY		
	All	White	Black	Asian/ Pacific Islander	American Indian/ Alaska Native	Hispanic	White Non-Hispanic	Black Non-Hispanic
First Trimester	83.7	85.4	75.2	84.8	69.8	76.7	88.6	75.2
Second Trimester	12.4	11.3	18.1	n/a	n/a	17.4	9.0	18.1
Late* or No Prenatal Care	3.6	3.1	6.2	3.1	8.0	5.5	2.2	6.2
Unknown	0.3	0.2	0.5	n/a	n/a	0.4	0.2	0.5

*Source: Martin et al. 2003. *Care beginning in the third trimester.*

Table III.4.
Infant Mortality Rate, by Race/Ethnicity and Trimester Began Prenatal Care: United States, 2002

	PERCENT							
	RACE					ETHNICITY		
	All	White	Black	Asian/ Pacific Islander	American Indian/ Alaska Native	Hispanic	White Non-Hispanic	Black Non-Hispanic
First Trimester	6.2	5.2	12.8	4.4	7.9	5.3	5.2	12.9
Second Trimester	7.3	6.5	10.5	4.3	8.9	5.2	7.4	10.5
Third Trimester	6.0	4.9	9.3	4.5	**	3.4	6.1	9.5
Late* or No Prenatal Care	38.4	29.9	58.0	30.5	**	23.0	36.4	57.9

*Source: Martin et al. 2004. *Care beginning in the third trimester. **The figure does not meet standard of reliability or precision, based on fewer than 20 deaths in the numerator.*

Prevention 1999a). NTDs were responsible for 1.4 percent of all infant deaths in 2000 (Williams et al. 2003). In addition, they are associated with spontaneous abortions and low birthweight/prematurity. Between 1996 and 1998, 74 percent of NTD-specific deaths were low birthweight, and 58 percent were preterm (Davidoff et al. 2002). [2]

The Healthy People 2010 goal is for 80 percent of women of child-bearing age to consume at least 400 micrograms of folic acid daily. Approximately only one in three women in the United States consume this amount (American Academy of Pediatrics 1999, Centers for Disease Control and Prevention 2005). Folic acid use was highest among White non-Hispanic women and lowest among Black non-Hispanic women

[2] *Reported infant mortality rates do not account for spontaneous abortions.*

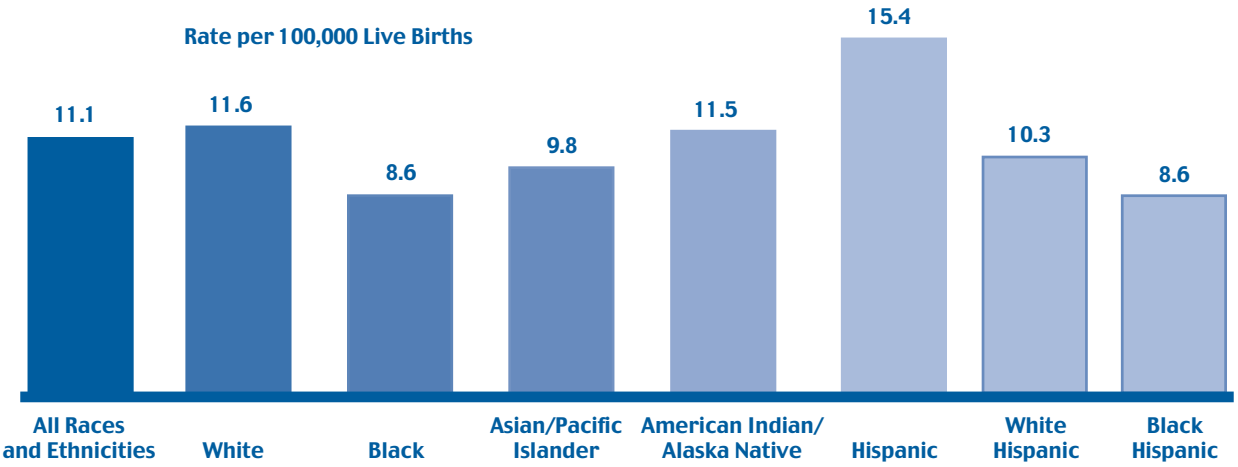
(Centers for Disease Control and Prevention 2002a).

Despite having lower levels of folic acid use, Black women had a lower NTD-specific infant mortality rate than White, Asian/Pacific Islander, and American Indian/Alaska Native women (Figure III.1). Black women had a rate of NTD-specific infant death of 8.6 per 100,000 live births, compared to 11.6, 9.8, and 11.5 for White, Asian/Pacific Islander, and American Indian/Alaska Native women, respectively. Infant mortality rates do not take into account spontaneous abortions that could be associated with NTD (Petrini et al. 2002). Therefore, the discrepancy in NTD-specific mortality rates between Blacks and Whites, in particular, could be connected to Black women having a higher rate of spontaneous fetal loss than White women; in 1999, 19.4 of 1,000 Black non-Hispanic women experienced fetal loss, compared to 14.8 of 1,000 White non-Hispanic women (Ventura et al. 2003). Further research is needed to examine this potential explanation.

Periodontal Care

Studies have shown that pregnant women with periodontal disease may be up to seven times more likely to deliver a preterm/low birthweight infant than those without such disease (American Academy of Periodontology 2004). Hormone changes during pregnancy, especially in the second and third trimesters, can cause a greater reaction to dental plaque, resulting in increased swelling, bleeding, and redness of the gums leading to periodontal disease. The disease may contribute to as many as 45,000 (18 percent) of the preterm births that occur every year (Offenbach et al. 1996). This is more than the preterm births attributed to alcohol consumption and tobacco use combined.

Figure III.1.
NTD–Specific Infant Mortality, by Race/Ethnicity: United States, 1996–1998



Source: Davidoff et al. 2002. Note: Detailed data are shown in Appendix A, Table A.9.

Lower socioeconomic and minority status are associated with untreated periodontal disease. For example, Blacks and American Indian/Alaska Natives have a higher prevalence of periodontal disease than Whites, with Blacks having the highest rate of periodontal disease of all races/ethnicities (Skrepcinski and Niendorff 2000). In addition, the disparity in the rate of disease between White and Black populations has increased since 1971 (Borrell et al. 2002). In general, Blacks are less likely to use dental services, which may increase the rate of periodontal disease or exacerbate its severity (Doty and Weech-Maldonado 2003).

Infant Sleep Position

SIDS is the leading cause of postneonatal mortality and the third leading cause of all infant

mortality in the United States, accounting for approximately eight percent of all infant deaths (Mathews et al. 2004). Infant sleep position and sleep environment have been identified as modifiable factors that can help reduce the risk of SIDS. Although SIDS declined almost 35 percent between 1995 and 2002 to 57.1 per 100,000 live births, experts are concerned about disparities in the rate of SIDS among different racial/ethnic groups (Table III.5) (Centers for Disease Control and Prevention 1996). As noted in Chapter II, American Indian/Alaska Native infants are more than twice as likely as White infants to die of SIDS, and Black infants have a SIDS rate more than twice the national average and that of Whites. The rate of SIDS among Blacks has also decreased at a lower rate than in the overall population. Despite having a SIDS rate below that of Blacks and American Indian/Alaska Natives for all years between 1997 and 2001, Puerto Ricans were the only racial/ethnic group for which the rate of SIDS increased during this time period.

Variations in infant sleep position may explain some of the disparity in the SIDS rate. A study conducted between 1994 and 1998 showed that 32 percent of Black mothers, compared to 17 percent of other mothers, place their infants to sleep in the prone position (on the stomach) (Willinger et al. 2000). Black infants who die of SIDS also have a higher prevalence of bed sharing and using bed surfaces other than those specifically designed and approved for infant use, as well as other risk factors for SIDS, such as smoking in the home, than White infants (Unger et al. 2003). Among American Indian/Alaska Natives, 16 to 24 percent put their babies to sleep on their stomach (U.S. Department of Health and Human Services 1998). American Indian/Alaska Native infants also have an increased risk of SIDS because their mothers are more likely than other mothers to binge drink during the first trimester of pregnancy; binge drinking increases the risk of SIDS eightfold among American Indian/Alaska Natives (Iyasu et al. 2002).

The Back to Sleep campaign, started in 1994, spreads awareness about the importance of sleep position in the reduction of SIDS and racial/ethnic

Table III.5.
SIDS Rate, by Race/Ethnicity: United States, 1995 – 2002

	Rate per 100,000 Live Births								
Race and Ethnicity	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**Percent Change 1995 to 2002**
All Races and Ethnicities	87.2	78.5	77.2	71.7	66.8	62.1	55.5	57.1	-34.5
RACE									
● White	72.3	64.3	64.8	59.5	55.6	51.8	45.6	55.2	-23.7
● Black	166.6	153.8	143.2	137.9	129.9	122.1	113.5	110.9	-33.4
● Asian/Pacific Islander	49.9	44.0	51.2	39.4	31.0	29.4	18.5	24.3	-51.3
● American Indian/ Alaska Native	206.6	203.3	155.6	151.5	146.9	120.0	145.7	123.3	-40.3
ETHNICITY									
● All Hispanics	47.7	48.5	46.5	37.4	37.2	34.3	27.1	29.7	-37.7
–Mexican			46.9	38.0	33.3	31.8	23.2	28.8	
–Puerto Rican			59.5	41.8	66.5	63.7	76.4	54.3	
–Central & South American			40.0	20.4	*	26.5	*	20.8	

**The figure does not meet standard of reliability or precision, based on fewer than 20 deaths in the numerator. — Data not available.*
Source: MacDorman and Atkinson 1998a, MacDorman and Atkinson 1998b, MacDorman and Atkinson 1999, Mathews et al. 2000, Mathews et al. 2002a, Mathews et al. 2002b, Mathews et al. 2003, Mathews et al. 2004. Notes: "Black" and "White" categories exclude women of Hispanic origin.

disparities in SIDS. Providers also play an important role in SIDS reduction by influencing the behavior of new mothers. In examining the relationship between information sources and SIDS risk behavior, specific instruction by a nurse or doctor in the hospital about how to properly place the infant for sleep positively influenced behavior after the mother left the hospital (Rasinski et al. 2003).

Breastfeeding

Breastfeeding provides nutritional and immunological benefits to the baby during and after the first year of life (U.S. Department of Health and Human Services 2000b). The American Academy of Pediatrics and the World Health Organization recommend that women breastfeed their infants for at least 1 year to reduce the incidence of acute illnesses (such as diarrhea, ear infections, pneumonia, and meningitis) and chronic diseases (such as SIDS, obesity, childhood leukemia, and asthma) (American Academy of Pediatrics 2004; Wolf 2003). Data from the 1988 National Maternal and Infant Health Survey of women with a live birth or infant death in 1988 showed that infants who were ever breastfed[3] had a 21 percent decreased odds of postneonatal death, compared to infants who were not ever breastfed (Chen and Rogan 2004). After controlling for demographic and socioeconomic characteristics, the study also found that breastfeeding reduced the odds of postneonatal deaths regardless of race. However, the magnitude of breastfeeding's impact on postneonatal death differed between Black and non-Black populations. Breastfeeding decreased the odds of postneonatal death by 31 percent among Black infants, while it reduced the odds by 19 percent among non-Black infants.

Between 1971 and 2001, breastfeeding rates increased in the early postpartum period from 25 percent to 70 percent and at 6 months postpartum from 5 percent to 33 percent (Ryan et al. 2002). However, these breastfeeding rates are still below Healthy People 2010 objectives of 75 percent of women breastfeeding in the early postpartum period and 50 percent at 6 months (U.S. Department of Health and Human Services 2000a). The breastfeeding rate at 1 year in 2001 was 12 percent, which also is lower than the Healthy People 2010 goal of 25 percent at 1 year (Li et al. 2003; U.S. Department of Health and Human Services 2000a).

In particular, Black women have consistently lower rates of breastfeeding than do White and Hispanic women. A report based on the 2004 National Immunization Survey indicated that 71.5 percent of non-Hispanic White children were ever breastfed in comparison to 50.1 percent of non-Hispanic Black children (Centers for Disease Control and Prevention 2006). Continuing to breastfeed until at least 6 months of age was also higher among White non-Hispanic women (53.9 percent) than Black non-Hispanic women (43.2 percent). In addition, the 1988-1994 National Health and Nutrition Examination Survey of women with children ages 12 to 71 months found that 26 percent of Black women had ever breastfed their infant, compared to 60 percent of White women and 55 percent of Mexican American women (Li and Grummer-Strawn 2002). Results from the 2001 Ross Laboratory Mothers Survey of women with infants ages 6 to 12 months and the 2001 National Immunization Survey of women with children ages 19 to 35 months showed that Black women had lower rates than White and Hispanic women of ever breastfeeding in hospital, at 6 months, and at 12 months (Ryan et al. 2002; Li et al. 2003).

According to results from the 1988 National Maternal and Infant Health Survey, Black women in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) were also less likely than White women to receive breastfeeding

[3] *Infants were considered "ever-breastfed" if their mother answered "yes" to the 1988 National Maternal and Infant Health Survey Question, "Did you ever breastfeed this infant?"*

advice from WIC counselors and more likely to receive bottle-feeding education from them (Beal et al. 2003). The disparity in breastfeeding behavior between Blacks and Whites who received breastfeeding advice was smaller than that between Blacks and Whites who did not receive advice, suggesting that increased education may help narrow the gap in breastfeeding practices.

Well-Child Care (Up to Two Years Old)

Health maintenance and preventive health care are important to a child's well-being after birth. Due to a combination of medical advances and public health measures, the overall health status of children in the United States has improved considerably during the past several decades. Mortality between 1950 and 1987 was reduced by 63 percent for children ages 1 to 4, and well-child visits promoting vaccinations and other preventive health measures significantly contributed to this improvement (Middleton and Schroeder 2002).

The American Academy of Pediatrics and the American Board of Family Practice recommend 11 well-child visits from birth to age 2 on the following schedule: at birth; at one week; and at 1, 2, 4, 6, 9,

Table III.6.
Vaccination Coverage Among Children 19–35 Months of Age, by Race/Ethnicity: United States, 1999

	PERCENT					
	All	White non-Hispanic	Black non Hispanic	Asian/Pacific Islander	American Indian/ Alaska Native	Hispanic
DTP (3 doses)[a]	95.9	96.6	94.4	96.5	94.7	95.1
DTP (4 doses)[b]	83.3	85.5	79.0	86.8	80.2	80.2
Polio[c]	89.6	90.3	87.0	90.1	88.2	89.4
MMR/MCV[d]	91.5	92.4	89.8	92.7	91.7	90.2
Hib[e]	93.5	94.8	91.8	90.2	91.4	92.0
Hepatitis B[f]	88.1	88.9	86.5	88.2	*	87.3
Varicella[g]	57.5	56.0	57.6	84.0	*	60.5
DTP (3 doses)[a], polio[c], MCV[d]	86.1	87.2	83.2	86.5	84.0	85.1
DTP (4 doses)[b], polio[c], MCV[d]	79.9	82.0	75.1	82.4	77.6	77.3
DTP (4 doses)[b], polio[c], MCV[d], Hib[e]	78.4	81.0	73.8	77.4	75.0	74.9
DTP (4 doses)[b], polio[c], MCV[d], Hib[e], Hep B[f]	73.2	75.6	69.4	73.4	*	69.6

Source: Lumen ET et al. 2001.

*Notes: *Estimate was not available because the unweighted sample size for the numerator was <30 or (confidence interval half wid th)/ Estimate<0.5 or (confidence interval half width)>10. Combined Hispanic and Non-Hispanic White and Black rates were not available.*

[a] *Three or more doses of any diphtheria and tetanus toxoids and pertussis vaccines including diptheria and tetanus toxoids, and any acellular pertussis vaccine (DTP/DTa/DT).*

[b] *Four or more doses of any diphtheria and tetanus toxoids and pertussis vaccines including diptheria and tetanus toxoids, and any acellular pertussis vaccine (DTP/DTa/DT).*

[c] *Three or more doses of any poliovirus vaccine.*

[d] *One or more doses of measles-mumps-rubella vaccine, previous reports of vaccination were for measles-containing vaccine (MCV).*

[e] *Three or more doses of Haemophilus influenza type B (Hib) vaccine.*

[f] *Three or more doses of hepatitis B vaccine.*

[g] *One or more doses of varicella at or after child's first birthday, unadjusted for history of varicella illness.*

12, 15, 18, and 24 months. Childhood vaccinations given during these visits have had a major impact on the reduction and elimination of many causes of childhood morbidity and mortality. For example, smallpox has been eradicated, and polio has been eliminated in the United States. Measles and Haemophilus influenza type b (Hib) have also been reduced to record low numbers (Centers for Disease Control and Prevention 1999b).

Currently, the CDC recommends that all infants finish the series of vaccinations shown in Table III.6 by age 2 (Centers for Disease Control and Prevention 2004c). In 1999, 73 percent of children ages 19 to 35 months met these recommendations (Table III.6, last row). Compliance with vaccination varies by race/ethnicity; in general, White non-Hispanic and Asian/Pacific Islanders had slightly higher rates of vaccination than Black non-Hispanics and American Indians/Alaska Natives. Researchers also found that racial/ethnic disparities in childhood vaccination were not driven by socioeconomic status; regardless of income level, Black non-Hispanics had the lowest rates of vaccination for DTP, polio, MMR, and hepatitis B compared to other populations (Barker and Lumen 2001; Lumen et al. 2001). They also had the lowest completion rate of the vaccination series. No racial/ethnic group has met the Healthy People 2010 objective to have 90 percent of all children ages 19 to 35 months complete the vaccination series which indicates that there is room for improvement for all groups (U.S. Department of Health and Human Services 2000a).

Interconceptional Care

The IOM notes, "One of the best protections available against low birthweight and other poor pregnancy outcomes is to have women actively plan for pregnancy, enter pregnancy in good health with as few risk factors as possible, and be fully informed about her reproductive and general health" (Institute of Medicine 1985). Experts suggest that, to restore the maternal nutritional resources necessary for a healthy pregnancy, it is essential to have one or more years between the birth of one infant and the conception of another (Klerman et al. 1998). Studies have shown that nearly a quarter of pregnant women have an interpregnancy period of less than a year (Zhu et al. 2001; James et al. 1999; Russo et al. 1993). Short interpregnancy intervals are associated with late entry into prenatal care, low birthweight, premature birth, and other poor pregnancy outcomes. Williams et al. (2003) found that, compared to infants born following an interpregnancy interval of less than 6 months, infants born to women who became pregnant 18 to 59 months after a prior birth had a lower risk of dying, being born preterm, being small for gestational age, or having low birthweight. Another study showed that infants born to women who become pregnant less than 6 months after delivery have three times the risk of infant death due to intentional injury, a 74 percent increased risk of unintentional injuries, and a 55 percent increased risk of SIDS (Easton 1999).

Black and Native American women have the highest rates of short interpregnancy intervals, compared to other racial/ethnic groups. From 1981 to 1989, 30 percent of Native American pregnancies were conceived less than a year after a prior birth, compared to 19 percent of pregnancies among White non-Hispanics (Khoshnood et al. 1998). Studies have shown that Black women are twice as likely as White women to have an interpregnancy period of 6 months or less (James et al. 1999; Zhu et al. 2001). Even among Black and White women with interpregnancy periods of 6 months or less, Blacks still had a higher rate of preterm birth than Whites. Although this suggests that other risk factors may act in conjunction with a short interpregnancy period to cause disparities in birth outcomes, having an adequate interpregnancy period may protect against poor birth outcomes for all women.

Risky Behaviors

Maternal Smoking

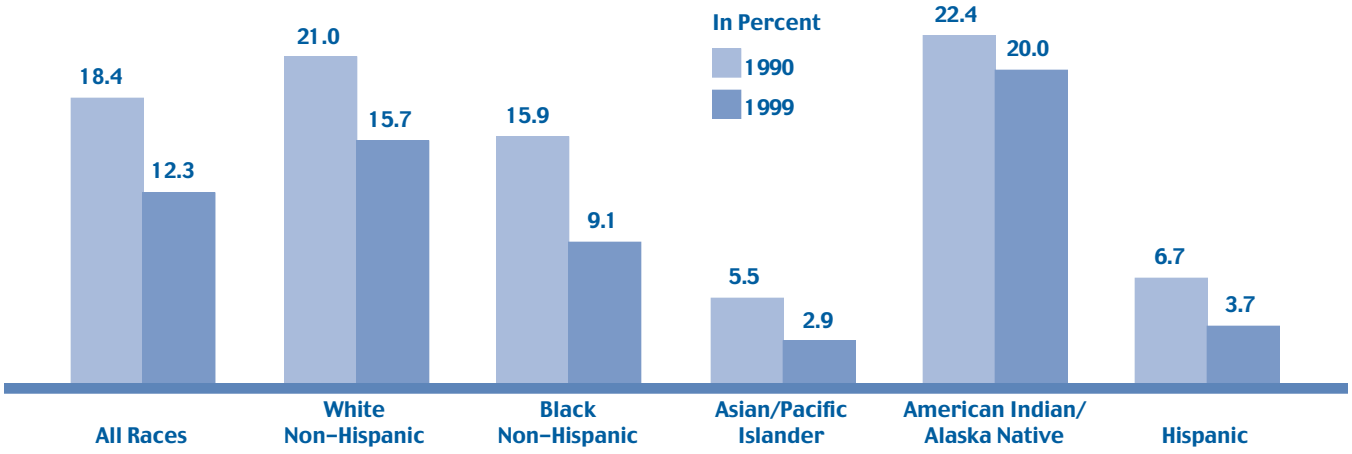
Research suggests that infants born to women who smoke cigarettes during pregnancy have a 40 percent higher risk of death in their first year than infants whose mothers did not smoke (Salihu et al. 2003). In the United States, an estimated five percent of infant mortality is attributable to smoking, with variation among different races and ethnicities. Smoking during pregnancy contributes to many adverse outcomes, including ectopic pregnancy, fetal death, stillbirth, spontaneous abortion, low birthweight, preterm delivery, SIDS, intrauterine growth retardation, placenta previa, abruptio placenta, and premature rupture of membranes. Morbidity and mortality increase with the amount of cigarettes consumed prenatally (Salihu et al. 2003).

Although the overall rate of smoking during pregnancy declined 33 percent between 1990 and 1999, more than 10 percent of women reported smoking during pregnancy in 1999 (Figure III.2). Rates of reported smoking were the highest among American Indian/Alaska Natives, who also had the lowest rate of decrease in reported smoking during pregnancy between 1990 and 1999. All other races and ethnicities reduced the reported rate of smoking during pregnancy by more than 20 percent, while American Indian/Alaska Natives reduced their reported rate by 11 percent.

The high rate of smoking during pregnancy among American Indian/Alaska Natives may contribute to their high rate of SIDS. However, due to the interaction of smoking with other factors that contribute to adverse birth outcomes, the direct impact of smoking during pregnancy on infant mortality is difficult to tease out. For example, why does smoking during pregnancy differentially affect infant survival across racial/ethnic groups? Smoking among Whites is associated with a 85 percent increased risk of infant mortality, while it is associated with an increased risk of 53, 147, and 57 percent among Blacks, Asian/Pacific Islanders, and American Indian/Alaska Natives, respectively (Figure III.3). It is difficult to understand the direct effect of smoking on birth outcomes, but it is clear that, for all racial/ethnic groups, women who smoked during pregnancy had higher rates of infant mortality than women who did not smoke.

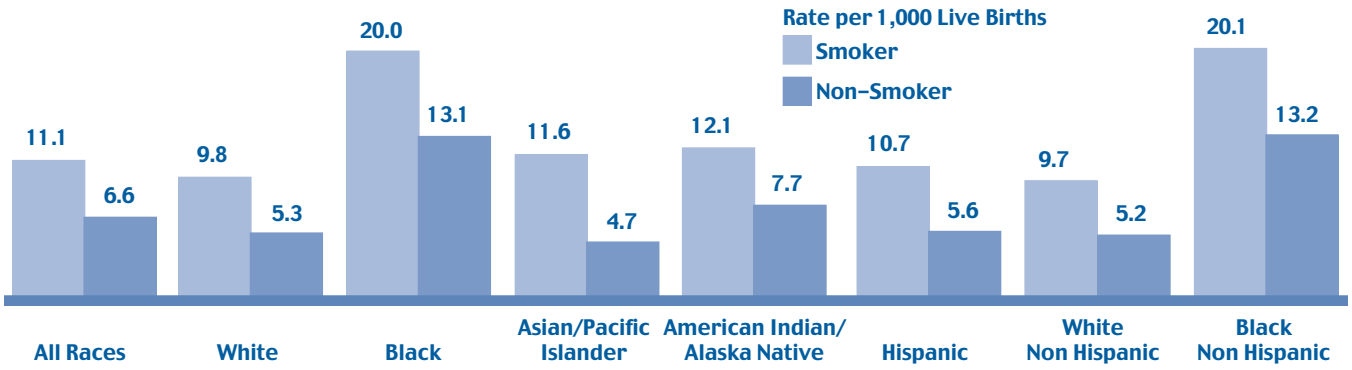
In addition to the adverse effect that smoking during pregnancy has on infants, smoke exposure after birth also has negative impacts on infant health.

Figure III.2.
Women Who Reported Smoking During Pregnancy, by Race/Ethnicity: United States, 1999



Source: Mathews 2001.
Notes: Excludes California, Indiana, New York State, and South Dakota. Combined Hispanic and Non-Hispanic White and Black percents were not available. Detailed data are shown in Appendix A, Table A.10.

Figure III.3.
Infant Mortality Rate, by Maternal Smoking Status and Race/Ethnicity: United States, 2002



Source: Mathews et al. 2004. Notes: Detailed data are shown in Appendix A, Table A.11.

Research has shown that secondhand cigarette smoke exposure increases the risk of respiratory illnesses among infants. Such illnesses, including asthma and lower respiratory tract infections, can lead to respiratory distress, the sixth leading causes of infant mortality in 2002 (DiFranza and Lew 1996). Although the overall rate of secondhand smoke exposure among infants has not been precisely measured, examination of smoking behavior by race shows that American Indian/Alaska Natives have the highest rate of tobacco use in comparison to other races and ethnicities (Table III.7).

To encourage pregnant and non-pregnant women of all races/ethnicities to stop smoking, the U.S. Public Health Service sponsors a best practice guideline called the "5 A's" (U.S. Surgeon General 2005). The "5 A's" guideline includes five steps to identify tobacco users and implement appropriate interventions based on their willingness to quit. The five major steps to intervention are: (1) ask about smoking status; (2) advise in a clear, strong, and personalized manner why the person should quit; (3) assess the willingness of the person to quit; (4) assist the person using counseling and pharmacotherapy if they are willing to quit; and (5) arrange for follow-up with the person. This guideline provides a conceptual framework for interventions to motivate pregnant and non-pregnant women to quit smoking.

Alcohol and Other Drug Use During Pregnancy

Drinking alcohol during the first seven months of pregnancy is associated with preterm delivery and low birthweight (Lundsberg et al. 1997). Though the risk of having poor birth outcomes rises with increas-

Table III.7.
Reported Tobacco Use by Race/Ethnicity: United States, 2003

	PERCENT WITH TOBACCO USE		
	Ever	During Past Year	During Past Month
All Races and Ethnicities	**72.7**	**35.1**	**29.8**
• White non-Hispanic	78.1	37.0	31.6
• Black non-Hispanic	63.3	34.0	30.0
• Asian	45.3	18.3	13.8
• Native Hawaiian/Pacific Islander	60.6	42.0	37.0
• American Indian/Alaska Native	79.4	48.4	41.8
• Hispanic	59.9	29.8	23.7

Source: U.S. Department of Health and Human Services 2004. Note: Tobacco use is reported for those age 12 and older.

ing alcohol use, any fetal alcohol exposure puts a fetus at risk for developing fetal alcohol syndrome.[4] Fetal alcohol exposure is the leading cause of preventable birth defects and developmental disorders in the United States. As many as 1 in 100 children in the United States are believed to be affected by fetal alcohol exposure, although fetal alcohol syndrome is 100 percent preventable (Meschke et al. 2003).

Data from the CDC's Birth Defects Monitoring Program showed that fetal alcohol syndrome increased fourfold between 1979 and 1992, to 3.7 cases per 10,000 live births (Centers for Disease Control and Prevention 2003a). In 1992, Behavioral Risk Factor Surveillance System data indicated that more than 12.4 percent of women reported drinking alcohol during pregnancy (Centers for Disease Control and Prevention 2002b). Since 1992, the prevalence of reported alcohol use among pregnant women has increased slightly, to 12.8 percent in 1999, and decreased slightly, to 12.5 percent in 2001 (Centers for Disease Control and Prevention 2002b; Floyd and Sidhu 2004). According to data reported on birth certificates, alcohol use during pregnancy was more frequent among American Indian/Alaska Natives than any other racial/ethnic group (Table III.8); they had three times the alcohol use rate during pregnancy of any other racial/ethnic group. Black and White women had the second-highest rate of alcohol use, while Hispanics had the lowest rate.

Table III.8.
Reported Alcohol Use During Pregancy, by Race/Ethnicity: United States, 2002

Race and Ethnicity	Percent Reporting Alcohol Use During Pregnancy
All Races and Ethnicities	**0.8**
RACE	
● White	0.8
● Black	0.9
● Asian/Pacific Islander	0.3
–Chinese	0.1
–Japanese	0.8
–Hawaiian	1.1
–Filipino	0.4
● American Indian/Alaska Native	2.5
ETHNICITY	
● All Hispanics	0.5
–Mexican	0.5
–Puerto Rican	0.7
–Cuban	0.3
–Central and South American	0.3
● White non-Hispanic	0.9
● Black non-Hispanic	0.9

Source: Martin et al. 2003.

The rate of fetal alcohol syndrome among different racial/ethnic groups follows a pattern similar to that of alcohol use among these groups during pregnancy. In 1994, the CDC's National Institute of Alcohol Abuse and Alcoholism reported that American Indian/Alaska Natives had more than four times the rate of fetal alcohol syndrome (30 cases per 10,000 births) than any other group; Black women had the second-highest rate (6 cases per 10,000 births) (Meschke et al. 2003). In contrast, Whites had an incidence of 0.9 cases per 10,000 births, followed by Hispanics (0.8 cases per 10,000 births) and Asian/Pacific Islanders (0.3 cases per 10,000 births).

Use of other substances, such as cocaine, marijuana, or other illicit drugs[5], during pregnancy is another risk factor for preterm, low birthweight, and very low birthweight births (Blatt et al. 2000). Women who use drugs such as cocaine during pregnancy have more than twice the odds of delivering a

[4] Fetal alcohol syndrome is defined as a group of symptoms caused by a pregnant woman's consumption of alcohol. These symptoms include abnormal facial features, growth impairment, problems with learning, memory, attention span, problem solving, speech, and hearing.

[5] Illicit drugs are controlled substances that possess a high potential for abuse, have no currently accepted medical use in the United States, and demonstrate a lack of accepted safety for use under medical supervision (U.S. Department of Health and Human Services 2004). Controlled substances so defined fall under seven headings: marijuana (marijuana, hashish); stimulants (amphetamines, cocaine); depressants (barbiturates, tranquilizers, hypnotics); hallucinogens (acid, PCP); opiates, or narcotics (heroin, morphine, opium, codeine); inhalants (sprays, solvents, glue); and designer drugs (synthetic drugs similar in effect to stimulants, hallucinogens, and narcotics). To be used legally and safely, some of these drugs must be prescribed by a physician. This list is not comprehensive; omitted substance may be illegal and may fall under the designation of controlled substances.

preterm, low birthweight, or very low birthweight baby as pregnant women who do not use any substances (Blatt et al. 2000; March of Dimes 2004). Women who use cocaine during pregnancy are also twice as likely as women who do not to have an infant die of SIDS and five times more likely to have a baby with a birth defect. Substance users are more likely than non-users to miss prenatal care appointments (Funai et al. 2003).

According to the Substance Abuse and Mental Health Services Administration's 2000 and 2001 National Household Survey on Drug Abuse, 3.7 percent of women reported using illicit drugs during pregnancy (U.S. Department of Health and Human Services 2002). Of the women who reported any illicit drug use during pregnancy, 70 percent reported using marijuana, and 8 percent reported using cocaine. Of those who used illicit drugs during pregnancy, more than half also smoked cigarettes or drank alcohol (Shahul and Gfroerer 2003).

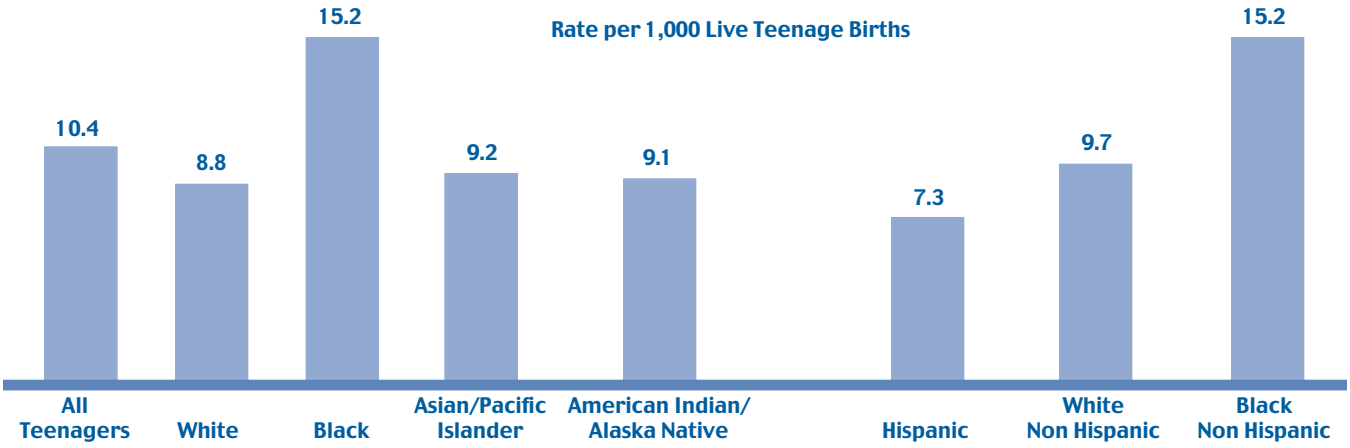
Drug use varies by race/ethnicity, with non-White women being almost twice as likely as White women to use illicit drugs (Kelly et al. 2002). Drug use during pregnancy has a differential impact on racial/ethnic groups; Black women who report illicit substance use had approximately a twofold increase in odds of delivering a preterm, low birthweight, or very low birthweight infant, compared to White women who reported illicit substance use (Kelly et al. 2002; March of Dimes 2004). This implies that drug use, like smoking, may be associated with other risk factors for poor perinatal outcomes.

Adolescent Pregnancy

Every year in the United States, more than 800,000 adolescent girls ages 15 to 19 become pregnant (Ventura et al. 2004). The rate of teenage pregnancy declined by nearly 10 percent between 1990 and 2000, to 104 pregnancies per 1,000 teenagers. However, the rate of births to adolescents in the United States still ranks much higher than that of most other developed countries, such as Sweden, France, Canada, and Great Britain (Darroch et al. 2001). In 2001, there were 43.5 births per 1,000 teenagers in the United States (Hamilton et al. 2003). Children born to teenagers have an increased risk of low birthweight, prematurity, intrauterine growth retardation, congenital malformations, and infant death (Cunnington 2001). Before controlling for demographic factors, adolescents have an infant mortality rate 1.6 times that of women older than age 20 (Mathews et al. 2004). When controlling for race and ethnicity, White and Asian/Pacific Islander teenagers have more than two times the infant mortality rate of their older counterparts, while Black and American Indian/Alaska Native teenagers have rates of infant mortality comparable to those of their older counterparts; Hispanic teenagers have 1.4 times the rate of their older counterparts (Mathews et al. 2004) (Appendix A, Table A.12). Although these results indicate that the risk of teenage pregnancy varies by race, pregnant teenagers are more likely than pregnant adults to have health behaviors that lead to poor birth outcomes, regardless of race (Elfenbein and Felice 2003). For example, they are less likely to gain adequate weight during pregnancy, take recommended daily vitamins during pregnancy, have good eating habits, and seek prenatal care. They are also more likely to smoke, drink alcohol, or take drugs and to have a shorter interpregnancy interval.

Black teenagers have nearly three times the pregnancy rate of White teenagers, and Hispanic teenagers have twice the rate of White teenagers (Ventura et al. 2004). Infants born to Black teenagers also have a higher rate of infant mortality than those born to White teenagers (Figure III.4). However, Hispanic teenagers have lower rates of infant mortality than White teenagers, although they had a higher number of pregnancies. The high teenage Hispanic birth rate and low infant mortality rate suggest that the risky behaviors associated with teenage pregnancy may be mitigated by other factors, such as culture. For example, one study found that the Mexican culture had

Figure III.4.
Infant Mortality Rate Among Teenagers Younger than 20 by Race/Ethnicity: United States, 2002



Source: Mathews et al. 2004.

a positive impact on birth outcomes (Jenny et al. 2001). That study also found that Mexican American infants born in counties with a high concentration of Mexican births to women of Mexican descent that is, a higher exposure to those with traditional Mexican pregnancy and child-rearing practices had lower mortality rates than Mexican American women without such exposure.

BIOLOGICAL/SOCIAL RISK FACTORS

PERINATAL DEPRESSION

Untreated depression during pregnancy is associated with adverse fetal outcomes. These include spontaneous abortion, preterm delivery, need for special neonatal care, increased uterine artery resistance, small head circumference, low APGAR scores, neonatal growth retardation, high cortisol levels at birth, maternal hypertension, and preeclampsia (Bonari et al. 2004). Mental illness can affect a pregnant woman's functional status and her ability to obtain prenatal care, eat properly, take prenatal vitamins, and avoid dangerous behavior, such as smoking, drinking alcohol, and using illicit drugs (Bonari et al. 2004; Zuckerman et al. 1989). In addition, research has shown that depression can negatively affect women's parenting behavior, which has implications for their children's health (Kavanaugh et al. 2006).

Approximately 10 percent of women in the United States have depressive symptoms during pregnancy. For a third of these women, it represents their first episode of major depression (Nonacs and Cohen 2003). The prevalence of depression is higher among those of low socioeconomic status (Hobfoll and Ritter 1995). Studies have not conclusively shown a relationship between race and depression during pregnancy; however, one study found that, in general, Blacks and Hispanics exhibit elevated rates of depression compared to Whites (Dunlop et al. 2003).

STRESS

Stress during pregnancy has been shown to significantly increase rates of prematurity and low birthweight (Copper et al. 1996). According to a study of 2,593 pregnant women performed through the Maternal-Fetal Medicine Units Network of NIH, women who experience stress during pregnancy, as measured by a 28-item Likert scale, are at 1.16 and 1.08 higher odds for delivering premature and low

birthweight infants, respectively, than women who do not experience stress during pregnancy. Behaviors further increasing the risk of prematurity and low birthweight, such as smoking, substance abuse, and poor weight gain during pregnancy, have been reported to be more prevalent among women who are under stress. In addition, it has been hypothesized that psychological distress may cause the secretion of placental corticotropin, releasing hormone (CRH) that can lead to increased susceptibility to infections, such as bacterial vaginosis (Kramer et al. 2001).

Exposure to psychosocial stressors among Black women in an urban setting has been shown to significantly increase the occurrence of low birthweight (Orr et al. 1996). This may be due to factors such as smoking, substance abuse, prevalence of infection, or poverty; the exact mechanism is not well understood.

BACTERIAL VAGINOSIS

Between 25 and 60 percent of preterm births are attributable to maternal infections that can lead to infant morbidity and mortality (Flynn et al. 1999). One such infection, bacterial vaginosis (BV), is estimated to be prevalent in 16 percent of pregnant women and 10 to 30 percent of nonpregnant women (Hillier et al. 1995). The vaginal flora imbalance that occurs with BV has been associated with preterm delivery, low birthweight, premature rupture of membranes, infection of the chorion and amnion, and infection of the amniotic fluid. Women with BV during pregnancy have 1.4 times the odds of delivering a low birthweight infant of pregnant women who do not have BV (Hillier et al. 1995). Preterm delivery among those with BV can be reduced by 18 percent with antibiotic prophylaxis (Hauth et al. 1995).

Abstaining from douching and reducing stress during pregnancy can also significantly decrease BV (Culhane et al. 2001; Holzman et al. 2001). A study conducted through the NIH and the CDC's National Survey of Family Growth found that Black women have higher rates than White and Hispanic women of vaginal douching, and have higher levels of stress (Copper et al. 1996; Centers for Disease Control and Prevention 2003b). Both douching and stress may contribute to pregnant Black women having three times the prevalence of BV than White women (Fiscella 2004; Paige et al. 1998).

DOMESTIC VIOLENCE

Research conducted in the United States between 1963 and 1995 reveals that up to 20 percent of women experience domestic violence during pregnancy (Gazmararian et al. 1996; Coker et al. 2004). The Pregnancy Risk Assessment Monitoring System found that, in 17 States surveyed, non-White women, Hispanic women, and women with Medicaid were consistently at higher risk of physical abuse by a husband or partner than their White, non-Hispanic, and non-Medicaid counterparts (Centers for Disease Control and Prevention 2002c). Physical abuse at this time can cause maternal and infant morbidity and mortality. Research suggests that physical violence during pregnancy is associated with an increased risk of antepartum hemorrhage, intrauterine growth restriction, and perinatal death. Rates of low birthweight among battered women are also 1.5 to 2.5 times higher than those of nonbattered women, and rates of preterm birth are 2.5 to 4.0 times higher (Gazmararian et al. 1996; Neggers et al. 2004). A recent study shows that women who experienced intimate partner violence during pregnancy had 3.8 times the odds of antepartum hemorrhage, 3.1 times the odds of intrauterine growth restriction, and 8.1 times the odds of perinatal death of women who did not experience such violence (Janssen et al. 2003). Physical abuse during pregnancy has also been found to be associated with many other risk factors for infant mortality, such as inadequate prenatal care, smoking, substance abuse, mental health-related illness, and

short interpregnancy interval (Curry et al. 1998; Lipsky et al. 2004).

MATERNAL BIRTHWEIGHT

Maternal birthweight has been suggested as a determinant of low infant birthweight and preterm delivery. Research has shown that women who were themselves born at a low birthweight or preterm are at significantly higher risk for having low birthweight or preterm infants than women who were not low birthweight or preterm (Coutinho et al. 1997; Porter et al. 1997; Sanderson et al. 1995; Wang et al. 1995). One study in Buffalo, New York, found that, compared to women who weighed 8.0 pounds at birth, women who weighed 6.0 to 7.9 pounds at birth and women who weighed 4.0 to 5.9 pounds at birth had 1.7 and 3.5 greater odds of delivering a low birthweight infant, respectively (Klenbanoff et al. 1984). Sanderson et al. (1995) found that, although both White and Black women who were low birthweight themselves were at higher risk of delivering low birthweight infants, only Black women who weighed less than 4.0 pounds at birth had significantly greater risk of delivering a normal birthweight infant who subsequently died before reaching 1 year of age. These researchers also demonstrated that higher prepregnancy weight and height among women born low birthweight reduced the risk of low birthweight deliveries. Such results suggest that, although low maternal birthweight plays an important role in birth outcomes, other factors may also mitigate the effects of maternal low birthweight and prematurity.

Birthweight may appear to be a genetically transmitted characteristic because of its seeming intergenerational trend; however, recurring and similar social and environmental stress across generations could cause familial clustering of low birthweight. Lu and Halfron (2003) examined the link between poor maternal and infant birth outcomes in the context of a life course perspective. These researchers proposed a model where there are critical periods in a woman's reproductive life when she is more vulnerable to risk factors and more amenable to protective factors. The earliest of these sensitive periods occurs when the baby grows in the mother's womb. Consequently, if a woman is exposed to risks during her time in utero, her reproductive potential will be adversely affected and could result in poor birth outcomes for herself and her own infant. In addition, if she continues to experience other stresses during her life, which are likely similar to the stresses her mother experienced, her risk of having an infant with poor birth outcomes may increase.

This life course perspective suggests that, because a woman's birth outcome and subsequent pregnancies are influenced by the accumulated life exposure of her mother and female ancestors before her, a short period of intervention during the pregnancy period may not be able to cause a dramatic decrease in the risk of poor birth outcomes. According to this model, the racial/ethnic disparities in birth outcomes we see today can be explained by many lifetimes of amassed racism, poverty, and stress. Many social and environmental risk factors need to be addressed during the birth, childhood, puberty, and young adulthood of a woman to influence her infant's birth outcome, but intervening during the pregnancy and interpregnancy period remains key to improving birth outcomes; targeting women during, and immediately after, pregnancy is a way to identify high-risk women and address their risks to improve outcomes for future generations (Kotelchuck 2003).

Chapter IV
Discussion

Trends in racial/ethnic disparities in infant mortality are consistent with the racial/ethnic patterns found in causes of infant mortality. Blacks and American Indian/Alaska Natives had the highest rate of infant mortality in 2002. Blacks had the highest rate of neonatal mortality while American Indian/Alaska Natives had one of the highest rates of postneonatal deaths. During the same year, preterm birth/low birthweight was the leading cause of neonatal mortality and Blacks had the highest rate of preterm birth/low birthweight. SIDS was the leading cause of postneonatal deaths in 2002; American Indians had the highest rate of SIDS.

The congruency in the data does not end with the racial/ethnic trends in infant mortality and causes of death. The racial/ethnic trends in causes of infant mortality correspond to the patterns of the risk factors for poor birth outcomes. For example, risk factors associated with preterm birth and low birthweight, such as late or no prenatal care, drug abuse, stress, depression, and bacterial vaginosis, are more prevalent among Blacks. Similarly, American Indian/Alaska Native women have the highest rates for risk factors associated with SIDS, such as smoking and binge drinking during pregnancy. Such data suggest that targeted interventions for these risk factors can help improve birth outcomes in the target population and reduce racial/ethnic disparities in infant mortality.

This paper has the same limitations as many literature reviews. For example, among the sources used for the paper, there were variations in research methods, categorizations of race/ethnicity, and years of information available. Moreover, using data from different sources made it difficult to isolate the direct contribution of each behavioral, biological, and social factor to the racial/ethnic disparities in infant mortality. For example, it would be interesting to further investigate the role that discrimination, genetic predisposition, life course, culture, or behavior play in producing the long-standing racial/ethnic disparities in birth outcomes.

Shiono et al. (1997) have studied the influence of many factors on ethnic differences in birthweight. Few researchers, however, have conducted similar studies that further the understanding of how behavioral, biological, and social factors affect racial/ethnic disparities in birth outcomes. The study by Shiono et al. (1997) controlled for 21 social, medical, socioeconomic, and psychological factors. It found that impoverished living environments, feelings of helplessness, and unstable social support were negatively associated with birthweight (that is, better living environments, feelings of hope, and stable social supports were associated with higher birthweight). Future studies to support such findings or provide further information about the mechanisms through which these factors affect birth outcomes will help researchers, health care providers, and other stakeholders to better understand the interplay between risk factors and birth outcomes.

Nevertheless, the data presented in this paper provide insight into the racial and ethnic trends in birth outcomes and the risk factors contributing to these outcomes. By showing how the factors associated with poor birth outcomes are associated with racial/disparities in birth outcomes, this information offers evidence to support targeted maternal and child interventions, such as those performed by Healthy Start and other perinatal health initiatives, to reduce racial and ethnic disparities in infant mortality.

Appendix A
Detailed Tables

TABLES

Table A.1.
Infant Mortality Rate, by Country, 2000

Rank	Country	IMR	Rank	Country	IMR
1	Iceland	2.4	49	Brunei Darussalam	9.9
2	Sweden	2.4	50	Costa Rica	10.0
3	Singapore	2.6	51	Ukraine	10.4
4	Finland	3.2	52	Bulgaria	10.7
5	Luxembourg	3.2	53	Seychelles	11.1
6	Czech Republic	3.4	54	Dominica	11.6
7	Japan	3.4	55	Nauru	11.8
8	Norway	3.5	56	Jamaica	11.9
9	Spain	3.9	57	The Former Yugoslav Republic of Macedonia	12.4
10	Switzerland	4.1	58	Yugoslavia	12.5
11	Austria	4.2	59	Qatar	13.2
12	Slovenia	4.3	60	Mauritius	13.4
13	France	4.5	61	Uruguay	13.7
14	Germany	4.5	62	Saint Lucia	14.3
15	Canada	4.6	63	Sri Lanka	15.3
16	Belgium	4.6	64	Saint Kitts and Nevis	15.4
17	Andorra	4.8	65	Samoa	15.6
18	Italy	4.8	66	Russian Federation	15.9
19	New Zealand	4.9	67	Jordan	16.5
20	Australia	5.0	68	Saint Vincent and Grenadines	16.6
21	Denmark	5.1	69	Republic of Moldova	16.8
22	Netherlands	5.2	70	Bosnia and Herzegovina	17.0
23	Monaco	5.4	71	Trinidad and Tobago	17.5
24	Bahrain	5.6	72	Argentina	17.6
25	Republic of Korea	5.6	73	Grenada	17.7
26	Ireland	5.8	74	Cook Islands	17.8
27	United Kingdom	5.8	75	Palau	8.1
28	Greece	5.9	76	Antigua and Barbuda	18.2
29	Portugal	5.9	77	Barbados	18.6
30	Malta	6.0	78	Oman	18.8
31	San Marino	6.0	79	Tonga	18.9
32	Israel	6.1	80	Panama	19.2
33	Cyprus	6.4	81	Venezuela (Bolivarian Republic of)	19.5
34	Poland	6.7	82	Colombia	20.4
35	Malaysia	6.9	83	Lebanon	21.7
36	Cuba	7.5	84	Tunisia	21.7
37	**United States of America**	**7.5**	85	Belize	22.7
38	Slovakia	7.5	86	Syrian Arab Republic	23.5
39	Kuwait	7.7	87	Saudi Arabia	23.7
40	Lithuania	7.7	88	Fiji	23.9
41	Hungary	8.1	89	Georgia	24.0
42	Croatia	8.2	90	Mexico	24.5
43	Bahamas	8.3	91	Niue	24.5
44	Chile	8.5	92	Libyan Arab Jamahiriya	25.0
45	Belarus	9.2	93	Suriname	25.2
46	Estonia	9.2	94	Marshall Islands	25.5
47	United Arab Emirates	9.3	95	Romania	26.0
48	Latvia	9.4	96	Albania	26.4

Table A.1.
Infant Mortality Rate, by Country, 2000 ***(continued)***

Rank	Country	IMR	Rank	Country	IMR
97	Paraguay	26.7	145	Pakistan	84.2
98	Ecuador	27.1	146	Eritrea	84.7
99	Armenia	27.6	147	Nepal	85.9
100	Viet Nam	27.6	148	Haiti	88.9
101	El Salvador	28.0	149	Kenya	90.1
102	Philippines	29.4	150	Congo	91.7
103	Democr. People's Republic of Korea	33.1	151	Gambia	91.8
104	Turkey	34.3	152	Yemen	96.6
105	Honduras	35.1	153	Zimbabwe	97.7
106	Nicaragua	35.1	154	Lesotho	98.1
107	Cape Verde	35.3	155	Cameroon	102.5
108	Algeria	35.7	156	Iraq	102.6
109	Thailand	35.8	157	Senegal	103.7
110	Iran (Islamic Republic of)	36.9	158	Togo	104.7
111	Peru	37.2	159	Lao People's Democratic Republic	105.8
112	China	37.9	160	Sao Tome and Principe	106.6
113	Egypt	38.1	161	Sudan	107.2
114	Tuvalu	38.1	162	Myanmar	111.5
115	Maldives	38.3	163	Uganda	120.2
116	Brazil	38.4	164	United Republic of Tanzania	123.4
117	Guatemala	38.5	165	Equatorial Guinea	125.4
118	Indonesia	39.5	166	Madagascar	131.4
119	Kazakhstan	40.5	167	Benin	132.3
120	Dominican Republic	41.1	168	Nigeria	133.7
121	Uzbekistan	41.7	169	Cambodia	37.2
122	Guyana	45.2	170	Djibouti	138.2
123	Vanuatu	49.8	171	Cote d'Ivoire	141.1
124	Micronesia (Federated States of)	49.9	172	Burundi	142.0
125	Turkmenistan	52.3	173	Ethiopia	142.6
126	Kyrgyzstan	54.4	174	Mauritania	148.4
127	Morocco	56.3	175	Mozambique	148.6
128	Mongolia	57.2	176	Rwanda	152.0
129	Botswana	58.6	177	Guinea	153.1
130	Kiribati	60.5	178	Somalia	157.1
131	Solomon Islands	65.9	179	Central African Republic	159.6
132	Bolivia	66.4	180	Chad	163.4
133	Bhutan	68.3	181	Burkina Faso	167.3
134	Namibia	69.1	182	Zambia	168.1
135	Ghana	69.6	183	Democratic Republic of the Congo	175.7
136	South Africa	73.3	184	Afghanistan	176.2
137	Papua New Guinea	73.7	185	Guinea-Bissau	176.7
138	Gabon	74.3	186	Malawi	198.8
139	Tajikistan	74.8	187	Mali	204.8
140	Comoros	75.1	188	Liberia	231.1
141	India	76.2	189	Niger	239.0
142	Bangladesh	76.6	190	Sierra Leone	257.7
143	Azerbaijan	78.3	191	Angola	261.5
144	Swaziland	80.4			

Source: World Health Organization 2004. *Note:IMR = Infant Mortality Rate, number of infant deaths per 1,000 live births.*

Table A.2.
Infant Mortality Rates, by Race/Ethnicity: United States, 2001

INFANT DEATH RATE PER 1,000 LIVE BIRTHS

State	Total	White	Black	American Indian/ Alaska Native	Asian/ Pacific Islander	Hispanic	White Non-Hispanic	Black Non-Hispanic
United States	***6.9***	***5.7***	***13.6***	***9.1***	***4.8***	***5.6***	***5.7***	***13.7***
Alabama	9.5	6.8	15.3	*	*	*	7.3	10.0
Alaska	7.0	5.6	*	11.9	*	5.7	5.9	16.0
Arizona	6.8	6.3	16.6	9.3	5.2	6.1	5.1	13.6
Arkansas	8.2	7.2	12.3	*	*	4.4	6.3	15.2
California	5.4	5.0	11.5	7.9	4.5	6.1	5.7	12.7
Colorado	6.2	5.8	12.7	*	6.2	6.6	6.4	*
Connecticut	6.2	5.3	13.1	*	*	8.1	6.6	*
Delaware	9.2	7.0	16.1	*	*	*	5.7	*
District of Columbia	13.0	5.3	16.9	*	*	*	6.4	*
Florida	7.1	5.5	12.7	*	4.9	*	5.9	*
Georgia	8.4	5.9	13.4	*	6.2	6.3	6.5	16.0
Hawaii	7.1	6.8	*	*	7.2	7.6	6.1	13.2
Idaho	6.9	6.8	*	*	*	6.8	5.0	11.4
Illinois	8.2	6.3	16.4	*	6.7	*	6.2	*
Indiana	7.8	7.0	14.4	*	*	*	7.0	*
Iowa	5.9	5.6	15.8	*	*	8.5	*	16.9
Kansas	7.1	6.6	14.1	*	*	5.5	5.2	11.9
Kentucky	6.8	6.5	10.4	*	*	5.5	4.1	11.1
Louisiana	9.4	6.4	13.7	*	*	4.9	4.9	10.3
Maine	5.3	5.3	*	*	*	4.2	7.5	12.2
Maryland	8.0	5.2	13.6	*	4.8	4.9	7.6	14.3
Massachusetts	4.9	4.4	9.9	*	3.8	7.0	6.8	15.2
Michigan	8.1	6.2	16.7	*	6.0	9.0	5.7	15.0
Minnesota	5.7	5.1	11.7	10.8	7.4	8.2	6.8	16.3
Mississippi	10.4	6.9	14.7	*	*	6.4	5.7	16.8
Missouri	7.4	5.9	16.0	*	*	5.8	4.8	11.4
Montana	6.6	5.9	*	11.7	*	*	6.5	10.5
Nebraska	6.9	6.3	13.0	17.3	*	*	6.9	14.6
Nevada	6.2	5.6	11.7	15.8	5.4	6.9	6.1	16.4
New Hampshire	5.2	5.1	*	*	*	6.3	6.3	16.5
New Jersey	6.4	5.0	13.5	*	3.7	6.3	6.7	14.1
New Mexico	6.6	6.5	14.6	7.1	*	5.3	6.5	13.7
New York	6.2	5.1	10.9	*	3.6	6.8	7.0	14.5
North Carolina	8.7	6.6	15.1	11.6	6.9	5.9	4.8	*
North Dakota	8.0	7.3	*	15.2	*	6.4	5.4	7.5
Ohio	7.8	6.6	15.1	*	4.2	7.5	6.6	14.9
Oklahoma	8.1	7.4	14.3	8.4	*	7.9	4.6	13.0
Oregon	5.5	5.5	7.3	9.5	4.0	7.5	4.7	13.3
Pennsylvania	7.2	6.0	15.1	*	.7	6.3	4.4	14.0
Rhode Island	6.3	5.5	12.8	*	*	6.6	5.5	15.8
South Carolina	9.3	6.2	15.2	*	*	4.9	5.5	13.0
South Dakota	7.1	6.2	*	11.7	*	*	4.5	*
Tennessee	8.5	6.5	16.0	*	5.8	5.1	5.4	10.9
Texas	5.9	5.3	10.9	*	3.9	5.0	5.6	12.8
Utah	5.0	5.0	*	*	7.0	*	5.3	*
Vermont	5.9	5.9	*	*	*	5.1	6.0	13.5
Virginia	7.2	5.5	13.0	*	4.6	6.3	6.9	14.7
Washington	5.3	5.0	10.8	8.9	4.4	5.1	4.7	11.6
West Virginia	7.4	7.3	9.9	*	*	5.9	6.7	15.1
Wisconsin	6.8	5.7	16.8	10.1	5.0	6.5	5.9	16.7
Wyoming	6.6	6.7	*	*	*	*	5.3	*

Source: Mathews et al. 2003. **Figure does not meet standard of reliability or precision, based on fewer than 20 deaths in the numerator.*

Table A.3.
Live Births, by Race/Ethnicity: United States, 2001

NUMBER OF LIVE BIRTHS

State	Total	White	Black	American Indian/ Alaska Native	Asian/ Pacific Islander	Hispanic	White Non-Hispanic	Black Non-Hispanic
United States	***5,025,933***	***3,177,626***	***66,156***	***41,872***	***200,279***	***851,851***	***2,326,578***	***589,917***
Alabama	60,454	40,604	19,199	182	469	2,254	38,342	19,183
Alaska	10,003	6,383	441	2,542	637	652	5,567	388
Arizona	85,597	75,219	2,762	5,498	2,118	36,183	38,878	2,560
Arkansas	37,010	28,836	7,435	244	495	2,649	26,082	7,422
California	527,750	428,238	33,774	2,926	62,827	261,071	167,025	32,551
Colorado	67,007	61,056	2,971	651	2,329	19,730	41,764	2,830
Connecticut	42,648	35,612	5,134	164	1,738	6,913	28,434	4,929
Delaware	10,749	7,668	2,710	26	345	1,083	6,598	2,684
District of Columbia	7,625	2,570	4,860	9	186	895	1,667	4,805
Florida	205,793	152,207	47,186	1,230	5,170	49,629	104,068	45,954
Georgia	133,526	85,648	43,727	275	3,876	15,699	69,306	43,076
Hawaii	17,072	3,815	527	183	12,547	2,237	3,119	495
Idaho	20,688	19,944	86	360	298	2,753	16,855	78
Illinois	184,064	142,474	33,203	261	8,126	40,973	101,660	32,995
Indiana	86,459	75,393	9,649	168	1,249	5,898	69,242	9,575
Iowa	37,619	35,324	1,266	232	797	2,232	33,068	1,237
Kansas	38,869	34,622	2,781	458	1,008	4,906	29,363	2,747
Kentucky	54,658	48,968	4,930	102	658	1,509	47,485	4,905
Louisiana	65,352	36,899	27,058	380	1,015	1,557	35,383	27,010
Maine	13,759	13,280	153	110	216	173	13,074	142
Maryland	73,218	45,068	24,252	212	3,686	5,301	39,798	24,046
Massachusetts	81,077	67,786	8,205	144	4,942	9,444	59,405	6,552
Michigan	133,427	105,235	23,613	641	3,938	7,335	96,346	23,399
Minnesota	67,562	57,982	4,767	1,312	3,501	4,543	53,141	4,685
Mississippi	42,282	22,808	18,817	265	392	719	22,073	18,809
Missouri	75,464	62,504	11,134	342	1,484	2,981	59,513	11,084
Montana	10,970	9,442	42	1,369	117	377	8,798	38
Nebraska	24,820	22,496	1,373	433	518	2,946	19,056	1,355
Nevada	31,382	26,284	2,518	482	2,098	10,855	15,323	2,414
New Hampshire	14,656	13,954	208	4	454	509	12,849	159
New Jersey	115,795	85,110	20,583	167	9,935	23,497	63,266	18,709
New Mexico	27,128	22,810	511	3,404	403	14,126	8,776	485
New York	254,026	182,191	52,190	710	18,935	54,544	130,637	46,709
North Carolina	118,185	85,315	28,393	1,689	2,788	14,539	70,863	28,250
North Dakota	7,629	6,625	102	806	96	140	6,299	101
Ohio	151,570	125,507	22,994	313	2,756	4,598	20,869	22,769
Oklahoma	50,118	39,218	4,612	5,258	1,030	4,942	34,360	4,574
Oregon	45,322	41,284	944	792	2,302	7,902	33,388	908
Pennsylvania	143,495	119,015	20,238	356	3,886	8,192	10,501	19,615
Rhode Island	12,713	10,960	1,112	127	514	2,196	7,676	994
South Carolina	55,756	35,866	18,927	153	810	2,988	32,932	18,878
South Dakota	10,483	8,475	101	1,776	131	257	8,254	97
Tennessee	78,340	60,216	16,603	181	1,340	3,905	56,363	16,568
Texas	365,410	311,979	40,750	854	11,827	172,354	139,104	40,221
Utah	47,959	45,440	342	742	1,435	6,543	38,682	325
Vermont	6,366	6,237	31	7	91	35	6,014	29
Virginia	98,884	70,946	22,272	120	5,546	9,143	61,871	22,082
Washington	79,570	67,437	3,334	1,897	6,902	12,140	54,468	3,219
West Virginia	20,428	19,576	704	19	129	83	19,446	698
Wisconsin	69,072	59,383	6,567	989	2,133	5,152	54,346	6,515
Wyoming	6,115	5,717	65	271	62	569	5,161	64

Source: Martin et al. 2002b.

Table A.4.
State Rank in Infant Mortality Rate and Difference Between Black and White Rates: United States, 2001

		INFANT DEATH RATE PER 1,000 LIVE BIRTHS			
Rank	State	All Races	White	Black	Black-White Difference
	United States	***6.9***	***5.7***	***13.6***	***7.9***
1	Massachusetts	4.9	4.4	9.9	5.5
2	Utah	5.0	5.0	*	*
3	New Hampshire	5.2	5.1	*	*
4	Maine	5.3	5.3	*	*
5	Washington	5.3	5.0	10.8	5.8
6	California	5.4	5.0	11.5	6.5
7	Oregon	5.5	5.5	7.3	1.8
8	Minnesota	5.7	5.1	11.7	6.6
9	Iowa	5.9	5.6	15.8	10.2
10	Texas	5.9	5.3	10.9	5.6
11	Vermont	5.9	5.9	*	*
12	Colorado	6.2	5.8	12.7	6.9
13	Connecticut	6.2	5.3	13.1	7.8
14	Nevada	6.2	5.6	11.7	6.1
15	New York	6.2	5.1	10.9	5.8
16	Rhode Island	6.3	5.5	12.8	7.3
17	New Jersey	6.4	5.0	13.5	8.5
18	Montana	6.6	5.9	*	*
19	New Mexico	6.6	6.5	14.6	8.1
20	Wyoming	6.6	6.7	*	*
21	Arizona	6.8	6.3	16.6	10.3
22	Kentucky	6.8	6.5	10.4	3.9
23	Wisconsin	6.8	5.7	16.8	11.1
24	Idaho	6.9	6.8	*	*
25	Nebraska	6.9	6.3	13.0	6.7
26	Alaska	7.0	5.6	*	*
27	Florida	7.1	5.5	12.7	7.2
28	Hawaii	7.1	6.8	*	*
29	Kansas	7.1	6.6	14.1	7.5
30	South Dakota	7.1	6.2	*	*
31	Pennsylvania	7.2	6.0	15.1	9.1
32	Virginia	7.2	5.5	13.0	7.5
33	Missouri	7.4	5.9	16.0	10.1
34	West Virginia	7.4	7.3	9.9	2.6
35	Indiana	7.8	7.0	14.4	7.4
36	Ohio	7.8	6.6	15.1	8.5
37	Maryland	8.0	5.2	13.6	8.4
38	North Dakota	8.0	7.3	*	*
39	Michigan	8.1	6.2	16.7	10.5
40	Oklahoma	8.1	7.4	14.3	6.9
41	Arkansas	8.2	7.2	12.3	5.1
42	Illinois	8.2	6.3	16.4	10.1
43	Georgia	8.4	5.9	13.4	7.5
44	Tennessee	8.5	6.5	16.0	9.5
45	North Carolina	8.7	6.6	15.1	8.5
46	Delaware	9.2	7.0	16.1	9.1
47	South Carolina	9.3	6.2	15.2	9.0
48	Louisiana	9.4	6.4	13.7	7.3
49	Alabama	9.5	6.8	15.3	8.5
50	Mississippi	10.4	6.9	14.7	7.8
51	District of Columbia	13.0	5.3	16.9	11.6

Source: Mathews et al. 2003. Black-White difference was calculated using data from Mathews et al. 2003.

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

Table A.5.
Five Leading Causes of Infant Death, by Race/Ethnicity: United States, 2002

	INFANT DEATH RATE PER 1,000 LIVE BIRTHS					
Race and Ethnicity	All Causes	Congenital Malformations	Preterm Birth/Low Birthweight	Sudden Infant Death Syndrome	Maternal Complications	Cord Complications
All Races and Ethnicities	**7.0**	**1.4**	**1.2**	**0.6**	**0.4**	**0.3**
RACE						
White	5.8	1.3	0.8	0.6	0.3	0.2
Black	13.9	1.7	3.2	1.1	0.9	0.5
Asian/Pacific Islander	4.8	1.1	0.8	0.2	0.3	0.2
American Indian/ Alaska Native	8.6	1.9	1.1	1.2	0.5	*
ETHNICITY						
All Hispanics	**5.6**	**1.5**	**0.9**	**0.3**	**0.3**	**0.2**
Mexican	5.4	1.5	0.8	0.3	0.2	0.2
Puerto Rican	8.2	1.7	1.7	0.5	0.5	*
Central and South American	5.1	1.4	0.7	0.2	0.2	*

Source: Mathews et al. 2004.
Note: "Black" and "White" categories exclude women of Hispanic origin.
* Figure does not meet standard of reliability precision, based on fewer than 20 deaths in the numerator.

Table A.6.
Preterm Birth/Low Birthweight, by Race/Ethnicity: United States, 2002

	PERCENT OF LIVE BIRTHS		
Race and Ethnicity	Preterm Births	Low Birthweight	Very Low Birthweight
All Races and Ethnicities	**12.1**	**7.8**	**1.5**
RACE			
White	11.1	6.8	1.2
Black	17.6	13.3	3.2
Asian/Pacific Islander	10.4	7.8	1.1
• Chinese	7.7	5.5	0.7
• Japanese	9.2	7.6	1.0
• Hawaiian	13.5	8.1	1.6
• Filipino	12.7	8.6	1.3
American Indian/Alaska Native	13.1	7.2	1.3
ETHNICITY			
All Hispanics	**11.6**	**6.5**	**1.2**
• Mexican	11.4	6.2	1.1
• Puerto Rican	14.0	9.7	2.0
• Cuban	10.5	6.5	1.2
• Central and South American	11.2	6.5	1.2
White Non-Hispanic	11.0	6.9	1.2
Black Non-Hispanic	17.7	13.4	3.2

Source: Martin et al. 2003.

Table A.7.
Preterm Birth, by Race/Ethnicity: United States, 1995–2002

PERCENT OF LIVE BIRTHS

Race and Ethnicity	1995	1996	1997	1998	1999	2000	2001	2002	% Change 1995 to 2002
All Races and Ethnicities	**11.0**	**11.0**	**11.4**	**11.6**	**11.8**	**11.6**	**11.9**	**12.1**	**10.0**
RACE									
White	9.7	9.8	10.2	10.5	10.7	10.6	11.0	11.1	14.4
Black	17.7	17.4	17.5	17.5	17.5	17.3	17.5	17.6	-0.6
Asian/Pacific Islander	9.9	10.0	10.2	10.4	10.4	9.9	10.3	10.4	5.1
• Chinese	7.2	7.4	7.4	7.6	7.6	7.3	7.7	7.7	6.9
• Japanese	8.3	8.2	8.1	8.7	9.3	8.3	8.8	9.2	10.8
• Hawaiian	11.0	11.5	11.0	12.0	12.3	11.7	14.2	13.5	22.7
• Filipino	11.7	11.5	11.9	11.8	12.4	12.2	12.5	12.7	8.5
American Indian/Alaska Native	12.4	11.9	12.2	12.2	12.9	12.7	13.2	13.1	5.6
ETHNICITY									
All Hispanics	**10.9**	**10.9**	**11.2**	**11.4**	**11.4**	**11.2**	**11.4**	**11.6**	**6.4**
• Mexican	10.6	10.5	10.9	11.0	11.1	11.0	11.2	11.4	7.5
• Puerto Rican	13.4	13.2	13.7	13.9	13.7	13.5	13.7	14.0	4.5
• Cuban	10.1	10.3	11.0	11.4	11.5	10.6	10.6	10.5	4.0
• Central and South American	10.7	10.9	11.2	11.6	11.4	11.0	11.2	11.2	4.7
Non-Hispanic White	9.4	9.5	9.9	10.2	10.5	10.4	10.8	11.0	17.0
Non-Hispanic Black	17.8	17.5	17.6	17.6	17.6	17.4	17.6	17.7	-0.6

Source: MacDorman and Atkinson 1998a, MacDorman and Atkinson 1998b, MacDorman and Atkinson 1999, Ventura et al. 1999, Ventura et al. 2000, Ventura et al. 2001, Mathews et al. 2000, Mathews et al. 2002a, Mathews et al. 2002b, Mathews et al. 2003, Mathews et al. 2004.
Note: Hispanic includes both White and Black Hispanics.

Table A.8.
Very Low Birthweight, by Race/Ethnicity: United States, 1995–2002

PERCENT OF LIVE BIRTHS

Race and Ethnicity	1995	19961	997	1998	1999	2000	2001	2002	% Change 1995 to 2002
All Races and Ethnicities	**1.3**	**1.4**	**1.4**	**1.4**	**1.5**	**1.4**	**1.4**	**1.5**	**15.4**
RACE									
White	1.1	1.1	1.1	1.1	1.2	1.1	1.2	1.2	9.1
Black	3.0	3.0	3.0	3.1	3.1	3.1	3.0	3.2	6.7
Asian/Pacific Islander	0.9	1.0	1.1	1.1	1.1	1.0	1.0	1.1	22.2
• Chinese	0.7	0.6	0.7	0.7	0.7	0.8	0.7	0.7	0.0
• Japanese	0.9	0.8	0.8	0.8	0.9	0.7	0.7	1.0	11.1
• Hawaiian	0.9	1.0	1.4	1.5	1.4	1.4	1.5	1.6	77.8
• Filipino	1.1	1.2	1.3	1.3	1.4	1.4	1.2	1.3	18.2
American Indian/Alaska Native	1.1	1.2	1.2	1.2	1.3	1.2	1.3	1.3	18.2
ETHNICITY									
All Hispanics	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.2**	**9.1**
• Mexican	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	10.0
• Puerto Rican	1.8	1.7	1.8	1.9	1.9	1.9	1.8	2.0	11.1
• Cuban	1.2	1.3	1.4	1.3	1.5	1.2	1.3	1.2	0.0
• Central and South American	1.1	1.1	1.2	1.2	1.1	1.2	1.2	1.2	9.1
Non-Hispanic White	1.0	1.1	1.1	1.1	1.2	1.1	1.2	1.2	20.0
Non-Hispanic Black	3.0	3.0	3.1	3.1	3.2	3.1	3.1	3.2	6.7

Source:MacDorman and Atkinson 1998a, MacDorman and Atkinson 1998b, MacDorman and Atkinson 1999, Ventura et al. 1999, Ventura et al. 2000, Ventura et al. 2001, Mathews et al. 2000, Mathews et al. 2002a, Mathews et al. 2002b, Mathews et al. 2003, Mathews et al. 2004.
Note: Hispanic includes both White and Black Hispanics.

Table A.9.
NTD–Specific Infant Deaths, by Race/Ethnicity: United States, 1996–1998, Aggregated

Race and Ethnicity	Rate per 100,000 Live Births	Relative Risk (95 Percent Confidence Interval)
ALL RACES AND ETHNICITIES	**11.1**	
RACE		
White	11.6	–
Black	8.6	0.73 (0.62-0.87)
Asian/Pacific Islander	9.8	0.85 (0.64-1.12)
American Indian/Alaska Native	11.5	0.96 (0.55-1.65)
ETHNICITY		
ALL HISPANICS	**15.4**	**1.49 (1.31-1.69)**
• Mexican	17.0	1.64 (1.42-1.89)
• Puerto Rican	10.4	0.98 (0.61-1.59)
• Central and South American	11.9	1.15 (0.82-1.62)
White Non-Hispanic	10.3	–
Black Non-Hispanic	8.6	1.49 (1.31-1.69)

Source: Davidoff et al. 2002.
Note: White and White non-Hispanic are the reference groups for the relative risk ratios.

Table A.10.
Women Who Reported Smoking During Pregnancy, by Race/Ethnicity: United States, 1990–1999

	PERCENT		
Race and Ethnicity	1990	1999	% Change 1990-1999
ALL RACES AND ETHNICITIES	**18.4**	**12.3**	**-33.1**
RACE			
White Non-Hispanic	21.0	15.7	-25.2
Black Non-Hispanic	15.9	9.1	-42.8
Asian/Pacific Islander	5.5	2.9	-47.3
• Chinese	–	0.5	–
• Japanese	–	4.5	–
• Hawaiian	–	14.7	–
• Filipino	–	3.3	–
American Indian/Alaska Native	22.4	20.0	-10.7
ETHNICITY			
ALL HISPANICS	**6.7**	**3.7**	**-44.8**
• Mexican	–	2.6	–
• Puerto Rican	–	10.5	–
• Cuban	–	3.3	–
• Central and South American	–	1.4	–

Source: Mathews et al. 2003.
Notes: Total Hispanic and non-Hispanic White and Black percents were not available.
– Data not available.

Table A.10.
Infant Mortality Rate, by Maternal Smoking Status and Race/Ethnicity: United States, 2002

Race and Ethnicity	INFANT DEATH RATE PER 1,000 LIVE BIRTHS		
	Smoker	Nonsmoker	% Difference (Smoker-Nonsmoker)
ALL RACES AND ETHNICITIES	**11.1**	**6.6**	**68.2**
RACE			
White	9.8	5.3	**84.9**
Black	20.0	13.1	**52.7**
Asian/Pacific Islander	11.6	4.7	**146.8**
American Indian/Alaska Native	12.1	7.7	**57.1**
ETHNICITY			
ALL HISPANICS	**10.7**	**5.6**	**91.1**
• Mexican	9.8	5.4	**81.5**
• Puerto Rican	12.4	7.9	**57.0**
• Cuban	*	3.5	*
• Central and South American	*	4.9	*
White Non-Hispanic	9.7	5.2	**86.5**
Black Non-Hispanic	20.1	13.2	**52.3**

Source: Mathews et al. 2004.
*Figure does not meet standard of reliability precision, based on fewer than 20 deaths in the numerator.

Table A.12.
Infant Mortality Rate, by Age and Race/Ethnicity: United States, 2002

Race and Ethnicity	YEARS OF AGE						
	Under 20	Over 20	20 to 24	25 to 29	30 to 34	35 to 39	40 to 54
ALL RACES AND ETHNICITIES	**10.4**	**6.5**	**7.8**	**6.0**	**5.6**	**6.5**	**8.5**
RACE							
White	8.8	5.5	6.4	5.1	4.7	5.5	7.3
Black	15.2	13.5	13.9	12.4	13.4	14.5	16.1
Asian/Pacific Islander	9.2	4.6	5.2	3.9	4.3	5.4	8.2
American Indian/Alaska Native	9.1	8.5	9.4	7.6	7.6	8.5	*
ETHNICITY							
ALL HISPANICS	**7.3**	**5.3**	**5.3**	**5.1**	**5.0**	**6.2**	**8.9**
• Mexican	6.8	5.2	5.0	4.8	5.1	6.3	9.2
• Puerto Rican	10.6	7.7	8.2	7.4	7.2	7.6	*
• Cuban	*	9.7	*	*	*	*	*
• Central and South American	6.8	4.9	4.8	4.9	4.4	5.1	8.2
White Non-Hispanic	9.7	5.5	6.9	5.1	4.6	5.3	6.8
Black Non-Hispanic	15.2	13.6	14.0	12.5	13.4	14.6	16.3

Source: Mathews et al. 2004.
* Figure does not meet standard of reliability precision, based on fewer than 20 deaths in the numerator.

Appendix B
Glossary

TERM	DEFINITION
• Abruptio Placenta	A disorder of pregnancy in which the placenta prematurely separates from the wall of the uterus.
• Amnion	The tissue membrane that expands to enclose the fetus and form the amniotic sac, protecting and cushioning the fetus during pregnancy, within which is the amniotic fluid (bag of water).
• Antenatal	The time period from conception until the onset of labor–about 40 weeks.
• Antepartum	Occurring or existing before birth; the prenatal period; antenatal care.
• APGAR	Designed in 1952 by Dr. Virginia Apgar at Columbia University's Babies Hospital, the APGAR (appearance, pulse, grimace, activity, respirations) score is a quick test performed at 1 and 5 minutes after birth to determine the physical condition of the newborn. The rating is based on a scale of 1 to 10. Ten suggests the healthiest infant, and scores below 5 indicate that the infant needs immediate assistance in adjusting to his or her new environment.
• Bacterial Vaginosis	An inflammation of the vagina caused by one or more bacteria that has replaced the normal flora of the vagina. Signs and symptoms include vaginal discharge–thin, creamy, and grayish, often unpleasant and fishy in odor, and vulval irritation, rather than itching.
• Chorion	The outermost membranous sac enclosing the embryo.
• Congenital Malformations	Physical and/or neurological defects that are present at delivery.
• Domestic Violence	Any physical abuse or threat or pattern thereof, between intimately involved partners, roommates, or family members.
• Eclampsia	Coma and convulsions during or immediately after pregnancy, characterized by edema, hypertension, and proteinuria.
• Ectopic Pregnancy	A pregnancy in which a fertilized egg begins to develop outside the uterus (for example, in a fallopian tube). Ectopic pregnancy can lead to tubal rupture, hemorrhage, and death.
• Fetal Alcohol Exposure	Exposure to alcohol of the developing fetus.
• Fetal Alcohol Syndrome	Refers to a group of symptoms exhibited by an infant or child resulting from a woman's consumption of alcohol during pregnancy. The symptoms may include differing levels of mental retardation, low birthweight, small size, and underdevelopment of the upper lip.
• Fetus	The clinical name for an unborn child after the eighth week of pregnancy.
• First Trimester	Time period extending from the first day of the last menstrual period through 12 weeks of gestation.
• Folic Acid	A nutrient found in some green, leafy vegetables, nuts, beans, citrus fruits, fortified breakfast cereals, and some vitamin supplements. Folic acid can help reduce the risk of birth defects of the brain and spinal cord (also called neural tube defects).
• Gestation Period	The period during when the embryo develops.

TERM	DEFINITION
• Gestational Age	The age of an embryo counting from the time of fertilization.
• Health Education	Health education includes instructional activities and other strategies to increase knowledge/awareness of an individual/group/community and to change individual health behavior.
• Healthy People 2010	A comprehensive, nationwide health promotion and disease prevention agenda launched by the U.S. Department of Health and Human Services in January 2000. Healthy People 2010 contains 467 objectives designed to serve as a road map for improving the health of all people in the United States during the first decade of the 21st century.
• In Utero	In the uterus; typically refers to events that occur in the womb before birth.
• Infant Mortality	Death during the first year of life.
• Interconceptional Care	Relating to the care recommended to women between pregnancies or up to 24 months postpartum. Interconceptional care generally consists of interventions to ensure that medical conditions, poor personal behaviors, and negative environmental conditions are treated and eliminated before conception, thus decreasing the likelihood of poor birth outcomes.
• Intrauterine Growth Retardation	A fetus whose weight is below the 10th percentile for gestational age.
• Low Birthweight	Refers to an infant weighing less than 2,500 grams (five pounds, eight ounces) at birth.
• Maternal Perinatal Depression	Refers to maternal depression occurring during the period shortly before or after birth.
• Neonatal Period	The first four weeks after birth.
• Neural Tube Defect	A congenital defect of the central nervous system, including the spinal cord, skull, and brain, resulting from failure of the neural tube to properly close during fetal development. Defects may include absence of the skull, and protrusions of the brain or spinal cord. Most such defects can be detected before birth through amniotic fluid or blood levels of alpha-fetoprotein and by ultrasonic scanning.
• Perinatal	Pertaining to or occurring in the period shortly before and after birth, variously defined as beginning with completion of the 20th to 28th week of gestation and ending 7 to 28 days after birth.
• Preterm/ Premature	Refers to an infant born before 37 weeks of gestation.
• Postneonatal Period	The period from 4 weeks to 52 weeks after birth.
• Sudden Infant Death Syndrome (SIDS)	The sudden death of an infant under 1 year of age that remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history.
• Very Low Birthweight	Refers to an infant weighing less than 1,500 grams (three pounds, four ounces) at birth.

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